Program: Bachelor of Science (BS), Industrial Engineering Technology (145)

College: Arts and Sciences

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Northwestern Mission. Northwestern State University is a responsive, student-oriented institution committed to acquiring, creating, and disseminating knowledge through innovative teaching, research, and service. With its certificate, undergraduate, and graduate programs, Northwestern State University prepares its increasingly diverse student population to contribute to an inclusive global community with a steadfast dedication to improving our region, state, and nation.

College of Arts and Sciences Mission. The College of Arts & Sciences, the largest college at Northwestern State University, is a diverse community of scholars, teachers, and students, working collaboratively to acquire, create, and disseminate knowledge through transformational, high-impact experiential learning practices, research, and service. The College strives to produce graduates who are productive members of society equipped with the capability to promote economic and social development and improve the overall quality of life in the region. The College provides an unequaled undergraduate education in the social and behavioral sciences, English, communication, journalism, media arts, biological and physical sciences, and the creative and performing arts, and at the graduate level in the creative and performing arts, English, TESOL, and Homeland Security. Uniquely, the College houses the Louisiana Scholars' College (the State's designated Honors College), the Louisiana Folklife Center, and the Creole Center, demonstrating its commitment to community service, research, and preservation of Louisiana's precious resources.

Engineering Technology Department Mission: The Engineering Technology Department is dedicated to delivering high-quality education in the areas of engineering technology, electronics engineering technology, and industrial engineering technology, as well as pre-engineering preparation. The department prepares students for successful careers and enriched lives in the public, private, and non-profit sectors, and promotes economic development and enrichment of the communities we serve.

Industrial Engineering Technology Mission Statement: The mission of the Industrial Engineering Technology program is to produce four-year graduates with the breadth and depth ofknowledge in industrial engineering technology to become lifelong productive members of the regional workforce and the local society.

Purpose: The Bachelor of Science in Industrial Engineering Technology program will prepare students to: 1) analyze, test, build, operate, and maintain industrial systems (equipment, warehouse operations, safety management, plant operations, etc.), and 2) manage manufacturing facilities, systems, and operations to include installation, motion and time, safety, and efficiency. It prepares students for entry positions in government and the private sector in which the ability to implement changes, upgrade operations, set- up equipment, analyze problems, and modify if necessary is increasingly critical. It will also prepare interested students for the pursuit of advanced degrees in Engineering and Technology at other institutions.

Methodology: The assessment process for the BS in Industrial Engineering Technology program is as follows:

(1) Data from assessment tools (both direct – indirect, quantitative, and qualitative) are collected and returned to the department head and ET ABET committee

(2) The department head and ET ABET committee analyze the data to determine whether students have met measurable outcomes

(3) Results from the assessment are discussed with the program faculty

(4) The department head, in consultation with the Engineering Technology Advisory Board, will propose changes to measurable outcomes, assessment tools for the next assessment period and, where needed, curricula and program changes.

Student Learning Outcomes (SLOs):

Student learning outcome data was collected, analyzed, and reported for the Industrial Engineering Technology degree program. Measures used to collect data include reports, case studies, projects, exams, presentations, and written exercises. Assessment data for academic cycle (AC) 2020-2021 show that targets were met or exceeded. Most of the students' performance indices for all SLOs were found to be satisfactory. For those assessments where the targets were not met, actions plans were devised and implemented in the next cycle.

From these results, there were several key actions recommended and decisions made to enhance the student experience and student learning outcomes with the focus on assuring that students meet and exceed target expectations.

SLO 1. Ability to apply knowledge, techniques, skills and modern tools of mathematics, science, engineering, and technology to solve broadly defined industrial engineering problems (ETAC of ABET Outcome 1).

Course Map: Tied to the course syllabus objectives
IET 4700: Manufacturing Facilities
IET 4960: Project Design II

Measure 1.1. Every spring semester, students are graded using a rubric on their ability to design and solve rotary table for manufacturing facilities in IET 4700. The acceptable target is 80% of students score at least 9 out of 12 on the rubric-based assessment of the assignment.

Finding: Target was met.

Analysis: In AC 2020-2021, the target was met. Based on the analysis of the AC 2020-2021 results, the faculty implemented the following changes in AC 2021-2022 to drive the cycle of improvement. Teams were assigned by the instructor to level off the team strength and all members were required to complete practice projects individually before the team project.

In AC 2021-2022, 13/14 (93%) of the students scored at least 12/16 (75%) on a rubric-based assessment of the assignment on "design and solve rotary table for manufacturing facilities". Because of the leveling of the strengths of the students across the groups, the group scores' average increased with a smaller standard deviation.

Decision: Based on the results of AC 2021-2022, the faculty will implement the following changes in AC 2022-2023 to drive the cycle of improvement. The problems will be amended to include multiple manufacturing supply and processing lines in the existing scenario that was given to students in the past.

Measure 1.2. Every spring semester, upon submission of IET 4960 project reports, ET faculty evaluate student performance with respect to their ability to apply industrial engineering technology knowledge, skills, and tools to real-world problem-solving. The acceptable target is 80% of IET students rate at least 80 out of 100 on the checklist-based assessment of the technical portion of the project report.

Finding: Target was not met.

Analysis: In AC 2020-2021, the target was met. Based on the analysis of AC 2020- 2021 results, in AC 2021-2022 the faculty made the following changes. The template for the final project report was revised and was made available for students in the learning management system (Moodle). Various additional areas/sections for "Scope of the Project" "Assumptions Made", "Project Constraints", *etc.* were added. Examples of in-text citations for an equation as well as the format of equation placement in the body of the text were added. The inclusion of pertinent appendices in the report was encouraged to include relevant calculations (technical and budgetary).

Despite these changes, in AC 2021-2022, the target was not met. During that AC, 2021-2022 only 7 out of 11 (64%) students were rated at least 80 out of 100 (80%) on the checklist-based assessment of the technical portion of the project report. Two members

of one group of four students including its leader had started a full-time internship position in a local manufacturing company. These two members were non-responsive at times to repeated attempts by the instructor to establish communication. When the group eventually got together again to salvage the project goals and objectives, it resulted in a technically mundane solution. This group failed to come up with a technically sound solution backed up by logic and data. This group was rated 'D' by the industry mentor on the technical merit of the solution presented.

Decision: Based on the results of the AC 2021-2022, and to drive the cycle of improvement, the faculty will implement the following changes in AC 2022-2023. To avoid a low degree of technical content in the final report, the teams will be required to present a draft outline of the process used to transition the theory to solution calculation and recommendations. This report will be due and graded as a part of the midterm grade for each team member and will be incorporated in their final grade.

SLO 2. Ability to perform tests, measurements, and experiments to analyzeand improve processes. (ETAC of ABET Outcome 4).

Course Map: Tied to the course syllabus objectives

IET 3510: Motion and Time Study
IET 4720: Quality Control

Measure 2.1. Every fall semester, students' grades on the semester projects in IET 3510 are used to assess the attainment of SLO 2. The acceptable target is 80% of students score at least 12 out of 16 on the rubric-based assessment of the project.

Finding: Target was met.

Analysis: In AC 2020-2021, the target was met. Based on the analysis of the AC 2020-2021 results, the faculty implemented the following changes in AC 2021-2022 to drive the cycle of improvement. The instructor encouraged the students to collect relevant additional information and asked them to submit a draft report to get the instructor's preliminary review and feedback before the project submission due date. In addition to this, the instructor emphasized project expectations,explained the grading rubrics, and stressed showing detailed calculations. The instructor also arranged a practice session in the classroom specifically for data collection and analysis. In addition, the instructor provided a complete report template which included example calculations.

As a result of these changes in AC 2021-2022, the target was met. Seven out of seven (100%) of the students scored at least 12 out of 16 (75%) on a rubric-based assessment of a group assignment. Due to the COVID-19 pandemic, in-person visits to the industrial partners were not feasible. Hence, the "time study" semester project was assigned based on previously recorded videoclips of workstation(s) imitating virtual visits to the industry. It was observedthat some students missed the class where the students participated in a practice session for data collection and calculation. As a result, a few students had both major and minor errors in their calculations.

Decision: Based on the analysis of the AC 2021-2022 results, the faculty will implement the following changes in AC 2022-2023 to drive the cycle of improvement. The instructor of IET 3510 will (1) arrange multiple practice sessions in the classroom for data collection and analysis, and (2) offer an additional practice session if needed for any student(s) due to absence or extended training.

Measure 2.2. Every spring semester, students are graded on an assignment of creating, analyzing, and interpreting control charts for variables or attributes in IET 4720 to assess the attainment of SLO 2. The acceptable target is 80% of students score at least 75% (9 out of 12 or 12 out of 16) on the rubric-based assessment of the assignment.

Finding: Target was met.

Analysis: In AC 2020-2021, the target was met. Based on the analysis of AC 2020-2021, the instructor implemented the following changes in AC 2021-2022 to drive the cycle of continuous improvement. The instructor developed a step-by-step procedure with examples, to show how similar problems are solved and put it in the learning management system (Moodle)for students to access and practice. In addition, students were provided with information regarding when to use which procedure to calculate standard deviation based on the chart type and sample size.

As a result of these changes in AC 2021-2022, the target was met. Eleven out of thirteen (84.6%) of the students scored at least 12 out of 16 (75%) on a rubric-based assessment of the assignment on control charts for variables.

Decision: Based on the analysis of the AC 2021-2022 results and to drive the cycle of continuous improvement for AC 2022-2023, the instructor will implement the following changes. The instructor will introduce Minitab software for Statistical Process Control (SPC) assignments in addition to the templates in MS Excel in which students are currently working. Students will be shown how Minitab calculates standard deviation based on the chart type and sample size. It will be required for students to be able to manually calculate standard deviations for the purpose of SPC procedures.

SLO 3. Ability to design systems, components, or processes meeting specified needs related to industrial engineering technology discipline (ETACof ABET Outcome 2).

Course Map: Tied to course syllabus objectives

IET 3510: Motion and Time Study
IET 4700: Manufacturing Facilities

Measure 3.1. Every fall semester, students' grades on assignment on ergonomics principles in a workplace in IET 3510 are used to assess the attainment of SLO 3. The acceptable target is 80% of students score at least 12 out of 16 (75%) on the rubric-based assessment of the assignment.

Finding: Target was met.

Analysis: In AC 2020-2021, the target was met. Based on the analysis of the AC 2020-2021 results, the faculty implemented the following changes in AC 2021-2022 to drive the cycle of improvement. These changes included (1) encouraging the students to be specific in identifying the ergonomic requirements and (2) providing a few examples on how to present evidence, logic, and/or theoretical background. The instructor also presented multiple video examples of ergonomics in action in the workplace.

As a result of these changes in AC 2021-2022, the target was met. Seven out of seven (100%) students scored at least 12 out of 16 (75%) on the rubric-based assessment. Due to theCOVID-19 pandemic, the scope of industry visits was very limited. Hence, multiple recorded videos of industrial operations were assigned to the students for completing this assignment. Students reported problems in collecting information about the physical condition of the assigned workstation because they only had the recorded videos.

Decision: Based on the analysis of the AC 2021-2022 results, in AC 2022-2023, the faculty will implement the following changes (1) local industries will be contacted request that they accommodate small group of students while following maximum safety protocols against COVID-19 pandemic so that students may experience the workplace in a live setting; (2) students will be provided with the recorded videos of some industrial operations as examples of ergonomic principles.

Measure 3.2. Every spring semester, students are graded on a timed assignment of a warehouse lighting project in IET 4700 to assess the attainment of SLO 3. The acceptable target is 80% of students score at least 9 out of 12 (75%) on the rubric-based assessment of the assignment.

Finding: Target was met.

Analysis: In AC 2020-2021, the target was met. Based on the analysis of AC 2020-2021 results, the faculty implemented the following changes in AC 2021-2022 to drive the cycle of continuous improvement. An individual practice assignment was given to the students before this assignment to sustain the level of the results achieved in this cycle.

In AC 2021-2021, 13/14 (93%) of the students scored at least 9 out of 12 (75%) on the rubric-based assessment on the warehouse lighting project.

Decision: Based on the analysis of the AC 2021-2021 results, the faculty will implement the following changes in AC 2022-2023 to drive the cycle of continuous improvement. Based on the grades from the individual practice assignment, the final team selection will be made in such a way that the team strength will be evenly balanced.

SLO 4. Ability to function effectively as a member of a team or as its leader (ETAC of ABET Outcome 5).

Measure 4.1. Every fall semester, students in EET 4940 assess their peers on a technical team concerning their ability and skill as a member or a leader of the team based on a

checklist-based peer-review survey. The acceptable target is 80% of IET students are rated at least 20 out of 25 (80%) on a checklist-based peer-review survey.

Finding: Target was met.

Analysis: In AC 2020-2021, the target was met. Based on the analysis of the AC 2020-2021 results, in AC 2021-2022, each member of the team had to submit their monthly progress report on their tasks delegated by the team leader and submit that report to their instructor. Each team leader had to submit the team member status report for each member at the end of every month. The instructor also had one-on-one meetings with any team member as needed based on feedback from the team leader's monthly status report.

As a result of these changes, in AC 2021-2022 the target was met. In AC 2021- 2022, 11 out of 11 (100%) of the students were rated at least 20 out of 25 (80%) on the checklist-based peer-review survey. Due to the COVID-19 pandemic, this course was offered in face-to-face format for the first time in almost two years.

Decision: Based on the analysis of the AC 2021-2022 results and to drive the cycle of improvement, the following changes will be applied in AC 2022-2023. Each member of the team will rate themselves on various aspects of the project design course components related to team assignments. The instructor of the course will develop a table of such factors or dimensions relevant to being an effective member/leader of the team from the team assignments' perspective. Rating will be done by each member on these dimensions on a 1 to 10 scale where 10 means very strong and 1 means do not feel comfortable in that dimension. This analysis will be shared among members of the team. It is believed that this will lead to a better team member task assignment and a better outcome for individual effort leading to better harmony and cohesiveness within the team.

Measure 4.2. Every spring semester, the instructor of the course rates students in IET 4960 based on their ability and skill as a member or a leader of the team on a checklist-based review survey. An instructor will use the overall impression of the team based on a semester-long interaction with the team to rate the team members and leaders. The acceptable target is 80% of students are rated at least 20 out of 25 on a checklist-based survey.

Finding: Target was not met.

Analysis: In AC 2020-2021, the target was met with 20 out of 22 (91%) of the students meeting the criteria. Based on the analysis of the AC 2020-2021 results, a team reflection paper on their experience from the previous semester in Project Design I (PDI) was required during the first few weeks of the Project Design II course (spring semester). This report included not only a collection of their individual experiences but also a summary of questions, comments, suggestions, and concerns expressed by the participants (in the audience) during the project proposal presentation in Project Design I. The revised plan to complete the project successfully was also required to be described in a separate section within the same report.

Despite these changes, in AC 2021- 2022, the target was not met. Only 7 out of 11 (63.6%) of the students met the criteria. Two members of one group of four students including its leader had started a full-time internship position in a local manufacturing company. These two members were non-responsive at times to repeated attempts by the instructor to establish communication. When the group eventually met again to salvage the project goals and objectives, it resulted in a subpar solution. This group was rated 'D' by the industry mentor on their overall performance for this semester.

Decision: Based on the analysis of the AC 2021-2022 results, and to drive the cycle of improvement, the faculty will implement the following change in AC 2022-2023. In light of the lapse of a strong commitment to timeliness, teamwork, and communication with the instructor, there will be a grade item assessed for the midterm test which will include a semi-finished project report with a detailed "list of not yet finished items" and the action plans for the remainder of the semester to successfully meet the project goals and objectives.

SLO 5. Ability to communicate effectively (ETAC of ABET Outcome 3).

Measure 5.1. Every fall semester, upon presentation of capstone projects in EET 4940, ET faculty evaluate student performance concerning the ability to communicate effectively in oral presentation of the technical report. The acceptable target is 80% of IET students to score at least 80 out of 100 (80%) on checklist-based assessment of the oral presentation.

Course Map: Tied to course syllabus objectives

EET 4940: Project Design I
IET 4960: Project Design II

Finding: Target was met.

Analysis: In AC 2020-2021, the target was met. Based on the analysis of AC 2020-2021 results, in AC 2021-2022 it was required that every group prepare each section of the oral presentation slides at specific benchmarks during the project's progression rather than just at the end of the semester. This was done to establish a continuous feedback process. The mock presentations were continued and were made for the first time as a separate graded assignment in this assessment cycle.

As a result of the changes, in AC 2021-2022, the target was met. In AC 2021-2022, 11 out of 11 (100%) of the students were rated at least 80 out of 100 (80%) on the checklist-based assessment on an oral presentation by the ET faculty. Two out of the three groups participated in the mock presentation and addressed the faculty feedback in their presentation slides and the final reports. Those two groups scored in the high 80% range. The third group of three students who did not participate in the mock presentation barely made it to the 80% threshold in this assessment.

Decision: Based on the analysis of the AC 2021-2022 results and to drive the cycle of improvement, faculty will implement the following changes in AC 2022-2023. Each team

will have to make their presentation template ready by the midterm. All the sections that the team can complete will be prepared and submitted to the instructor for feedback. The instructor of the course will make the guidelines for the presentation available to the students in the first week of the project. This should help all groups to perform better in both the oral presentations and the written final reports.

Measure 5.2: Every spring semester, upon submission of capstone project reports in IET 4960, ET faculty evaluate students with respect to their ability to write a technical report using relevant literature, graphs, charts, results, and recommendations adhering to the format prescribed by the instructor to assess the attainment of SLO 5. The acceptable target is 80% of IET students are rated at least 80 out of 100 on checklist-based assessment of the written project report.

Finding: Target was met.

Analysis: In AC 2020-2021, the target was not met. Based on the analysis of the AC 2020-2021 results, in AC 2021-2022, faculty implemented a mandatory schedule for each group to meet at least once every two weeks for a face-to-face meeting with the instructor. This had not been possible because of the pandemic in the previous semester. One of the agendas items for this meeting was to aid students in any difficulties they were experiencing in preparing reports related to figures, charts, formatting, writing style, and editing the documents. Any deficiencies presented during these bi-weekly meetings were addressed immediately. As a result of these changes in AC 2021-2022, 11/11 (100%) of the students scored at least 80 out of 100 (80%) on the checklist-based assessment of the written project report.

Decision: Based on the analysis of the AC 2021-2022 results and to drive the cycle of improvement, the following changes will be implemented in AC 2022-2023. Faculty will meet with each group and explain how to address a rubric item such as "Text is unbiased and free from group stereotype" and explains "properly citing sources" used for the project. These two items are where students are currently showing room for improvement. With these items addressed, the faculty believe that the score for this SLO in the next cycle will result in a higher than the threshold score (80%) for each group. The present three groups met the criteria with 80%, 82%, and 86% scores on the checklist-based assessment, which the faculty felt too close to the threshold and needed addressing.

Comprehensive Summary of the Key Evidence of Improvement Based on Analysis of Results. The following reflects all the changes implemented to drive the continuous process of seeking improvement in AC 2021-2022. These changes are based on the knowledge gained through the analysis of AC 2020-2021 results.

- In IET 3510 (SLO 2), the students were encouraged to collect relevant additional information and asked to submit a draft report to get the instructor's preliminary review and feedback before the project submission due date. The instructor emphasized on project expectations, explained the grading rubrics, and stressed showing detailed calculations. The instructor also arranged a practice session in the classroom specifically for data collection and analysis, as well as provided a complete report template which included example calculations.

- In IET 3510 (SLO 3), the students were encouraged to be very specific in identifying the ergonomic requirements and provided with a few examples on how to present evidence, logic, and/or theoretical background. The instructor also presented multiple video examples of ergonomics in action in the workplace.

- In EET 4940 (SLO 4), each member of the team had to submit their monthly progress report on their tasks delegated by the team leader and submit it to the instructor. Each team leader had to submit the team member status report for each member at the end of every month. The instructor also had one-on-one meetings with any team member on a required basis based on feedback from the team leader's monthly status report.

- In IET 4700 (SLO 1), teams were assigned by the instructor to level off the team strength and all members were mandatorily required to complete practice projects individually before the team project.

- In IET 4700 (SLO 3), An individual practice assignment was given to the students before this assignment to sustain the level of the results achieved in this cycle.

- In IET 4960 (SLO 1), the template for the final project report was revised and was made available for students in the learning management system (Moodle). Various additional areas/sections for "Scope of the Project" "Assumptions Made", "Project Constraints", etc. were added. Examples of in-text citations for an equation as well as the format of equation placement in the body of the text were added. The inclusion of pertinent appendices in the report was encouraged to include relevant calculations (technical and budgetary).

- In IET 4960 (SLO 4), a team reflection paper on their experience from the previous semester in Project Design I (PDI) was required within the first few weeks of the Project Design II course (spring semester). This report had to include not only a collection of their individual experiences but also a summary of questions, comments, suggestions, and concerns expressed by the participants (in the audience) during the project proposal presentation in PD I. The revised plan to complete the project successfully was also required to be described in a separate section within the same report.

- In IET 4960 (SLO 5), faculty implemented a mandatory schedule for each group to meet at least once every two weeks for a face-to-face meeting with the instructor. This had not been possible because of the pandemic in the previous semester. One of the agendas items for this meeting was to aid students in any difficulties they were experiencing in preparing reports related to figures, charts, formatting, writing style, and editing the documents. Any deficiencies presented during these bi-weekly meetings were addressed immediately.

- In IET 4720 (SLO 2), the instructor developed a step-by-step procedure with examples to show how similar problems are solved and placed it in the learning management system (Moodle) for students to access and practice. In addition,

students were provided with information regarding when to use which procedure to calculate standard deviation based on the chart type and sample size.

Plan of action moving forward:

- The instructor of IET 3510 (SLO 2) will arrange multiple practice sessions in the classroom for data collection and analysis and offer an additional practice session if needed for any student(s) due to absence or extended training.

- In IET 3510 (SLO 3) the faculty will (1) contact local industries to request that they accommodate small group of students while following maximum safety protocols against COVID-19 pandemic; (2) continue providing with the recorded videos of some industrial operations as examples, to explain the ergonomic principles.

- In EET 4940 (SLO 4), each member of the team will rate themselves on various aspects of the project design course components related to team assignments. The instructor of the course will develop a table of such factors or dimensions relevant to being an effective member/leader of the team from the team assignments' perspective. Rating will be done by each member on these dimensions on a 1 to 10 scale where 10 means very strong and 1 means do not feel comfortable in that dimension. This analysis will be shared among members of the team. It is believed that this will lead to a better team member task assignment and a better outcome for individual effort leading to better harmony and cohesiveness within the team.

- In IET 4700 (SLO 1), the problems will be amended to include multiple manufacturing supply and processing lines in the existing scenario that was given to students in the past.

- In IET 4700 (SLO 3), the final team selection will be made in such a way that the team strength will be evenly balanced, based on the grades from the individual practice assignment.

- In IET 4960 (SLO 1), to avoid a low degree of technical content in the final report, the team will be required to present a draft outline of the process used to transition the theory to solution calculation and recommendations. This report will be due and graded as a part of the midterm grade for each team member and will be incorporated in their final grade.

- In IET 4960 (SLO 4), in light of the lapse of a strong commitment to timeliness, teamwork, and communication with the instructor, there will be a grade item assessed for the midterm test, that will include a semi-finished project report with a detailed "list of not yet finished items" and the action plans for the remainder of the semester to successfully meet the project goals and objectives.

- In IET 4960 (SLO 5), faculty will meet with each group and explain how to address a rubric item such as "Text is unbiased and free from group stereotype" and

explains "properly citing sources" used for the project. These two items are where students are currently showing room for improvement. With these items addressed, the faculty believes that the score for the next cycle for this SLO will result in a higher than the threshold score (80%) for each group. The present three groups met the criteria with 80%, 82%, and 86% scores on the checklist-based assessment, which the faculty felt too close to the threshold and needed addressing.

- In IET 4720 (SLO 2), the instructor will introduce Minitab software for Statistical Process Control (SPC) assignments in addition to the templates in MS Excel students are currently working. Students will be shown how Minitab calculates standard deviation based on the chart type and sample size. It will be made required for students to be able to manually calculate standard deviations for the purpose of SPC procedures.