Institutional Effectiveness
2024-2025

Program: Mechanical Engineering BS
College and Department: College of Engineering, Mechanical Engineering
Contact: Dr. Mohan Rao
Mission:

Mission: The Mechanical Engineering (ME) Department, within a regional and global context, will prepare its students for productive careers in a competitive, dynamic, technologically based society; will advance the knowledge of mechanical engineering principles and applications; and will serve the public.

Vision: The Mechanical Engineering Department at Tennessee Tech aspires to be recognized globally for outstanding education and research, leading to well-qualified engineers who are adaptive professionals, inquisitive, entrepreneurial and successful in engineering practice, research, and public service.

The B.S. in Mechanical Engineering (BSME) at Tennessee Tech is a traditional, on-campus lecture/laboratory program with on-ground course delivery offered almost exclusively during the day. There currently are no distance learning courses offered by the Mechanical Engineering Department. A co-op program is available through the Tennessee Tech Center for Career Development as an optional (but very popular) choice.

Attach Curriculum Map (Educational Programs Only):
Attached Files: See Appendix 1

SO1: Identify, Formulate and Solve Engineering Problems

Define Outcome:

It is expected that by the time of graduation, Tech's ME students will have an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.

Assessment Methods:

Direct Measure

- AEC Plan and Departmental Rubrics
    - In Fall 2021, the ME Department adopted a new paradigm for continuous improvement. The AEC Plan is based on a two-year cycle for assessing, evaluation, and change. The AEC Plan designates that four of the seven outcomes (SO1, SO3, SO4, SO5) are assessed during odd years (Fall 2021-Spring 2022, Fall 2023-Spring 2024, Fall 2025 - Spring 2026). The assessment stage is followed by evaluation and change in Fall 2022, Fall 2024, and Fall 2026.
    - The remaining three outcomes (SO2, SO6, SO7) are assessed during the even years (Fall 2022-Spring 2023, Fall 2024-Spring 2025, Fall 2026-Spring 2027), followed by evaluation and change in Fall 2023, Fall 2025, Fall 2027.
    - New departmental rubrics were developed by the faculty to assess student artifacts from the Senior Capstone projects and applied during faculty retreats. The rubrics are provided in separate documents. The assessment stage is described in a Standard Operating Procedures (SOP) and attached in a separate document. The Direct Measure is called the Faculty Review of Capstone Artifacts (FRCA).

Additional Measures

Four survey instruments (Alumni Survey, Co-op Employer Survey, Instructional Outcome - Student Survey and Senior Exit Interview Written Survey) and a faculty instrument (Instructional Outcome - Faculty Assessment) are conducted each year and have been kept active during the transition to implementation of the AEC Plan.

- Alumni Survey
- Co-op Employer Survey
- Instructional Outcome - Faculty Assessment
- Instructional Outcome - Student Survey
- Senior Exit Interview Written Survey

Attached Files: See Appendices 2 and 3

Criteria for Success (Thresholds for Assessment Methods):

Direct Measure

The expected level of attainment of Student Outcomes using the direct measure of the Faculty Review of Capstone Artifacts (FRCA) is a threshold of 85% of student evidence indicated as Fair, Good, or Exemplary.

Additional Measures

The expected level of attainment of Student Outcomes with the Additional Measures is scored with a 0–4-point level of attainment scale where each level is defined as 4 = Excellent, 3 = Good, 2 = Satisfactory, 1 = Low, and 0 = Negligible. Data from the Additional Measures assessment instruments are combined according to the evaluation plan to determine the final scored value each year for each Student Outcome.

A score of 3-to-4 is the desired level of attainment for each Student Outcome. A score between 2-to-3 is cause for review by the ME Goals and Assessments Committee, with possible actions and/or continued monitoring recommended to the ME faculty. A score lower than 2 requires corrective action to be taken by the ME faculty after review and recommendations for change by the ME Goals and Assessments Committee.

Link to 'Tech Tomorrow' Strategic Plan:

1.A Experiential Learning,2.B Research, Scholar, Intellect, and Creativity

Results and Analysis:

Direct Measures

- **Faculty Review of Capstone Artifacts (FRCA)**
- SO 1 is not evaluated in even years, next evaluation will occur in Fall 2025

Additional Measures in Table Form

SO1: Identify, Formulate and Solve Engineering Problems			
	2022-23	2023-24	2024-25
Alumni Survey	3.0	3.6	3.2
Co-op Employer Survey	3.2	3.3	3.4
Instructional Outcomes - Faculty Assessment (IOFA)	---	---	WIP
Instructional Outcomes - Student Survey (IOSS)	3.0	3.0	2.8
Senior Exit Survey	3.4	3.1	WIP
AVERAGE	3.2	3.2	3.1

The Alumni Survey data indicate exceeding the threshold (3.2 > 3.0), decreasing from the prior year. No action required.

The Co-op Employer Survey data exceeds the threshold (3.4 > 3.0), increasing from the prior year. No action required.

The Instructional Outcomes - Faculty Assessment (IOFA) assessment instrument has been revised and implemented in Fall 2024-Spring 2025. The data analysis from the IOFA instrument is a "Work in Progress (WIP)". It is expected to be complete in July 2025.

The Instructional Outcomes - Student Assessment (IOSS) data indicates a decrease from the prior year, now less than the threshold (2.8 < 3.0). Action is required.

The Senior Exit Survey assessment instrument data has not been assessed as of May. It is expected to be complete in June 2025.

The overall average of the Additional Measures for SO1 exceeds the threshold (3.1 > 3.0), thus no overall action is required.

Use of Results to Improve Outcomes:

From the Additional Measures, the Instructional Outcomes - Student Survey (IOSS) the drop below threshold (2.8 < 3.0) will be discussed with the Faculty in Fall Retreat. Ideas for how to ensure students perceive they are making progress on SO1 will be documented and any substantial actions decided upon will be described as an outcome of the Fall Retreat.

SO2: Apply Engineering Design to Produce Solutions That Meet Specified Needs

Define Outcome:

It is expected that by the time of graduation, Tech's ME students will have 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.

Assessment Methods:

Direct Measure

- AEC Plan and Departmental Rubrics
    - In Fall 2021, the ME Department adopted a new paradigm for continuous improvement. The AEC Plan is based on a two-year cycle for assessing, evaluation, and change. The AEC Plan designates that four of the seven outcomes (SO1, SO3, SO4, SO5) are assessed during odd years (Fall 2021-Spring 2022, Fall 2023-Spring 2024, Fall 2025 - Spring 2026). The assessment stage is followed by evaluation and change in Fall 2022, Fall 2024, and Fall 2026.
    - The remaining three outcomes (SO2, SO6, SO7) are assessed during the even years (Fall 2022-Spring 2023, Fall 2024-Spring 2025, Fall 2026-Spring 2027), followed by evaluation and change in Fall 2023, Fall 2025, Fall 2027.
    - New departmental rubrics were developed by the faculty to assess student artifacts from the Senior Capstone projects and applied during faculty retreats. The rubrics are provided in separate documents. The assessment stage is described in a Standard Operating Procedures (SOP) and attached in a separate document. The Direct Measure is called the Faculty Review of Capstone Artifacts (FRCA).

Additional Measures

Four survey instruments (Alumni Survey, Co-op Employer Survey, Instructional Outcome - Student Survey and Senior Exit Interview Written Survey) and a faculty instrument (Instructional Outcome - Faculty Assessment) are conducted each year and have been kept active during the transition to implementation of the AEC Plan.

- Alumni Survey
- Co-op Employer Survey
- Instructional Outcome - Faculty Assessment
- Instructional Outcome - Student Survey
- Senior Exit Interview Written Survey

Attached Files: See Appendices 3, 4, and 5

Criteria for Success (Thresholds for Assessment Methods):
Direct Measure

The expected level of attainment of Student Outcomes using the direct measure of the Faculty Review of Capstone Artifacts (FRCA) is a threshold of 85% of student evidence indicated as Fair, Good, or Exemplary.

Additional Measures

The expected level of attainment of Student Outcomes is scored with a 0-4 point level of attainment scale where each level is defined as 4 = Excellent, 3 = Good, 2 = Satisfactory, 1 = Low, and 0 = Negligible. Data from the assessment instruments are combined according to the evaluation plan to determine the final scored value each year for each Student Outcome.

A score of 3-to-4 is the desired level of attainment for each Student Outcome. A score between 2-to-3 is cause for review by the ME Goals and Assessments Committee, with possible actions and/or continued monitoring recommended to the ME faculty. A score lower than 2 requires corrective action to be taken by the ME faculty after review and recommendations for change by the ME Goals and Assessments Committee.

Link to 'Tech Tomorrow' Strategic Plan:
1.A Experiential Learning

Results and Analysis:
Direct Measures

- **Faculty Review of Capstone Artifacts (FRCA)**

SO2 Percent of Students Achieving Fair, Good or Exemplary			
Performance Indicator (PI)		**2022-2023**	**2024-2025**
SO2-PI1	Produce a clear problem statement	94%	97%
SO2-PI2	Plan design approach, follow design methodology	94%	97%
SO2-PI3	Justify design decisions and implement designs	94%	90%
SO2-PI4	Assess designs	77%	84%

Analysis of the FRCA data indicates that the percentage of student evidence for Performance Indicators SO2-PI1, SO2-PI2, SO2-PI3 continue to exceed the threshold of

85%. No action is required. However, the SO2-PI4 "Assess Designs" is less than the threshold, thus action is required.

Additional Measures in Table Form

SO2: Apply Engineering Design to Produce Solutions that Meet Specified Needs			
	2022-23	**2023-24**	**2024-25**
Alumni Survey	3.0	3.6	3.2
Co-op Employer Survey	3.3	3.3	3.1
Instructional Outcomes - Faculty Assessment (IOFA)	---	---	WIP
Instructional Outcomes - Student Survey (IOSS)	2.9	2.9	2.9
Senior Exit Survey	3.2	3.1	WIP
AVERAGE	3.1	3.1	3.1

The Alumni Survey data indicate exceeding the threshold (3.2 > 3.0), decreasing from the prior year. No action required.

The Co-op Employer Survey data exceeds the threshold (3.1 > 3.0), decreasing from the prior year. No action required.

The Instructional Outcomes - Faculty Assessment (IOFA) assessment instrument has been revised and implemented in Fall 2024-Spring 2025. The data analysis from the IOFA instrument is a "Work in Progress (WIP)". It is expected to be complete in July 2025.

The Instructional Outcomes - Student Assessment (IOSS) data indicates an ongoing lower than threshold value (2.9 < 3.0). Action is required.

The Senior Exit Survey assessment instrument data has not been assessed as of May. It is expected to be complete in June 2025.

The overall average of the Additional Measures for SO2 exceeds the threshold (3.1 > 3.0), thus no overall action is required.

Use of Results to Improve Outcomes:

The Faculty Review of Capstone Artifacts (FRCA) will be discussed in the Fall 2025 Faculty Retreat, August 2025. Evaluation of the less than threshold (77%, 84% < 85%) for the

Performance Indicator SO2-PI4 "Assess Design" will occur. Decisions regarding what changes to implement and how to track those changes during the following year (Fall 2025-Spring 2026) will be documented outcomes for the Fall Faculty Retreat.

From the Additional Measures, the Instructional Outcomes - Student Survey (IOSS) having ongoing less than threshold trend (2.9 < 3.0) will be discussed with the Faculty in Fall Retreat. Ideas for how to ensure students perceive they are making progress on SO2 will be documented and any substantial actions decided upon will be described as an outcome of the Fall Retreat.

SO3: Communicate Effectively

Define Outcome:
It is expected that by the time of graduation, Tech's ME students will have an ability to communicate effectively with a range of audiences.

Assessment Methods:
Direct Measure

- AEC Plan and Departmental Rubrics
    - In Fall 2021, the ME Department adopted a new paradigm for continuous improvement. The AEC Plan is based on a two-year cycle for assessing, evaluation, and change. The AEC Plan designates that four of the seven outcomes (SO1, SO3, SO4, SO5) are assessed during odd years (Fall 2021-Spring 2022, Fall 2023-Spring 2024, Fall 2025 - Spring 2026). The assessment stage is followed by evaluation and change in Fall 2022, Fall 2024, and Fall 2026.
    - The remaining three outcomes (SO2, SO6, SO7) are assessed during the even years (Fall 2022-Spring 2023, Fall 2024-Spring 2025, Fall 2026-Spring 2027), followed by evaluation and change in Fall 2023, Fall 2025, Fall 2027.
    - New departmental rubrics were developed by the faculty to assess student artifacts from the Senior Capstone projects and applied during faculty retreats. The rubrics are provided in separate documents. The assessment stage is described in a Standard Operating Procedures (SOP) and attached in a separate document. The Direct Measure is called the Faculty Review of Capstone Artifacts (FRCA).

Additional Measures
Four survey instruments (Alumni Survey, Co-op Employer Survey, Instructional Outcome - Student Survey and Senior Exit Interview Written Survey) and a faculty instrument (Instructional Outcome - Faculty Assessment) are conducted each year and have been kept active during the transition to implementation of the AEC Plan.

- Alumni Survey
- Co-op Employer Survey
- Instructional Outcome - Faculty Assessment
- Instructional Outcome - Student Survey
- Senior Exit Interview Written Survey

Criteria for Success (Thresholds for Assessment Methods):

Direct Measure

The expected level of attainment of Student Outcomes using the direct measure of the Faculty Review of Capstone Artifacts (FRCA) is a threshold of 85% of student evidence indicated as Fair, Good, or Exemplary.

Additional Measures

The expected level of attainment of Student Outcomes is scored with a 0–4-point level of attainment scale where each level is defined as 4 = Excellent, 3 = Good, 2 = Satisfactory, 1 = Low, and 0 = Negligible. Data from the assessment instruments are combined according to the evaluation plan to determine the final scored value each year for each Student Outcome.

A score of 3-to-4 is the desired level of attainment for each Student Outcome. A score between 2-to-3 is cause for review by the ME Goals and Assessments Committee, with possible actions and/or continued monitoring recommended to the ME faculty. A score lower than 2 requires corrective action to be taken by the ME faculty after review and recommendations for change by the ME Goals and Assessments Committee.

Link to 'Tech Tomorrow' Strategic Plan:

1.A Experiential Learning,4.D Alumni/Friend Engagement

Results and Analysis:

Direct Measures

- **Faculty Review of Capstone Artifacts (FRCA)**
- SO 3 is not evaluated in even years, next evaluation in Fall 2025

Additional Measures in Table Form

SO3: Communicate Effectively			
	2022-23	2023-24	2024-25
Alumni Survey	3.0	3.1	2.8
Co-op Employer Survey	3.3	3.2	3.1
Instructional Outcomes - Faculty Assessment (IOFA)	---	---	WIP
Instructional Outcomes - Student Survey (IOSS)	2.9	2.9	2.8
Senior Exit Survey	3.3	3.2	WIP
AVERAGE	3.1	3.1	2.9

The Alumni Survey data indicate below the threshold (2.8 < 3.0), decreasing from the prior year. Action is required.

The Co-op Employer Survey data exceeds the threshold (3.1 > 3.0), remaining the same as the prior year. No action required.

The Instructional Outcomes - Faculty Assessment (IOFA) assessment instrument has been revised and implemented in Fall 2024-Spring 2025. The data analysis from the IOFA instrument is a "Work in Progress (WIP)". It is expected to be complete in July 2025.

The Instructional Outcomes - Student Assessment (IOSS) data indicates an ongoing lower than threshold value (2.8 < 3.0). Action is required.

The Senior Exit Survey assessment instrument data has not been assessed as of May. It is expected to be complete in June 2025.

The overall average of the Additional Measures for SO3 has dropped below the threshold (2.9 < 3.0), thus overall action is required.

Use of Results to Improve Outcomes:

From the Additional Measures, the Instructional Outcomes - Student Survey (IOSS) the continued trend and the decrease below threshold (2.8 < 3.0) will be discussed with the Faculty in Fall Retreat. Ideas for how to ensure students perceive they are making progress on SO3 will be documented and any substantial actions decided upon will be described as an outcome of the Fall Retreat.

SO4: Recognize Ethical and Professional Responsibilities and Make Informed Judgments

Define Outcome:

It is expected that by the time of graduation, Tech's ME students will have an ability to 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.

Assessment Methods:

Direct Measure

- AEC Plan and Departmental Rubrics
    - In Fall 2021, the ME Department adopted a new paradigm for continuous improvement. The AEC Plan is based on a two-year cycle for assessing, evaluation, and change. The AEC Plan designates that four of the seven outcomes (SO1, SO3, SO4, SO5) are assessed during odd years (Fall 2021-Spring 2022, Fall 2023-Spring 2024, Fall 2025 - Spring 2026). The assessment stage is followed by evaluation and change in Fall 2022, Fall 2024, and Fall 2026.
    - The remaining three outcomes (SO2, SO6, SO7) are assessed during the even years (Fall 2022-Spring 2023, Fall 2024-Spring 2025, Fall 2026-Spring 2027), followed by evaluation and change in Fall 2023, Fall 2025, Fall 2027.
    - New departmental rubrics were developed by the faculty to assess student artifacts from the Senior Capstone projects and applied during faculty retreats. The rubrics are provided in separate documents. The assessment stage is described in a Standard Operating Procedures (SOP) and attached in a separate document. The Direct Measure is called the Faculty Review of Capstone Artifacts (FRCA).

Additional Measures

Four survey instruments (Alumni Survey, Co-op Employer Survey, Instructional Outcome - Student Survey and Senior Exit Interview Written Survey) and a faculty instrument (Instructional Outcome - Faculty Assessment) are conducted each year and have been kept active during the transition to implementation of the AEC Plan.

- Alumni Survey
- Co-op Employer Survey
- Instructional Outcome - Faculty Assessment
- Instructional Outcome - Student Survey
- Senior Exit Interview Written Survey

Criteria for Success (Thresholds for Assessment Methods):

Direct Measure

The expected level of attainment of Student Outcomes using the direct measure of the Faculty Review of Capstone Artifacts (FRCA) is a threshold of 85% of student evidence indicated as Fair, Good, or Exemplary.

Additional Measures

The expected level of attainment of Student Outcomes is scored with a 0-4 point level of attainment scale where each level is defined as 4 = Excellent, 3 = Good, 2 = Satisfactory, 1 = Low, and 0 = Negligible. Data from the assessment instruments are combined according to the evaluation plan to determine the final scored value each year for each Student Outcome.

A score of 3-to-4 is the desired level of attainment for each Student Outcome. A score between 2-to-3 is cause for review by the ME Goals and Assessments Committee, with possible actions and/or continued monitoring recommended to the ME faculty. A score lower than 2 requires corrective action to be taken by the ME faculty after review and recommendations for change by the ME Goals and Assessments Committee.

Link to 'Tech Tomorrow' Strategic Plan:

1.B General Education Curriculum,1.C Diversity

Results and Analysis:

Direct Measures

- **Faculty Review of Capstone Artifacts (FRCA)**
- SO 4 is not evaluated in even years, next evaluation in Fall 2025

Additional Measures in Table Form

SO4: Recognize Ethical and Professional Responsibilities and Make Informed Judgements			
	2022-23	2023-24	2024-25
Alumni Survey	2.9	3.4	2.8
Co-op Employer Survey	3.3	3.2	3.4
Instructional Outcomes - Faculty Assessment (IOFA)	---	---	WIP
Instructional Outcomes - Student Survey (IOSS)	2.9	2.9	2.8
Senior Exit Survey	3.5	3.3	WIP
AVERAGE	3.2	3.2	3.0

The Alumni Survey data has dropped below the threshold (2.8 < 3.0), decreasing from the prior year. Action is required.

The Co-op Employer Survey data exceeds the threshold (3.4 > 3.0), remaining the same as the prior year. No action required.

The Instructional Outcomes - Faculty Assessment (IOFA) assessment instrument has been revised and implemented in Fall 2024-Spring 2025. The data analysis from the IOFA instrument is a "Work in Progress (WIP)". It is expected to be complete in July 2025.

The Instructional Outcomes - Student Assessment (IOSS) data indicates an ongoing lower than threshold value (2.8 < 3.0). Action is required.

The Senior Exit Survey assessment instrument data has not been assessed as of May. It is expected to be complete in June 2025.

The overall average of the Additional Measures for SO4 equals the threshold but has dropped from prior year. Overall action is required.

Use of Results to Improve Outcomes:

From the Additional Measures, the Instructional Outcomes - Student Survey (IOSS) the continued trend below threshold and recent drop (2.8 < 3.0) will be discussed with the Faculty in Fall Retreat. Ideas for how to ensure students perceive they are making progress on SO4 will be documented and any substantial actions decided upon will be described as an outcome of the Fall Retreat.

SO5: Teamwork

Define Outcome:
It is expected that by the time of graduation, Tech's ME students will have 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.

Assessment Methods:
Direct Measure

- AEC Plan and Departmental Rubrics
    - In Fall 2021, the ME Department adopted a new paradigm for continuous improvement. The AEC Plan is based on a two-year cycle for assessing, evaluation, and change. The AEC Plan designates that four of the seven outcomes (SO1, SO3, SO4, SO5) are assessed during odd years (Fall 2021-Spring 2022, Fall 2023-Spring 2024, Fall 2025 - Spring 2026). The assessment stage is followed by evaluation and change in Fall 2022, Fall 2024, and Fall 2026.
    - The remaining three outcomes (SO2, SO6, SO7) are assessed during the even years (Fall 2022-Spring 2023, Fall 2024-Spring 2025, Fall 2026-Spring 2027), followed by evaluation and change in Fall 2023, Fall 2025, Fall 2027.
    - New departmental rubrics were developed by the faculty to assess student artifacts from the Senior Capstone projects and applied during faculty retreats. The rubrics are provided in separate documents. The assessment stage is described in a Standard Operating Procedures (SOP) and attached in a separate document. The Direct Measure is called the Faculty Review of Capstone Artifacts (FRCA).

Additional Measures
Four survey instruments (Alumni Survey, Co-op Employer Survey, Instructional Outcome - Student Survey and Senior Exit Interview Written Survey) and a faculty instrument (Instructional Outcome - Faculty Assessment) are conducted each year and have been kept active during the transition to implementation of the AEC Plan.

- Alumni Survey
- Co-op Employer Survey
- Instructional Outcome - Faculty Assessment
- Instructional Outcome - Student Survey
- Senior Exit Interview Written Survey

Criteria for Success (Thresholds for Assessment Methods):

Direct Measure

The expected level of attainment of Student Outcomes using the direct measure of the Faculty Review of Capstone Artifacts (FRCA) is a threshold of 85% of student evidence indicated as Fair, Good, or Exemplary.

Additional Measures

The expected level of attainment of Student Outcomes is scored with a 0-4 point level of attainment scale where each level is defined as 4 = Excellent, 3 = Good, 2 = Satisfactory, 1 = Low, and 0 = Negligible. Data from the assessment instruments are combined according to the evaluation plan to determine the final scored value each year for each Student Outcome.

A score of 3-to-4 is the desired level of attainment for each Student Outcome. A score between 2-to-3 is cause for review by the ME Goals and Assessments Committee, with possible actions and/or continued monitoring recommended to the ME faculty. A score lower than 2 requires corrective action to be taken by the ME faculty after review and recommendations for change by the ME Goals and Assessments Committee.

Link to 'Tech Tomorrow' Strategic Plan:

4.C Network of Scholars,4.D Alumni/Friend Engagement

Results and Analysis:

Direct Measures

- **Faculty Review of Capstone Artifacts (FRCA)**
- SO5 is not evaluated in even years, next evaluation in Fall 2025

Additional Measures in Table Form

SO5: Teamwork			
	2022-23	2023-24	2024-25
Alumni Survey	3.4	3.6	3.3
Co-op Employer Survey	3.5	3.5	3.5
Instructional Outcomes - Faculty Assessment (IOFA)	---	---	WIP
Instructional Outcomes - Student Survey (IOSS)	3.0	3.0	2.9
Senior Exit Survey	3.5	3.5	WIP
AVERAGE	3.4	3.4	3.2

The Alumni Survey data indicate exceeding the threshold (3.3 > 3.0), decreasing from the prior year. No action required.

The Co-op Employer Survey data exceeds the threshold (3.5 > 3.0), remaining the same as the prior year. No action required.

The Instructional Outcomes - Faculty Assessment (IOFA) assessment instrument has been revised and implemented in Fall 2024-Spring 2025. The data analysis from the IOFA instrument is a "Work in Progress (WIP)". It is expected to be complete in July 2025.

The Instructional Outcomes - Student Assessment (IOSS) data indicates an ongoing lower than threshold value (2.9 < 3.0). Action is required.

The Senior Exit Survey assessment instrument data has not been assessed as of May. It is expected to be complete in June 2025.

The overall average of the Additional Measures for SO5 exceeds the threshold (3.2 > 3.0), thus no overall action is required.

Use of Results to Improve Outcomes:

From the Additional Measures, the Instructional Outcomes - Student Survey (IOSS) the drop below threshold (2.9 < 3.0) will be discussed with the Faculty in Fall Retreat. Ideas for how to ensure students perceive they are making progress on SO5 will be documented and any substantial actions decided upon will be described as an outcome of the Fall Retreat.

SO6: Experiment, Interpret Data, and Use Engineering Judgment

Define Outcome:
It is expected that by the time of graduation, Tech's ME students will have an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.

Assessment Methods:
Direct Measure

- AEC Plan and Departmental Rubrics
    - In Fall 2021, the ME Department adopted a new paradigm for continuous improvement. The AEC Plan is based on a two-year cycle for assessing, evaluation, and change. The AEC Plan designates that four of the seven outcomes (SO1, SO3, SO4, SO5) are assessed during odd years (Fall 2021-Spring 2022, Fall 2023-Spring 2024, Fall 2025 - Spring 2026). The assessment stage is followed by evaluation and change in Fall 2022, Fall 2024, and Fall 2026.
    - The remaining three outcomes (SO2, SO6, SO7) are assessed during the even years (Fall 2022-Spring 2023, Fall 2024-Spring 2025, Fall 2026-Spring 2027), followed by evaluation and change in Fall 2023, Fall 2025, Fall 2027.
    - New departmental rubrics were developed by the faculty to assess student artifacts from the Senior Capstone projects and applied during faculty retreats. The rubrics are provided in separate documents. The assessment stage is described in a Standard Operating Procedures (SOP) and attached in a separate document. The Direct Measure is called the Faculty Review of Capstone Artifacts (FRCA).

Additional Measures
Four survey instruments (Alumni Survey, Co-op Employer Survey, Instructional Outcome - Student Survey and Senior Exit Interview Written Survey) and a faculty instrument (Instructional Outcome - Faculty Assessment) are conducted each year and have been kept active during the transition to implementation of the AEC Plan.

- Alumni Survey
- Co-op Employer Survey
- Instructional Outcome - Faculty Assessment
- Instructional Outcome - Student Survey
- Senior Exit Interview Written Survey

Attached Files: See Appendices 3, 5, and 6

Criteria for Success (Thresholds for Assessment Methods):

Direct Measure

The expected level of attainment of Student Outcomes using the direct measure of the Faculty Review of Capstone Artifacts (FRCA) is a threshold of 85% of student evidence indicated as Fair, Good, or Exemplary.

Additional Measures

The expected level of attainment of Student Outcomes is scored with a 0-4 point level of attainment scale where each level is defined as 4 = Excellent, 3 = Good, 2 = Satisfactory, 1 = Low, and 0 = Negligible. Data from the assessment instruments are combined according to the evaluation plan to determine the final scored value each year for each Student Outcome.

A score of 3-to-4 is the desired level of attainment for each Student Outcome. A score between 2-to-3 is cause for review by the ME Goals and Assessments Committee, with possible actions and/or continued monitoring recommended to the ME faculty. A score lower than 2 requires corrective action to be taken by the ME faculty after review and recommendations for change by the ME Goals and Assessments Committee.

Link to 'Tech Tomorrow' Strategic Plan:

1.A Experiential Learning,1.D High Impact Practices

Results and Analysis:

Direct Measures

- **Faculty Review of Capstone Artifacts (FRCA)**

SO6 Percent of Students Achieving Fair, Good or Exemplary			
Performance Indicator (PI)		2022-2023	2024-2025
SO6-PI1	Perform experiment and collect data based on prescribed procedure(s)	66%	74%
SO6-PI2	Analyze, reduce, and present collected data	89%	78%
SO6-PI3	Develop and support conclusions based on interpreted data	80%	90%

Analysis of the FRCA data indicates that the percentage of student evidence for Performance Indicators SO6-PI1 has increased from the prior cycle of assessment and now exceeds the threshold (90% > 85%), thus no action is required.

The data for SO6- PI1 has increased from 66% to 74% but is still below the threshold. SO6-PI2 has decreased from the prior cycle and is now below the threshold (78% < 85%). Action is required for SO6-PI1 and SO6-PI2.

Additional Measures in Table Form

SO6: Experiment, Interpret Data, and Use Engineering Judgement			
	2022-23	2023-24	2024-25
Alumni Survey	3.1	3.4	3.0
Co-op Employer Survey	3.2	3.3	3.5
Instructional Outcomes - Faculty Assessment (IOFA)	---	---	WIP
Instructional Outcomes - Student Survey (IOSS)	2.9	2.9	2.8
Senior Exit Survey	3.2	3.2	WIP
AVERAGE	3.1	3.1	3.1

The Alumni Survey data indicate equaling the threshold, decreasing from the prior year. Review of qualitative comments is recommended.

The Co-op Employer Survey data exceeds the threshold (3.5 > 3.0), decreasing from the prior year. No action required.

The Instructional Outcomes - Faculty Assessment (IOFA) assessment instrument has been revised and implemented in Fall 2024-Spring 2025. The data analysis from the IOFA instrument is a "Work in Progress (WIP)". It is expected to be complete in July 2025.

The Instructional Outcomes - Student Assessment (IOSS) data indicates an ongoing lower than threshold value (2.8 < 3.0). Action is required.

The Senior Exit Survey assessment instrument data has not been assessed as of May. It is expected to be complete in June 2025.

The overall average of the Additional Measures for SO2 exceeds the threshold (3.1 > 3.0), thus no overall action is required.

Use of Results to Improve Outcomes:

The Faculty Review of Capstone Artifacts (FRCA) will be discussed in the Fall 2025 Faculty Retreat, August 2025. Evaluation of the less than threshold values for the Performance

Indicators SO6-PI1 and SO6-PI2 will occur. Decisions regarding what changes to implement and how to track those changes during the following year (Fall 2025-Spring 2026) will be documented outcomes for the Fall Faculty Retreat.

From the Additional Measures, the Instructional Outcomes - Student Survey (IOSS) having ongoing less than threshold (2.8 < 3.0) as a trend will be discussed with the Faculty in Fall Retreat. Ideas for how to ensure students perceive they are making progress on SO6 will be documented and any substantial actions decided upon will be described as an outcome of the Fall Retreat.

SO7: Ability to Acquire and Apply New Knowledge

Define Outcome:

It is expected that by the time of graduation, Tech's ME students will have an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Assessment Methods:

Direct Measure

- AEC Plan and Departmental Rubrics
    - In Fall 2021, the ME Department adopted a new paradigm for continuous improvement. The AEC Plan is based on a two-year cycle for assessing, evaluation, and change. The AEC Plan designates that four of the seven outcomes (SO1, SO3, SO4, SO5) are assessed during odd years (Fall 2021-Spring 2022, Fall 2023-Spring 2024, Fall 2025 - Spring 2026). The assessment stage is followed by evaluation and change in Fall 2022, Fall 2024, and Fall 2026.
    - The remaining three outcomes (SO2, SO6, SO7) are assessed during the even years (Fall 2022-Spring 2023, Fall 2024-Spring 2025, Fall 2026-Spring 2027), followed by evaluation and change in Fall 2023, Fall 2025, Fall 2027.
    - New departmental rubrics were developed by the faculty to assess student artifacts from the Senior Capstone projects and applied during faculty retreats. The rubrics are provided in separate documents. The assessment stage is described in a Standard Operating Procedures (SOP) and attached in a separate document. The Direct Measure is called the Faculty Review of Capstone Artifacts (FRCA).

Additional Measures

Four survey instruments (Alumni Survey, Co-op Employer Survey, Instructional Outcome - Student Survey and Senior Exit Interview Written Survey) and a faculty instrument (Instructional Outcome - Faculty Assessment) are conducted each year and have been kept active during the transition to implementation of the AEC Plan.

- Alumni Survey
- Co-op Employer Survey
- Instructional Outcome - Faculty Assessment
- Instructional Outcome - Student Survey
- Senior Exit Interview Written Survey

Attached Files: See Appendices 3, 5, and 7

Criteria for Success (Thresholds for Assessment Methods):

Direct Measure

The expected level of attainment of Student Outcomes using the direct measure of the Faculty Review of Capstone Artifacts (FRCA) is a threshold of 85% of student evidence indicated as Fair, Good, or Exemplary.

Additional Measures

The expected level of attainment of Student Outcomes is scored with a 0-4 point level of attainment scale where each level is defined as 4 = Excellent, 3 = Good, 2 = Satisfactory, 1 = Low, and 0 = Negligible. Data from the assessment instruments are combined according to the evaluation plan to determine the final scored value each year for each Student Outcome.

A score of 3-to-4 is the desired level of attainment for each Student Outcome. A score between 2-to-3 is cause for review by the ME Goals and Assessments Committee, with possible actions and/or continued monitoring recommended to the ME faculty. A score lower than 2 requires corrective action to be taken by the ME faculty after review and recommendations for change by the ME Goals and Assessments Committee.

Link to 'Tech Tomorrow' Strategic Plan:

1.A Experiential Learning,1.D High Impact Practices

Results and Analysis:

Direct Measures

- **Faculty Review of Capstone Artifacts (FRCA)**

SO7 Percent of Students Achieving Fair, Good or Exemplary			
Performance Indicator (PI)		**2022-2023**	**2024-2025**
SO7-PI1	Recognize the need for acquiring new knowledge/tools to meet a specific need	77%	84%
SO7-PI2	Engage in planning and using effective learning strategies	80%	74%
SO7-PI3	Seek information from valid sources	69%	84%
SO7-PI4	Demonstrate use of the new knowledge and reflect on learning process	60%	68%

Analysis of the FRCA data indicates that the percentage of student evidence for Performance Indicators are all less than the threshold of 85%. SO7-PI1 and SO7-PI3 increased from the prior assessment cycle and are close to the threshold (84% < 85%) so these require minimal attention. The SO7-PI2 has decreased from the prior assessment cycle, dropping from 80% to 74%; action is required. The SO7-PI4, while increasing from

the prior assessment cycle from 60% to 68%, remains less than the threshold, thus action is required.

Additional Measures in Table Form

SO7: Ability to Acquire and Apply New Knowledge			
	2022-23	**2023-24**	**2024-25**
Alumni Survey	3.4	3.6	3.2
Co-op Employer Survey	3.5	3.5	3.5
Instructional Outcomes - Faculty Assessment (IOFA)	---	---	WIP
Instructional Outcomes - Student Survey (IOSS)	2.9	2.9	2.8
Senior Exit Survey	3.5	3.4	WIP
AVERAGE	3.3	3.3	3.2

The Alumni Survey data indicate exceeding the threshold (3.2 > 3.0), decreasing from the prior year. No action required.

The Co-op Employer Survey data exceeds the threshold (3.5 > 3.0), remaining the same as the prior year. No action required.

The Instructional Outcomes - Faculty Assessment (IOFA) assessment instrument has been revised and implemented in Fall 2024-Spring 2025. The data analysis from the IOFA instrument is a "Work in Progress (WIP)". It is expected to be complete in July 2025.

The Instructional Outcomes - Student Assessment (IOSS) data indicates an ongoing lower than threshold value (2.8 < 3.0). Action is required.

The Senior Exit Survey assessment instrument data has not been assessed as of May. It is expected to be complete in June 2025.

The overall average of the Additional Measures for SO7 exceeds the threshold (3.2 > 3.0), thus no overall action is required.

Use of Results to Improve Outcomes:

The Faculty Review of Capstone Artifacts (FRCA) will be discussed in the Fall 2025 Faculty Retreat. Evaluation of the less than threshold values for the Performance Indicator SO7-PI2 and

SO7-PI4 will be priority focus, with minimal discussion of the two other performance indicators that are close to threshold. Decisions regarding what changes to implement and how to track those changes during the following year (Fall 2025-Spring 2026) will be documented outcomes for the Fall Faculty Retreat.

From the Additional Measures, the Instructional Outcomes - Student Survey (IOSS) having ongoing less than threshold (2.8 < 3.0) as a trend will be discussed with the Faculty in Fall Retreat. Ideas for how to ensure students perceive they are making progress on SO7 will be documented and any substantial actions decided upon will be described as an outcome of the Fall Retreat.

Summative Evaluation:

The detailed evaluation of performance indicators for SO2, SO6, and SO7 as presented in the report demonstrates high levels of achievement across all areas with need for improvement identified in some. Students achieved "Exemplary" or "Good" or “Fair” ratings in the Faculty Review of Capstone Artifacts (FRCA), surpassing the 85% performance target in three of the four Performance Indicators for SO2 and one of the three Performance Indicators for SO6, while none of the SO7 Performance Indicators exceeded the threshold.

SO2 Percent of Students Achieving Fair, Good or Exemplary

Performance Indicator (PI)	2024-2025
SO2-PI1	97%
SO2-PI2	97%
SO2-PI3	90%
SO2-PI4	*84%*

SO6 Percent of Students Achieving Fair, Good or Exemplary

Performance Indicator (PI)	2024-2025
SO6-PI1	*74%*
SO6-PI2	*78%*
SO6-PI3	90%

SO7 Percent of Students Achieving Fair, Good or Exemplary

Performance Indicator (PI)	2024-2025
SO7-PI1	*84%*
SO7-PI2	*74%*
SO7-PI3	*84%*
SO7-PI4	*68%*

The SO2-PI4 is at 84%, close to threshold. SO6-PI2, and SO6-PI3, are within a range of 10 below the threshold at 74% and 78%. SO7-PI1 and SO7-PI3 are close to threshold at 84% and SO7-PI2 and SO7-PI4 are within a range of 17 below the threshold at 74% and 68%.

This FRCA performance measures reflects the majority of students' strong preparation and readiness to meet the challenges of the engineering profession, with mostly positive sentiment across all outcomes and performance indicators.

The ME Faculty will evaluate these FRCA results during the Fall 2025 Faculty Retreat, August 2025. Decisions about subsequent actions taken to address the below threshold performance indicators will be documented and tracked during the Fall 2025-Spring 2026 portion of the two-year AEC Plan cycle for SO2, SO6, and SO7.

The ME Faculty will also consider the assessment results from the IOSS, where students' perceptions of their learning indicate a marginal value below threshold (2.9 < 3.0). Any changes made to instructional design will be noted and reported on in the next cycle.

Assessment Plan Changes:
The AEC Plan, with Departmental Rubrics and Faculty Review of Capstone Artifacts is working well and provides detailed data that can be evaluated to inform change in instructional design to improve student outcomes. No changes to the AEC Plan are needed. The Additional Measures do offer a continuity of assessment with prior practice; use of the assessment instruments will continue.

List of Appendices:
Appendix 1: Curriculum Map
Appendix 2: SO1 Departmental Rubric
Appendix 3: AEC Plan Overview
Appendix 4: SO2 Departmental Rubric
Appendix 5: AEC_4_05132025
Appendix 6: SO6 Departmental Rubric
Appendix 7: SO7 Departmental Rubric

Appendix 1: Curriculum Map

Course	Student Outcomes I = Introduce, R = Reinforce, D = Demonstrate						
Number and Title	**1**	**2**	**3**	**4**	**5**	**6**	**7**
ME 2330 Dynamics	I						I
ME 2910 Professionalism and Ethics			R	D	R		I
ME 3001 Mechanical Engineering Analysis	I				I	I	I
ME 3010 Materials & Processes in Manufacturing	I	I		I			
ME 3023 Measurements in Mechanical Systems	R			I	I	R	I
ME 3050 Dynamic Modeling & Controls	I	I					
ME 3060 Dynamic Modeling & Controls Lab			I		I	R	I
ME 3210 Thermodynamics I	I						
ME 3220 Thermodynamics II	R	I		I			
ME 3610 Dynamics of Machinery	R	I		I	I		
ME 3710 Fluid Dynamics	R						
ME 3720 Heat Transfer	R						
ME 4010 Machine Design	R	R		I		I	
ME 4020 Applied Machine Design	D	D	R	I	I	R	R
ME 4410 Senior Design Project I	D	R	R	R	R		D
ME 4420 Senior Design Project II		D	D	D	D	D	D
ME 4720 Thermal Design	D	D	R	I	I	R	R
ME 4751 Energy Systems Lab	R					D	

Appendix 2: SO1 Departmental Rubric

SO1 - The ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.

Performance Indicators	Level 4 (Exemplary)	Level 3 (Good)	Level 2 (Fair)	Level 1 (Poor)	Level 0 (No Evidence)
SO1-PI1 Restate complex problems into subparts with proper assumptions	• Identify all influential knowns, including those directly provided in the problem statement and those requiring one to interpret a figure, table, or any other object[1] • Break the problem into smaller parallel or consecutive components[2] • Make reasonable assumptions to simplify the problem and understand how the assumptions affect the findings[3] • Identify all major constraints[4]	• Identify the influential knowns directly provided in the problem's description and partially interpret the figures, tables, and other available information • Breaking the problem into major components but missing some minor ones (see footnote 1) • Make some of the major assumptions while understanding their impact or making all the required assumptions without understanding their impact • Recognize most of the major constraints	• Identifying only those influential knowns that are provided directly but being incapable of interpreting the hidden information • Missing some of the major and minor components but understanding the need to break down the problem • Make some of the necessary assumptions without understanding their impact • Recognize some of the major constraints	• Uncapable of extracting the knowns • A failed, confused attempt to solve a complex problem as a whole without recognizing a need for restating the problem into subparts • Not recognizing the need or lacking the knowledge to make the required assumptions • Failing to identify all major constraints	• No evidence
SO1-PI2 Identify and apply appropriate methods	• Identify and apply appropriate equations • Simplify the equations by using the identified assumptions and constraints • Employ and implement proper techniques to solve the equations • Apply appropriate unit conversions • Apply appropriate mathematics, including basic algebra[5]	• Identify and apply most of the appropriate equations • Partial simplification of the equations by applying *most* of the identified assumptions and constraints • Making some minor[6] mistakes throughout the implementation of the employed technique • Correct unit conversions all along except the final conversion • Apply appropriate mathematics	• Identify and apply some of the appropriate equations • Partial simplification of the equations by applying *some* of the identified assumptions and constraints • Making some major mistakes throughout the solution[7] • Some incorrect unit conversions • Making minor math mistakes	• Struggle to identify the appropriate equations • Failing to simplify the equations by applying the identified assumptions and constraints • Adapting the wrong technique to solve the equations • Wrong unit conversions • Making major mistakes in applying the mathematics	• No evidence

[1] Example: The acceleration is not spelled out in the problem statement, but it is known via the slope of a given velocity diagram

[2] Example: A water flow goes through a pipeline. Students are asked to compute the force exerted on the knee that turns the flow by 90 degrees. Students are expected to know that this problem needs to be broken into two parallel components, i.e., the "continuity" and "Bernoulli," followed by a "conservation of momentum" problem, as three major components of the solution. A minor component of the solution would be "computing energy losses caused by pipe fittings, such as valves, expansions, etc." Developing this understanding is what this PI aims to evaluate. Proper implementation of the respected equations to solve each of these components is within the scope of the next PI.

[3] Example: A "steady-state" assumption in heating up a plate with a candle would lead to larger local temperatures within the plate; A "frictionless" assumption for the problem of flow through a pipe would "underestimate" the required pump power

[4] Examples: Cycle efficiency in Thermodynamics, Betz limit in Aerodynamics, Resources in Senior Design

[5] Example: In Heat Transfer, $\frac{1}{U} = \frac{1}{h_h} + \frac{1}{h_c}$, where U is the overall heat transfer coefficient, and h_h, and h_c are convective heat transfer coefficients of the hot and cold fluids. Based on this equation, some students conclude $U = h_h + h_c$.

[6] Example: Mistakes in integrating terms, etc.

[7] Employing a wrong solution to a differential equation

SO1 - The ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.

SO1-PI3 Analyze data resulting from the methods	• Perform data analysis by employing an appropriate technique, such as qualitative techniques, statistical methods, or predictive analysis • Identify and apply appropriate methods to visualize[8] and interpret the results • Validate and verify the solution	• Data analysis is mostly correct • Data visualization and interpretation is mostly correct • Most of the required validation/verification elements exist	• Data analysis is mostly wrong • Data visualization and interpretation is mostly wrong • Most of the required validation/verification elements are missing	• No or completely wrong data analysis • Results are not visualized and interpreted correctly • No appropriate validation and verification	• No evidence
SO1-PI4 Produce a viable approach/deliverable	• Produce a final deliverable that meets all the predefined criteria[9]	• Produce a final deliverable that meets most of the predefined criteria	• Produce a final deliverable that meets some of the predefined criteria	• Failed to produce the expected deliverable	• No evidence

[8] Example: Know that y needs to be plotted versus x to allow a meaningful interpretation
[9] Applicable to courses with projects and Senior design

Appendix 3: AEC Plan Overview

Mechanical Engineering Department - Assessment Evaluation Change (AEC) Plan Overview

In Fall 2021, the ME Department adopted a new paradigm for continuous improvement. The AEC Plan is based on a two-year cycle for assessing, evaluation, and change. The AEC Plan designates that four of the seven outcomes (SO1, SO3, SO4, SO5) are assessed during Fall 2021-Spring 2022, and again in Fall 2023-Spring 2024. The assessment stage is followed by evaluation and change in Fall 2022-Spring 2023, then again in Fall 2024-Spring 2025. The remaining three outcomes (SO2, SO6, SO7) are assessed during Fall 2022 – Spring 2023 and again in Fall 2024-Spring 2025, followed by evaluation and change in Fall 2023-Spring 2024 and again in Fall 2025-Spring 2026. New departmental rubrics were developed by the faculty to assess student artifacts from the Senior Capstone projects and applied during faculty retreats. The rubrics are provided in separate documents. The assessment stage is described in a Standard Operating Procedures (SOP), and attached in a separate document.

Student Outcome	20-21	21-22	22-23	23-24	24-25	25-26
SO 1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.		A	E C	A	E C	A
SO 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.			A	E C	A	E C
SO 3. An ability to communicate effectively with a range of audiences.		C A	E C	A	E C	A
SO4. 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.		A	E C	A	E C	A
SO5. 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	E C	A	E C	A
SO 6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.			A	E C	A	E C
SO 7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.			A	E C	A	E C

Appendix 4: SO2 Departmental Rubric

SO2 (Student Outcome):

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.

PI (Performance Indicator)	**Level 4 (high)**	**Level 3 (med-high)**	**Level 2 (med-low)**	**Level 1 (low)**
PI1: **Produce** a clear problem statement	• Identify the issue or challenge that needs to be addressed. • Define the scope with specific boundaries and limitations of the problem. • Gather a complete set of information and relevant data about the problem • State the problem in a concise and specific manner. • Identify and describe the major impact(s) of the problem on the individuals or groups affected, as well as on the broader community	• Partially identify the issue or challenge that needs to be addressed. • Define the scope with some boundaries and limitations of the problem. • Gather some information and relevant data about the problem • State the problem in a verbose, non-specific manner. • Identify and describe some impact(s) of the problem on the individuals or groups affected, as well as on the broader community	• Partially identify challenges • Partially define the scope • Minimal information and relevant data about the problem is provided. • Gather minimal amount of information and relevant data about the problem • State the problem with vague or ambiguous language. • Identify and describe at least one impact of the problem on the individuals or groups affected, as well as on the broader community	• Unable to identify challenges • Did not define the scope • No information and relevant data about the problem is provided • No information or data gathered about the problem • Unable to state the problem. • Did not identify or describe the impact(s) of the problem on the individuals or groups affected, as well as on the broader community
PI2:	• Well formulated plan for the design, analysis, and testing activities for	• Somewhat well formulated plan for	• Fair to poor plan for the design, analysis,	• Poor or missing plan for the design,

Plan design approach, follow the design methodology	project • Plan is thorough (both time and skills) and well balanced • Procedures and methods are well suited for the project and would be considered current best practices • Appropriate and creative use of computational and experimental analysis for project • Well thought out plan for reviewing analysis and test results	the design, analysis, and testing activities for project • Plan is reasonable (both time and skills) and well balanced • Procedures and methods are well suited for the project but would be considered dated by current practice • Appropriate use of computational and experimental analysis for project • Reasonable plan for reviewing analysis and test results	and testing activities for project • Plan is missing some considerations of available time and skills • Procedures and methods are somewhat well suited for the project but would be considered dated by current practice • Missing a needed computational or experimental analysis plan for project • Weak plan for reviewing analysis and test results	analysis, and testing activities for project • Plan is unreasonable or missing analysis or testing plan • Procedures and methods are poorly suited for the project and would be considered out of date by current practice • Poorly documented computational and experimental analysis plan • no plan for reviewing analysis and test results
PI3: **Justify** design decisions, and implement designs	• Clear connection between design decisions and project goals • Clear review of concepts considered and reasoning of concept selections	• Some connection between design decisions and project goals • Partial review of concepts considered and reasoning of concept selections	• Limited connection between design decisions and project goals • Limited review of concepts considered and reasoning of concept selections	• Superficial connection between design decisions and project goals • Superficial review of concepts considered and reasoning of concept selections

	• Exceptional use of analysis tools to guide design decisions • High-quality construction documentation (specifications and drawings)	• Adequate use of analysis tools to guide design decisions • Reason able construction documentation (specifications and drawings)	• Limited use of analysis tools to guide design decisions • Adequate construction documentation (specifications and drawings)	• Inadequate use of analysis tools to guide design decisions • Poor quality construction documentation (specifications and drawings)
PI4: **Assess** solutions	• Established complete set of assessment tools for results and procedures. • Evaluated performances based on the established assessment tools • Quantitative and qualitative assessments were performed. • Applied High quality assessment procedures (including consideration of external or third-party assessment tools)	• Partial set of assessment tools for results and procedures • Partial evaluation of performances based on the established assessment tools • Quantitative or qualitative assessment was performed (not both). • Assessment procedures were established.	• Indicated assessment tools are needed but not implemented. • Marginal evaluation of performances based on the established assessment tools • Marginal assessment was performed (not both). • Importance of assessment was discussed.	• No awareness of the importance of assessment • No evaluation of performances based on the established assessment tools • No assessment was performed. • Results are inconsistent to be assessed. • Lacking consideration of assessment of solutions.

Appendix 5: AEC_4_05132025

Standard Operating Procedure Identifier: AEC_4

Title: Faculty Review of Capstone Artifacts (FRCA) by Cohorts using Departmental Rubrics for Student Outcomes (SO) - SO2, SO6, SO7

Date: May 14, 2025 – May 21, 2025

Conducted by: Faculty Cohort Coaches

Conducted on Data: Fall 2024 Cohorts, Capstone Artifacts

STEP 1: Faculty Cohort Coaches find their assigned teams listed in Table 1

Table 1: Faculty Reviewing Capstone Artifacts, Fall 2024 Cohorts

Concentrations	Capstone Presentations on May 2 from 2:00pm - 4:00pm in designated rooms	Faculty Reviewer 1	Faculty Reviewer 2	Faculty Reviewer 3
Aero				
	Host - Sam Chumney			
	Cohort 1 - BRWN 208			
	F24-1-JetCat Instrumentation	Bruce Jo	Rory Roberts	Ahmed Abounassif
	F24-1-JetCat Vectored Thrust			
	F24-1-JetCat Teststand			
	F24-1-JetCat Variable Nozzle			
Mechatronics and Robotics				
	Host - Brandon Hines			
	Cohort 2 - BRWN 320			
	F24-2-IEEE Robot	Daniel Yoon	Steve Canfield	Tristan Hill
	F24-2-Intelligent Ground Vehicle Competition			
	F24-2-Knee Motion			
ME Thermal Fluids				
	Host - David Schafer			
	Cohort 3 - AIEB 354			
	F24-3-Lochinvar Defrost	Hiyam Farhat	Ethan Languri	Will Brookshear
	F24-3-Lochinvar Electric Element Surface Tem			
	F24-3-Lochinvar Induction Heating			
	F24-3-Lochinvar Optimized Line Geometry			
	F24-3-Fume Hood			
ME General				
	Host - Andrew Gothard			
	Cohort 4 - BRWN 315			
	F24-4-Drop System	John Zhu	Jie Cui	Steve Anton
	F24-4-Wood Floor Vibration			
	F24-4-Brown & Prescott Remodel			
	F24-4-Carlstar Data Dashboard			
Vehical Systems				
	Host - Griffin Layhew			
	Cohort 5 - AIEB 361			
	F24-5-Nissan - Wire Connector Assy	Daniel Yoon	Pingen Chen	Peng Zhang
	F24-5-Nissan - Wiring Routing 1			
	F24-5-Nissan - Wiring Routing 2			
	F24-5-Control Panel Heat Generation			
	F24-5-Pep Truck Suspension			

STEP 2:

- Faculty Cohort Coaches visit the MS Teams Site name: **ME Faculty**
- Go to Channel: **AEC Plan/Files**
- Under **Files/Capstone Artifacts/F24 Cohorts**

  - Enter subfolders labeled as in Table 1 to find three Capstone Artifacts per team
  - Proposal from first semester, Fall 2024
  - Final Report from second semester, Spring 2025
  - Video file of Final Presentation, Spring 2025
- Review these Capstone Artifacts for each team
- Tip 1: You may wish to download these artifacts for ease of viewing on your computer rather than viewing them from within MS Teams

STEP 3:

- Apply Departmental Rubrics **SO2, SO6, SO7** to Capstone Artifacts
  - Read Performance Indicators for the SO2, SO6, SO7
  - PDFs are in **AEC Plan/Files/ME Departmental Rubrics**
- Identify what level of achievement the team demonstrates within the artifacts
  - Please note you can look across all Artifacts for evidence, simultaneously
- Fill out the online form for each rubric applied to each team, see Table 2

Table 2: Links to Survey Forms

SO2 Rubric Applied to Fall 2024 Cohorts	https://forms.office.com/r/whUEMqUFcr
SO6 Rubric Applied to Fall 2024 Cohorts	https://forms.office.com/r/58ZAFfswYs
SO7 Rubric Applied to Fall 2024 Cohorts	https://forms.office.com/r/T3hGapXx13

- Tip 2: You may want to apply one rubric at a time to ALL the teams in your cohort
  - For example, you have the SO2 survey form open and are referring to the full Departmental Rubric for descriptors of the levels, and
  - you examine Team X artifacts for SO2, apply the rubric and fill out the survey,
  - then examine Team Y artifacts, and apply the rubric and fill out the survey, and
  - then examine Team Z, etc.
- Tip 3: Or you may want to review one team at a time and apply all three rubrics to that team.
  - For example, while you are looking at Team X artifacts
  - you have the three rubrics surveys open simultaneously and are looking at the three Departmental Rubrics simultaneously and completing all three SOs review before moving on to the next team.

Appendix 6: SO6 Departmental Rubric

Student Outcome 6 (SO6): an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.

Performance Indicator (PI)	Level 4 (high)	Level 3 (med-high)	Level 2 (med-low)	Level 1 (low)
SO6-PI1 Perform experiment and collect data based on prescribed procedure(s)	• Convey experimental plan with well-defined objectives and clearly identified procedures • Cite reference(s) for the selected experimental procedures and use of instrumentation • Identify all relevant variables to be considered • Complete measurement instrumentation plan (considerations of sensitivity, calibration, etc.) to ensure accuracy • Ensure accuracy and precision with relevant sensitivity and calibration information for measurement instrumentation • Explain data acquisition setup and justify selected	• Convey experimental plan with defined objectives and identified procedures • Cite reference(s) for the selected experimental procedures and use of instrumentation • Identify most relevant variables to be considered • Partially complete measurement instrumentation plan (considerations of sensitivity, calibration, etc.) to ensure accuracy • Ensure accuracy and precision with relevant sensitivity and calibration information for measurement instrumentation	• Ill-defined experimental plan with vague objectives • Insufficient citations • Variables poorly defined • Simplistic measurement instrumentation plan (lacking considerations of sensitivity, calibration, etc.) • Generic partially relevant consideration of accuracy, precision, sensitivities, and calibration • Data acquisition setup is minimally described • Data collection is incomplete	• Missing experimental plan • No citations • Variables not identified • measurement instrumentation plan does not consider sensor characteristics or desired accuracy • Accuracy and precision not considered, sensitivity and calibration not considered • Data acquisition setup not explained • Data not collected

	instrumentation settings • Excellent implementation of the data collection plan	• Explain data acquisition setup and justify some selected instrumentation settings • Good implementation of the data collection plan		
SO6-PI2 Analyze, reduce, and present collected data	• Create well organized plots and tables (with labels and units) of data in time domain and/or frequency domain using appropriate computer software (EXCEL, MATLAB, Python) with explanation • Compute statistics (mean, standard deviation, RMS) with explanation • Identify trends, transient and steady-state behavior • Discuss stability, repeatability, and uncertainty of data • Compare experimental data and results to	• Adequate plots and tables (with labels and units) of data in time domain and/or frequency domain, partially explained • Adequate consideration of statistics (mean, standard deviation, RMS) • Adequate identification of data trends • Adequate discussion of stability, repeatability, and uncertainty • Adequate comparison of experimental results with theoretical models, not well quantified	• Disorganized plots and tables (with labels and units) of data in time domain and/or frequency domain, not explained • Minimal consideration of statistics • Partial identification of data trends • Minimal discussion of stability, repeatability, and uncertainty of data • Minimal comparison with to theoretical models	• Plot and/or tables of data are not labeled, do not include units, are not organized • Data statistics are not presented • No observations are provided regarding data behavior • Stability, repeatability, uncertainty not discussed • No comparison made with theoretical models

	appropriate theoretical models with percent difference			
SO6-PI3 Develop and support conclusions based on interpreted data	• Summarize clearly and concisely key results from data analysis • Discuss how well experimental objectives are met • Interpretation and significance of findings are accurately described • Generate concise conclusions with rational connections to the obtained data	• Adequate summary of key results from data analysis is provided • Experimental objectives are declared as met with some discussion • Interpretation and significance of findings are partially described • Adequate conclusions are generated with connections to the obtained data	• Minimal summary of key results from data analysis is provided • Minimal discussion of having met experimental objectives • Vague interpretation and significance of findings are minimally described • Generic conclusions are poorly connected to the obtained data	• No summary of key results is provided • Lacks discussion of having met experimental objectives • Missing statements of interpretation • Conclusions are generic and not justified with data

Appendix 7: SO7 Departmental Rubric

Student Outcome 7 (SO7): an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Performance Indicator	Level 4 (high)	Level 3 (medium-high)	Level 2 (medium-low)	Level 1 (low)
SO7-PI1 Recognize the need for acquiring new knowledge/tools to meet a specific need	• Reflect on what is already known in a concise, specific, and logical manner • Self-identify gap(s) in required knowledge, skill, or ability (KSA) with specific connections to the current situation • Define primary motivator(s) to acquire the new KSA in a clear and compelling manner	• Reflect on what is already known in a general non-specific manner • Self-identify gap(s) in required knowledge, skill, or ability (KSA) with adequate connection to the current situation • Define primary motivator(s) to acquire the new KSA in a generic manner	• Minimal reflection on what is already known • Gap(s) in required knowledge, skill, or ability (KSA) are not well defined nor well connected to current situation • Motivation to acquire the new KSA is marginally defined	• No reflection on what is already known • Unable to identify a gap in knowledge, skill, or ability (KSA) • Motivation to acquire the new KSA is poorly defined
SO7-PI2 Engage in planning and using effective learning strategies	• Describe multiple options for learning the new KSA (reading, watching how-to videos, apprenticeship, etc) • Consider the resources needed (time, fees, equipment, software, etc) to learn based on the options	• Describe one to two options for learning the new KSA • Partial consideration of the resources needed to learn • Self-identify what is best learning strategy with partial	• Identify one option to learn the new KSA • Minimal consideration of the resources needed to learn • Minimal justification for choice of learning strategy	• Options for learning new KSA not discussed • Resources required to learn not identified • Missing identification of best learning strategy

	• Self-identify what is best learning strategy with justification based on prior evidence • Develop a self-guided learning plan that includes estimated time and tracks actual time • Identify what forms of documentation will be used to demonstrate the learning of the new KSA	justification • Self-guided learning plan is adequately described • Adequate consideration of how to demonstrate the learning of the new KSA	• Self-guided learning plan is minimally described • Marginal consideration of how to demonstrate the learning of the new KSA	• Learning plan is not provided • Learning plan is not provided
SO7-PI3 Seek information from valid sources	• Examine all widely known and relevant sources (library, internet, training sites, etc) • Select sources based on use of an evaluative scheme (such as the CRAAP Test)	• Adequate consideration of sources • Select sources based on use of an evaluative scheme	• Minimal consideration of sources • Lacking justification for selected sources	• No consideration of sources • Lacking use of an evaluation scheme to select sources
SO7-PI4 Demonstrate use of the new knowledge and reflect on learning process	• Describe outcomes of the self-guided learning plan • Interpret how the new KSA connects to and builds on prior knowledge/tools	• Adequately presents outcomes of the self-guided learning plan • Partial Interpretation of how the new KSA	• Partially considers the outcomes of the self-guided learning plan • Offers vague connections to prior knowledge	• Lacks statements of outcomes of the self-guided learning plan • Does not connect new KSA to prior knowledge

	• Document the use of the new KSA and describe how it fills the gap and meets the need	connects to prior knowledge • Adequately documents the use of the new KSA and describe how it fills the gap and meets the need	• Minimally describes use of the new KSA and partially describes how it fills the gap and meets the need	• Lacks use of the new KSA