PURDUE SCHOOL OF ENGINEERING AND TECHNOLOGY 2021-2022 ACADEMIC YEAR ASSESSMENT REPORT

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Activity Summary: ABET accreditation visit preparation

The 2021-2022 academic year saw the preparation of comprehensive Self-Studies in preparation for an accreditation visit in Fall 2022 for our six programs accredited by the Engineering Accreditation Commission (EAC) of ABET and two Computing programs accredited by the Computing Accreditation Commission (CAC) of ABET:

- Biomedical Engineering (EAC)
- Computer Engineering (EAC)
- Electrical Engineering (EAC)
- Energy Engineering (EAC)
- Mechanical Engineering (EAC)
- Motorsports Engineering (EAC)
- Computer Graphics Technology (CAC)
- Computer & Information Technology (CAC)

Of relevance to our IUPUI campus-level reporting on assessment activities, each program's Self Study includes a Continuous Improvement chapter (Criterion 4) that should "document [the program's] processses for regularly assessing and evaluating the extent to which the student outcomes are being attained", "document the extent to which the student outcomes are being attained", and "describe how the result of these processes are utilized to affect continuous improvement of the program." (The ABET outcomes for EAC and CAC for the 2022-23 evaluation cycle are available at https://bulletins.iu.edu/iupui/2022-2023/schools/purdue-engineer-tech/undergraduate/student_learning_outcomes/biomedical_engineering.shtml and https://bulletins.iu.edu/iupui/2022-2023/schools/purdue-engineer-tech/undergraduate/student_learning_outcomes/Comp-infor-tech-bs.shtml#CIT, respectively.)

Below are a few highlights of assessment findings and continuous improvement activities presented in these self-studies:

Engineering Programs (accredited by the Engineering Accreditation Commission (EAC) of ABET)

These programs are required to address the following student outcomes, among other criteria:

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
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.
3. an ability to communicate effectively with a range of audiences.
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.
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.

6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Biomedical Engineering (BME)
BME collects and evaluates assessment data every three years. In comparing results from the 2017-18 and 2020-21 evaluation years, there was a recurring theme across several courses in the curriculum that despite other challenges during the pandemic year, the move toward making lecture recordings available to students positively impacted students' mastery of foundational course concepts. Other results and improvements of note include:

BME 24101, Outcome 1: "Students will demonstrate an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics": After the 2017-18 data collection, the instructor noted that underperforming students often leave exam problems blank, making it difficult to assess any aspect of their knowledge. In subsequent years, the instructor brought back quizzes to the lecture portion of the class (instead of lab) and used these as formative assessments prior to exams. The instructor also discussed striating the exam problem and rubric to analyze where the students are missing the most content to help in adjusting how the material is taught. The striated exam problem occurred in the 2020-21 data collection on a midterm exam which is showing that the majority of students (93%) are excelling at the most basic mechanics problem given in an exam situation. This assessment was also tracked in the following year (fall 2021) and the instructor reported 79% of students are performing at the target performance level and 91% performing at a satisfactory level. This evidence is showing that the continued improvement of lecture resources, namely recorded lectures and problem-solving videos that stemmed from pandemic limitations, has led to a sustained level of student performance in the formative assessment and an increased level of student performance in an assessed Final Exam problem.

BME 49100/49200, Outcome 2: "Students will demonstrate 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": This 2-semester capstone design experience includes a reflection on how the student's design project meets specified needs while considering the multiple factors expressed in this outcome. Assessment of projects and the associated reflections showed students overall are demonstrating technical competence and considering environmental and economic factors, but notes that more instructional emphasis should be placed on global, cultural, and social factors, as students are generally not explicitly including these in their reflections.

Results of curricular revisions since the prior visit: The BME curriculum underwent a significant revision in Fall 2018 to help improve student outcomes in three areas: use of mathematical modeling and other analytical tools to support design; technical writing and presentation; and professional development and ethics. Incorporating more intentional design experiences throughout the curriculum has increased the use of appropriate analytical tools as part of the capstone design process. In addition, a student survey asking which prior courses or experiences best prepared them for their capstone design projects is helping identify areas to improve multidisciplinary connections that support biomedical design and problem solving. By breaking a prior 2-credit technical communication course (that many students put off until their senior year) into two 1-credit courses each tied as a corequisite to a required BME sophomore or junior level course, students are developing, applying, and receiving feedback on their technical writing and presentation skills earlier in the curriculum, giving them better preparation for the heavily project-based senior courses. Similarly, instruction in ethics was previously concentrated in the 2-semester capstone experience in the senior year; but supported by the IUPUI NSF I-CELER award, ethics has been

infused into additional assignments in the sophomore and junior years. In response to graduating senior and alumni feedback suggesting additional professional development activities, the program has added an annual BME open house that includes an alumni networking panel; the BeingME speaker series, inviting professionals from diverse backgrounds to share their stories; and a clinical shadowing experience prompting students to identify user needs in a clinical setting. Student surveys indicate that they find these experiences valuable for giving them useful perspectives on the BME field.

Electrical Engineering (EE) and Computer Engineering (CmpE)
Both EE and CmpE, which are housed in the same department, assess student outcomes every three years, with a heavy focus on assessment in the two-semester capstone design course. EE assessment results met targets for performance on all seven outcomes, and CmpE met targets for performance on all but Outcome 2, where they fell just below the target. Of note, however, these overall results were pulled down by an exam question in ECE 36500, in which only 50% of CmpE students met the target; by contrast, 100% met the targets on assessments in the capstone class.

An important observation made in the self-study is that students seemed to be struggling more during the Fall 2020-Spring 2021 assessment cycle than in previous years with their mathematical understanding, most likely exacerbated by interruptions to in-person math instruction brought on by the pandemic. The department will begin providing tutoring hours for ECE courses to help students who may be struggling with the mathematical or other content.

Energy Engineering (EEN) and Mechanical Engineering (ME)
Both EEN and ME, which are housed in the same department, have moved from an every-three-year assessment cycle to requiring data collection every semester in order to ensure consistency and availability of data for evaluation. By making regular data collection part of departmental culture, they ensure new faculty whose courses are targeted for assessment come up to speed quickly and have a robust pool of course outcomes data even in the event that a faculty member leaves the university before submitting data from their final semester. In addition, the department's Assessment Committee can monitor the data each semester and revise the assessment plan if deficiencies become apparent, as well as tracking the effect of previous changes and implementing additional changes if prior improvements are not found to be effective.

Like the EE and CmpE programs, the EEN and ME self-studies note in their assessment of Outcome 1 that students are struggling with some math topics and have reached out to the math department to provide feedback about topics to be emphasized more strongly in foundational math courses. In addition, they note in the evaluation of Outcome 4 for ME that their curriculum introduces engineering ethics and its impact in the sophomore year but does not formally revisit it until the final semester, where students are performing below targets. They have added an additional ethics assignment in a mid-level course to help reinforce these concepts, but the effects will not be evident until later this year. Other outcomes for both programs met performance targets.

Motorsports Engineering (MSTE)
Like EEN and ME, the MSTE program collects student outcomes data every semester; most of the courses in their curriculum are taught once per year. Aggregate data over the last four years demonstrated that outcomes data met the desired target for performance on each of the seven outcomes, as well as for all but two of the performance indicators used for outcomes assessment. Assessment of Outcome 7 in the capstone design course MSTE 41400 used a rubric applied to the Concept Review of students' design projects. Overall this fell just shy of the target, but the self-study notes that student performance has actually exceeded the target since 2020 as a result of improvements made in the assignment. The other low-scoring performance indicator, final exam questions in a Vehicle Dynamics course used to assess Outcome 1, has been consistently low-scoring each of the last four years except for Fall 2020, when

students were given a take-home exam due to COVID policies in place at the time. The self-study notes that improvements in scores on that exam were most likely due to unauthorized collaboration with other students. Scores have otherwise been improving over time, however, as a result of improvements to the course. The self-study further notes that students are performing satisfactorily in subsequent courses that rely on Vehicle Dynamics as a prerequisite.

Computing Programs (accredited by the Computing Accreditation Commission (CAC) of ABET)

These programs are required to address the following student outcomes, among other criteria:

Graduates of the program will have an ability to:

1. Analyze a complex computing problem and to apply principles of computing and other relevant disciplines to identify solutions.
2. Design, implement, and evaluate a computing-based solution to meet a given set of computing requirements in the context of the program's discipline.
3. Communicate effectively in a variety of professional contexts.
4. Recognize professional responsibilities and make informed judgments in computing practice based on legal and ethical principles.
5. Function effectively as a member or leader of a team engaged in activities appropriate to the program's discipline.

Computer Graphics Technology (CGT)

CGT collects and evaluates outcomes data from courses every three years. One overall theme of the improvements between the 2017 and 2020 data collection cycles was the recognition that students needed more time for feedback and help prior to the due date on major labs and class projects. For Outcome 1, "Analyze a complex computing problem and apply principles of computing and other relevant disciplines to identify solutions," several courses making this improvement (CGT 11200, CGT 21100, CGT 35600) went from not quite meeting the target for performance on this outcome to meeting the target. Overall, the program met targets for performance on four out of five student outcomes in the 2020 collection cycle, an improvement over the previous cycle as shown in the graph below:

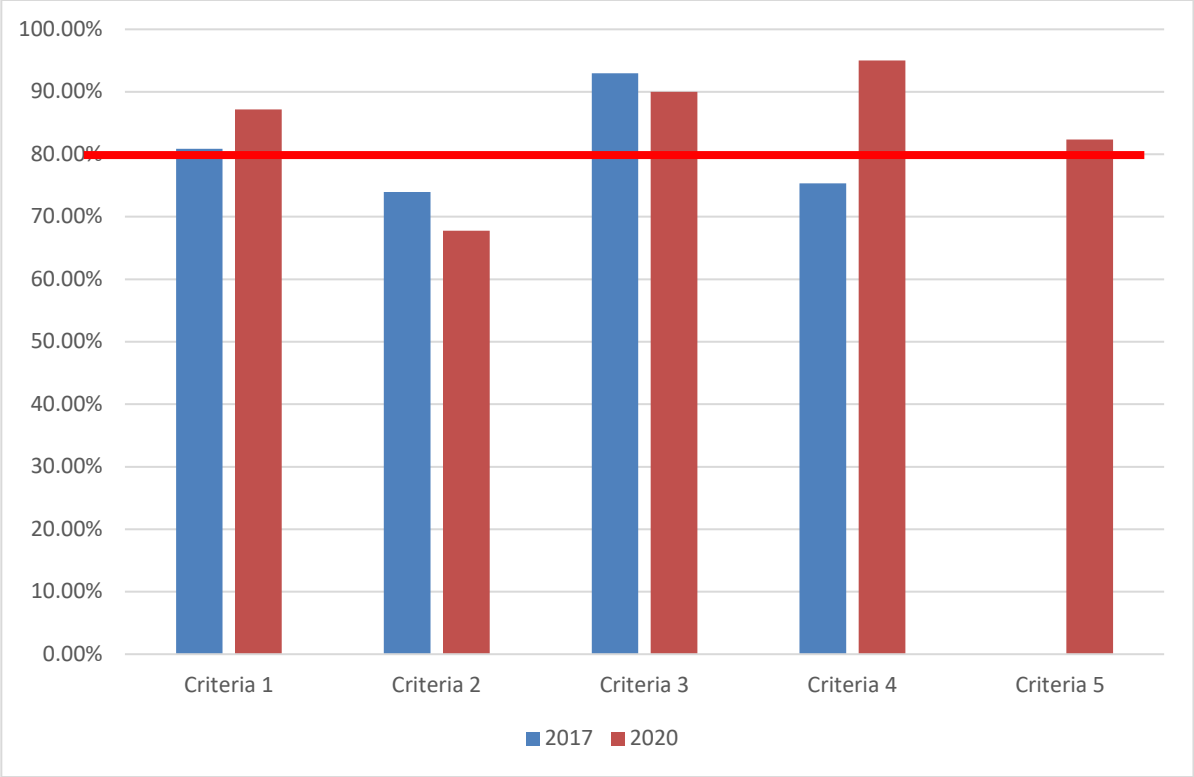

Figure 1 Percentage of Students Meeting Performance Target by Student Outcome ***(the red line indicates the overall performance target)***

Only Outcome 2, "Design, implement, and evaluate a computing-based solution to meet a given set of computing requirements in the context of the program's discipline," remained below the target for performance. The program has made plans for improvements in the background material and instruction provided to students, with more relevant examples that provide clearer guidance on project expectations.

Computer & Information Technology (CIT)

Like CGT, the CIT program assesses student learning outcomes every 3 years. They met targets for performance in three of five outcomes, and fell just short on Outcome 2, "Design, implement, and evaluate a computing-based solution to meet a given set of computing requirements in the context of the program's discipline," as well as Outcome 3, "Communicate effectively in a variety of professional contexts". The level of performance on Outcome 2 has been steady at just under the desired target for performance over the last 6 years; the program plans to incorporate structured design problems into all 200-level programming courses and in CIT 21400, a requirement for all CIT students. On Outcome 3, results actually met the target for performance in all junior and senior-level classes, but was significantly below the target in CIT 21300, the lone sophomore-level class evaluated. The self-study notes that the effect of COVID had a huge impact on student performance, and the program is reevaluating the assignment used for assessment to find ways to improve student performance.

An additional recommendation to the assessment process itself was suggested by the visiting ABET team during the September 2022 visit: Currently the program collects data for each outcome from performance indicators in multiple classes, then averages all data into a single "% above threshold" that they use to

decide whether they have met the target. However, this averaging can obscure useful information – such as the above noted success at meeting targets at the junior and senior level, but not at the sophomore level – and so a more nuanced process was recommended. The program has responded with a revision of their process and a re-evaluation of outcomes data as part of their due process response.

Accreditation Review Timeline

All ABET programs visited in the 2022-23 cycle will be discussed this summer by their respective Commissions, who will make final accreditation decisions during that meeting. We anticipate getting notifications of these results in Fall 2023.

Other Upcoming Accreditation Activities

The department of Music and Arts Technology was tentatively scheduled for a reaccreditation visit this spring by the National Association of Schools of Music (NASM). However, in light of the upcoming realignment, which will see the department moving to a new school home, on the advice of NASM this visit and accompanying self-study have been postponed for at least a year.

The Construction Management program in the Department of Engineering Technology is currently working on a self-study in preparation for a reaccreditation visit by the American Council for Construction Education (ACCE), tentatively scheduled for September 2023.