Outcome 1. Students will have acquired the ability to use modern and classical Industrial Engineering methodologies such as operations research, manufacturing systems, computer programming and simulation, production systems, human factors and ergonomics, engineering statistics and quality control, and engineering economics.

The assessment is performed with respect to the key abilities that the students are expected to acquire in specific courses that have been identified with respect to this outcome.

Methodology: Operations Research

Course	Key abilities	Performance indicators
IENG 350	Linear Programming	Students will be able to formulate and solve linear programming models using linear programming methods such as the simplex method. Students will be able to use duality theory and conduct sensitivity analysis.
	Project Management	Students will be able to use the Critical Path Method (CPM) to solve a project management problem
	Queuing Theory	Students will be able to analyze simple queuing systems using the most commonly used measures of performances.
	Transportation and assignment problems	Students will be able to formulate and solve transportation and assignment models using appropriate methods.
IENG 305	Systems engineering fundamentals	Students will be able to determine the critical path and slack times of a project. Students will be able to select design alternatives using analytic hierarchy process. Students will be able to determine the overall reliability of a system. Students will be able to perform a Failure Mode and Effects Analysis (FMEA) to identify failure modes and to engineer solutions to minimize the effects or eliminate the failure modes that are identified.

Methodology: Manufacturing Systems

Course	Key abilities	Performance indicators
IENG 302	Manufacturing Processes	Students will be able to apply process selection procedure methodology to develop feasible processes and then apply process performance evaluation to pick up the optimal process and materials. Students will be able to apply various formulae for various types of processes to determine design criteria, such as developing gating system criteria for the casting process. Students will be able to apply design considerations to powder metallurgy processing to determine the amounts of particular materials to be mixed during manufacturing. Students will be able to solve for suitable operating parameters and cost for use in machining, casting, joining, bulk deformation, and powder metallurgy processing. Students will be able to work in interdisciplinary teams to solve problems using strength of materials relationships, material properties, mechanical properties and cost properties to best select the shape and material to meet the design requirements. Students will be able to apply minimum cost design for strength and stiffness for tension/compression loading and center load bending applications. Students will be able to apply the design relationships to obtain the minimum material required and minimum material cost required for designs.
IENG 303	Manufacturing Processes Laboratory	Students will be able to correctly set the CNC machine as per G-Code programming. The student will be able to design a part using AutoCAD to be machined on a CNC machine. The student will be able to set the conventional metal cutting machines for RPM and feed rate as per material being machined, so as to meet product quality and machining time requirements. The student will be able to properly mix the green sand and other casting compounds to produce a part that meets quality requirements. Students will be able to set the furnace melting temperature accurately to produce a part with desired quality when the metal is poured into molds. The student will be able to set the welding machines or torches so as to produce a quality weld. Students will be able to properly hold the welding

		torch. Students will be able to choose the correct welding rods and weld temperature to produce a quality weld.
ENG 301	Manufacturing cost aspects	Students must be able to apply engineering economics to a variety of production models for breakeven analysis and profit analysis for both 1) variable production time and fixed production level and 2) variable production level with fixed time period.
	Mechanical material properties	Students will be able to apply the stress-strain diagrams and solve various mathematical problems related to true stress, true strain, engineering stress, engineering strain and modulus of elasticity for a variety of materials. Students will be able to solve problems based on an understanding of the relationship between stress and strain. Students will be able to apply methodologies using the weight and volume percentages of various alloys and micro-constituents to determine the mechanical properties such as stress when two or more alloys are combined. Students will be able to apply various methods such as solution hardening, grain size control, strain hardening, and heat treatment for increasing the mechanical properties such as hardness and yield stress. Methods applied would be solution hardening, grain size control, strain hardening and heat treatment.
	Physical material properties	Students will be able to refer to a general or iron-carbide phase diagram and determine mathematically via the reverse lever rule and other equations the weight and volume percentages of various alloys, phases and micro-constituents present at various temperatures. Students will be able to apply cooling curves and alloy cooling descriptions to determine physical material properties. Students will be able to use the Transformation Diagrams (TTT) to determine various physical properties and to determine the status of age-hardening of materials.

Methodology: Computer Programming and Software

Course	Key abilities	Performance indicators
IENG 331	Learn and use a computer programming language	Students will be able to understand and apply various number systems and data representation schemes used on digital computers. Students will be able to design, implement, and debug computer programs using one and two dimensional arrays, data structures and databases.
IENG 455	Learn and use simulation software package	Students will be able to use a simulation package such as ARENA.
	Build simulation models, perform stochastic input modeling	Students will be able to identify appropriate probability distributions for stochastic inputs. Students will be able to develop, verify, and validate computer simulation models representing business, manufacturing and service systems.

Methodology: Production Systems

Course	Key abilities	Performance indicators
IENG 220	Time and motion study	Students will be able collect time and motion study data. Students will be able to do the necessary calculations to determine the time standards.
	Work measurement	Students will be able to analyze a work process and recommend improvements which are cost effective.
	Learning Curves	Students will be able to measure work effort and apply these measurements in a variety of applications.
	Task analysis	Students will be able to do task analysis and be able to improve task productivity. Students will be able to apply various industrial engineering principles in work practice design.

IENG 343	Capacity planning	Students will be able to apply capacity methodologies to determine design, effective and actual capacity for various problems and for their own company that they have set up.
	Forecasting	Students will be able to apply various demand capacity methodologies to determine forecasted demand for a future year for their own company utilizing the demand from the previous two years. Students will be able to solve problems using various forecasting methods such as moving average, exponential smoothing, and linear trend. Students will be able to apply capacity methodologies to determine design, effective and actual capacity for various problems and their own company that they have set up.
	Materials Requirement Planning	Students will be able to use material requirements planning methodologies to determine planned order release for the first six months of the student's company next year planning cycle. Students will be able to apply material requirements planning methodologies to determine planned order release for various problems and utilizing a variety of lot-sizing techniques.
	Inventory models	Students will be able to solve problems using inventory model methodologies to determine planned order lot-sizes during the first six months of the student's company next year planning cycle. Students must solve problems using inventory model methodologies to determine inventory costs such as holding cost rate, purchase order cost and manufacturing order cost for their company. Students will be able to apply ABC analysis of their inventory for their company and develop a cycle counting schedule for all of their company parts in inventory. Students will be able to use inventory methodologies to develop their ending inventory balance and average inventory value for the previous full year of their company.
	Scheduling and sequencing	Students will be able to solve problems based on the Johnson's rule. Students will be able to determine the values for various criteria such as average lateness, number of jobs in the system when scheduling jobs.
	Lean manufacturing systems	Students will be able to apply facilities layout lean manufacturing methodologies to their company to improve productivity. Students will be

		able to solve problems using JIT inventory techniques and lean manufacturing methodologies and apply them to their company to improve productivity. Students will be able to apply lean manufacturing methodologies of the 5S Workplace Principles, Seven Wastes, Poka Yoke fail safe methodology, and Total Productive Maintenance System to their company to improve productivity and minimize costs.
IENG 446	Facilities Layout	Students will be able to use appropriate tools to generate and evaluate layout alternatives during the facilities planning process.
	Facility Location	Students will be able to solve simple facility location problems using relevant techniques.
	Material Handling Systems	Students will be able to design and analyze the effectiveness of simple material handling systems.

Methodology: Human Factors and Ergonomics

Course	**Key abilities**	**Performance indicators**
IENG 360	Human output control	Students will be able to solve biomechanical loading problems by applying engineering statics. Students will be able to use physiological approach to estimate stress-strain relationship during physical activities. Students will be able to solve manual material handling problems using NIOSH equation and Job Severity Index (JSI)
	Engineering design for human factors	Students will be able to apply anthropometric principles to engineering design problems.
	Environmental analysis and human performance	Students will be able to evaluate major components of physical environment (e.g. illumination, noise, climate, vibration) on human performance.
	Human Information Processing	Students will be able to estimate information associated with control display systems using information processing theory. Students will be able to estimate background noise and operator characteristics on the process of

		signal detection using signal detection theory. Students will be able to evaluate audio, visual, tactile and olfactory displays.

Methodology: Engineering Statistics

Course	Key abilities	Performance indicators
IENG 213	Probability distributions	Students will solve word problems using probability distributions to find relevant coefficients or probabilities.
IENG 213, IENG 314	Confidence intervals, Hypothesis testing	Students will be able to determine confidence intervals using common distributions, such as normal, F, chi-square (213). Students will be able to test hypotheses using common distributions, such as normal, F, and chi-square (213). Students will be able to calculate confidence intervals for mean responses, individual responses, and regression coefficients (314). Students will be able to test hypotheses about mean responses, individual responses, and regression coefficients (314).
IENG 314	Regression analysis	Students will be able to build good regression models. Students will be able to identify "best" regression models using different criteria. Students will be able to calculate confidence intervals for mean responses, individual responses, and regression coefficients. Students will be able to test hypotheses about mean responses, individual responses, and regression coefficients. Students will be able to diagnose problems with regression models and take remedial measures. Students will be able to use statistical software packages for regression analysis and analysis of variance, and to properly interpret the results.
	Analysis of variance	Students will be able to use statistical software packages for regression analysis and analysis of variance, and to properly interpret the results. Students will be able to perform analysis of variance for simple designs of experiments.

	Learn and use statistical software packages	Students will be able to use statistical software packages for regression analysis and analysis of variance, and to properly interpret the results.

Methodology: Quality Control

Course	Key abilities	Performance indicators
IENG 316	Process control	Students will be able to decide where to focus resources to enhance quality and to minimize waste. Students will be able to decide which process control procedure to apply in a specific situation.
	Quality control sampling	Students will be able to decide whether to use a sampling plan or perform 100% inspection. Students will be able to select the most appropriate sampling inspection procedure and ensure that it is executed properly.

Methodology: Engineering Economics

Course	Key abilities	Performance indicators
IENG 377	Cash flow equivalence	Students will be able to use equivalence formulas to calculate equivalence for engineering projects and personal investments.
	Depreciation and depletion	Students will be able to calculate year by year deprecation for an engineering investment.
	After tax economic analysis	Students will be able to perform after tax economic analysis on an engineering project investment.
	Evaluation of multiple alternatives	Students will be able to pick best solution to an engineering problem by choosing from multiple alternatives.
	Balance sheets and financial statements	Students will be able to create a balance sheet and an income statement by accounting for a list of business transactions.

Tools used:	Course assessments by faculty.
Data Collection:	The data are collected every semester based on the course offerings. The assessment of the key abilities is being done through the performance indicators using a scale from 1 to 5 with 1 representing the least desirable attribute and 5 representing the most.
Frequency of data collection:	The data are collected every time courses are taught.
Data Analysis:	The data obtained are analyzed every year.
Closing the loop:	This outcome is subject to review every year based on performance criteria and metrics; and specific action items are developed, if necessary, to revise the content of the courses. The analyzed data are presented to the faculty and discussed in meetings.

Performance criteria:

a) Students must be able to demonstrate the use of modern and classical industrial engineering methodologies through performance indicators centered on key abilities in courses.

Metrics:

a) At least 70% of the students must be able to demonstrate the fulfillment of the outcome in course assessments by obtaining a score of 3 or higher in each key ability being assessed.

Assessment Tool:

Course Assessment by Faculty

IENG XXX OUTCOME BASED ASSESSMENT

This course relates to outcomes 1,3, 4, and 5. The syllabus shows the breakdown of these outcomes into key abilities expected from the students. In teaching this course during Fall XXXX, the assessment of student performance was done with respect to projects (4), exams (3), and presentation (1). The outcome 1 was assessed 6 times, outcome 3 was assessed 6 times, outcome 4 was assessed 7 times, and outcome 5 was assessed 4 times during the course. The table summarizes the outcomes and their key abilities with respect to which "closing the loop" was done.

Outcome #	**Student key abilities requiring "closing" the loop" effort**
1	Ability to use materials handling systems design concepts (2)
3	Ability to make oral presentation (1)
4	Ability to work in a project team (1)
4	Ability to formulate and solve problems (2)
4	Ability to communicate in written report (2)

The numbers in the parenthesis indicates the number of instances at which the "closing the loop" was required for the key abilities. It can be observed that the ability to communicate in a written report is of a major concern that needs to be addressed, along with the ability to formulate and solve problems in the material handling systems design domain. Hence, when the course is taught next time, the following will be done to "close the loop".

Efforts for "closing the loop"

1. Special emphasis will be placed on the importance of communicating findings using a written report. Examples of good reports will be showcased and compared with reports that are less than satisfactory. Techniques and skills in writing good technical reports will be emphasized.
2. Systems design methodology pertaining to materials handling, already covered in the course, will be subject to enhancement and increase in scope.
3. More example problems will be presented in class to illustrate effective problem formulation and solution strategies.
4. Team dynamics and its importance will be covered in more detail.
5. Specific information will be presented to showcase the importance of effective oral presentation.

IENG XXX Special Topic Presentations

The topics chosen by the students were as below.

1. Lean Manufacturing
2. Eco-Industrial Parks
3. JIT Systems
4. Conveyor Systems Applications
5. ASRS Systems
6. Materials Management in Hospitals
7. Bar Coding Technology Applications
8. Automated Palletizers
9. Automated Trailer Loading and Unloading
10. Historical Evolution of Layouts
11. Belt Conveyor Systems
12. Radio Control Technology Applications

This presentation maps to Outcome 3. The key ability expected from the students would be to make an effective oral presentation.

IENG XXX COURSE ASSESSMENT RUBRIC

Oral Presentations by Student Teams

This activity corresponds to Outcome 3 and targets the key ability "oral communication".

Scale: Excellent - 5, Good - 4, Satisfactory - 3, Below average – 2, Poor – 1

Student Team	**Content and quality of slides**	**Time Management**	**Speaking skill**	**Relevance to topic**
Number of students with a score of 3 or above				
Percentage of students obtaining a score of 3 or above				

Assessment of student performance

For the key ability "content and quality of slides", 53% of the students have obtained a score of 3 or above. Since this is below the established metric of 70%, corrective action is required. For the key ability "time management", 73% of the students have obtained a score of 3 or above, hence requiring no corrective action. For the key ability "speaking skill", 67% of the students have obtained a score of 3 or higher, hence requiring corrective action. For the key ability "relevance to topic", 73% of the students have obtained a score of 3 or higher, hence requiring no corrective action. The content of the slides can improve. The students are not fully aware how to design the slides for a ten-minute presentation to capture the details of the topic they have chosen. The material content was somewhat trivial in some instances while in others the text and graphics quality were not up to standard expectations. On the whole the time management was good in all presentations. Some students do not maintain good eye contact with the audience and some of them just read from prepared material. In most cases the presentations were relevant in terms of the chosen topic although in a couple of cases material not within the scope of the chosen topic was presented.

Efforts for "Closing the Loop"

Although this was the last class of the course, the following will be done when the course is taught next time to address the required corrective action.

1. Discuss the process and importance of researching a topic and developing slides for effective time managed presentations.
2. Show video presentations of effective presentations made on technical topics.
3. Illustrate the importance of effective presentation skills for an engineering professional.

IENG XXX COURSE ASSESSMENT RUBRIC

Project on flow, space, activity relationships and personnel requirements

Project assessed student performance with respect to outcomes 4 and 5

Scale: Excellent - 5, Good - 4, Satisfactory - 3, Below average – 2, Poor – 1

O1 – Outcome 1, O2 – Outcome 2, O3 – Outcome 3, O4 – Outcome 4, O5 – Outcome 5

Student name/Team members	Ability to use facilities planning methodologies (O1)	Ability to use materials handling systems design concepts (O1)	Ability to analyze and interpret system data (O3)	Ability to develop practical and cost effective recommendations (O3)	Ability to conduct an analysis of different alternatives (O3)	Ability to make oral presentation (O3)	Ability to gather information from a variety of sources (O3)	Ability to work in a project team (O4)	Ability to formulate and solve problems (O4)	Ability to communicate in written report (O4)	Ability to develop flow and space requirements to develop activity relationships for developing and/or improving facilities design (O5)
Number of students with a score of 3 or above											
Percentage of students with a score of 3 or above											

Assessment of student performance

The students worked in teams of two. This project focused on determining flow from system data and also on determining personnel based requirements in a factory. There were some complaints from the students on the effectiveness of working in a team and this showed in the quality of the project. In the problem on determining personnel requirements some of the students had done the formulation well while others needed to show improvement in this regard. The activity relationships problem was solved well by most of the students. For the key ability “ability to work in a project team”, 69% of the students had a score of 3 or above. For the key ability “Ability to formulate and solve problems”, 69% of the students had a score of 3 or above. Hence both these key abilities pertaining to outcome 4 need corrective actions. For the key ability “Ability to develop flow and space requirements to develop activity relationships for developing and/or improving facilities design” pertaining to outcome 5, 85% of the students had a score of 3 or above hence requiring no corrective action as this falls above the established metric of 70%.

Efforts for “closing the loop”

The project was given back to the students and discussed. The importance of formulating the solution was emphasized and the students were given a small quiz to reinforce this concept. A whole class period was devoted to systematically explain the details regarding a successful formulation strategy. The quiz was immediately discussed in class. The aspects relating to building team effectiveness was discussed.

IENG XXX COURSE ASSESSMENT RUBRIC

Project on using MCRAFT to develop layouts

Project assessed student performance with respect to outcomes 1, 3, and 4

O1 – Outcome 1, O2 – Outcome 2, O3 – Outcome 3, O4 – Outcome 4, O5 – Outcome 5

Scale: Excellent - 5, Good - 4, Satisfactory - 3, Below average – 2, Poor - 1

Student name/Team members	Ability to use facilities planning methodologies (O1)	Ability to use materials handling systems design concepts (O1)	Ability to analyze and interpret system data (O3)	Ability to develop practical and cost effective recommendations (O3)	Ability to conduct an analysis of different alternatives (O3)	Ability to make oral presentation (O3)	Ability to gather information from a variety of sources (O3)	Ability to work in a project team (O4)	Ability to formulate and solve problems (O4)	Ability to communicate in written report (O4)	Ability to develop flow and space requirements to develop activity relationships for developing and/or improving facilities design (O5)
Number of students with a score of 3 or above											
Percentage of students with a score of 3 or above											

Assessment of student performance

The students worked in teams of two. This project focused on using the MCRAFT software to design and develop layout recommendations based on flow data between departments. In general the quality of the written report could have been improved. The explanations were not clear and in some cases there was not any explanation of approach at all. The students did not for the most part evaluate alternate layouts by varying the input data within allowable ranges. In some cases printouts from the software were not enclosed. For the key ability “Ability to communicate in a written report” pertaining to outcome 4, 62% of the students had obtained a score of 3 or above, hence requiring corrective action.

Efforts for “closing the loop”

The project was given back to the students and discussed. The importance of effective written communication was emphasized. Examples of sample technical reports were discussed. The generation of alternate layouts using MCRAFT was shown using a computer with a projection screen. The alternate layouts were compared and selection criteria were discussed. It was decided to emphasize the quality of written reports whenever any future projects were given out.

IENG XXX COURSE ASSESSMENT RUBRIC

Project on developing flow data from a process plan and using it to develop block layouts

Project assessed student performance with respect to outcomes 1, 3, 4, and 5

O1 – Outcome 1, O2 – Outcome 2, O3 – Outcome 3, O4 – Outcome 4, O5 – Outcome 5

Scale: Excellent - 5, Good - 4, Satisfactory - 3, Below average – 2, Poor - 1

Student name/Team members	Ability to use facilities planning methodologies (O1)	Ability to use materials handling systems design concepts (O1)	Ability to analyze and interpret system data (O3)	Ability to develop practical and cost effective recommendations (O3)	Ability to conduct an analysis of different alternatives (O3)	Ability to make oral presentation (O3)	Ability to gather information from a variety of sources (O3)	Ability to work in a project team (O4)	Ability to formulate and solve problems (O4)	Ability to communicate in written report (O4)	Ability to develop flow and space requirements to develop activity relationships for developing and/or improving facilities design (O5)
Number of students with a score of 3 or above											
Percentage of students with a score of 3 or above											

Assessment of student performance

The students worked in teams of two. This project focused on developing the flow data from department to department in a job shop from a process plan for an actual product named as a Powerarm. The major weaknesses as seen from this project were related to applying and synthesizing information presented in class for developing flow data using materials handling systems design concepts. Some of the students were not able to analyze their results in terms of practicality or cost effectiveness. In general, the students worked well in a team format and were able to gather information from various sources to supplement the data provided. In some reports, the written communication can be improved. Once again some of the students generated very few alternate solutions to the problem for the report. For the key ability "Ability to use materials handling systems design concepts" pertaining to outcome 1, 62% of the students had obtained a score of 3 or above. For the key ability "Ability to communicate in written report" related to outcome 4, 62% of the students obtained a score of 3 or above. Hence corrective actions are required for the improvement of these key abilities.

Efforts for "closing the loop"

The project was given back to the students and discussed. The importance of effective written communication was emphasized. Examples of sample technical reports were discussed. Examples of solutions to the project that were possible but were not practical or cost effective were presented to illustrate the need for the students to apply their engineering judgment in generating solutions. Systems design concepts were discussed and reemphasized for almost a half of a class period.

IMSE 449 COURSE ASSESSMENT RUBRIC

Exam I

This exam assessed student performance with respect to outcomes 1, 3, and 4

O1 – Outcome 1, O2 – Outcome 2, O3 – Outcome 3, O4 – Outcome 4, O5 – Outcome 5

Scale: Excellent - 5, Good - 4, Satisfactory - 3, Below average – 2, Poor - 1

Student name/Team members	Ability to use facilities planning methodologies (O1)	Ability to use materials handling systems design concepts (O1)	Ability to analyze and interpret system data (O3)	Ability to develop practical and cost effective recommendations (O3)	Ability to conduct an analysis of different alternatives (O3)	Ability to make oral presentation (O3)	Ability to gather information from a variety of sources (O3)	Ability to work in a project team (O4)	Ability to formulate and solve problems (O4)	Ability to communicate in written report (O4)	Ability to develop flow and space requirements to develop activity relationships for developing and/or improving facilities design (O5)

Number of students with a score of 3 or above											
Percentage of students with a score of 3 or above											

Assessment of student performance

This exam was focused on fundamentals of product, process, and schedule design information analysis, the pre-requisite for facilities planning and materials handling systems design activities. The major weaknesses of the students centered on the inability of break down problems and formulate a solution strategy, especially for non-numerical general problems. This was especially true in problems where the information needed to be synthesized and taken to the next level for obtaining a solution. The solution strategies found by some students lacked in practical and cost effective aspects. However, for all the key abilities pertaining to outcomes 1, 3, and 4, at least 70% of the students had obtained a score of 3 or above, hence requiring no significant corrective actions.

Efforts for “closing the loop”

The exam was given back to the students and discussed. Examples and non-numeric open ended problems ere presented in class and solved. The need for synthesizing information and developing solution strategies was emphasized. These weaknesses will be addressed by a review session prior to the second examination.

IENG XXX COURSE ASSESSMENT RUBRIC

Exam II

This exam assessed student performance with respect to outcomes 1, 3, 4, and 5

O1 – Outcome 1, O2 – Outcome 2, O3 – Outcome 3, O4 – Outcome 4, O5 – Outcome 5

Scale: Excellent - 5, Good - 4, Satisfactory - 3, Below average – 2, Poor - 1

Student name/Team members	Ability to use facilities planning methodologies (O1)	Ability to use materials handling systems design concepts (O1)	Ability to analyze and interpret system data (O3)	Ability to develop practical and cost effective recommendations (O3)	Ability to conduct an analysis of different alternatives (O3)	Ability to make oral presentation (O3)	Ability to gather information from a variety of sources (O3)	Ability to work in a project team (O4)	Ability to formulate and solve problems (O4)	Ability to communicate in written report (O4)	Ability to develop flow and space requirements to develop activity relationships for developing and/or improving facilities design (O5)

Number of students with a score of 3 or above											
Percentage of students with a score of 3 or above											

Assessment of student performance

This exam was focused on layout development and the types of layouts used in industry. The most commonly made mistakes related to determination of layout configuration from basis process data. However, for all the key abilities pertaining to outcomes 1, 3, 4, and 5, at least 70% of the students had obtained a score of 3 or above, hence requiring no significant corrective actions.

Efforts for "closing the loop"

The exam was given back to the students and discussed. Industrial examples relating to product layout, process layout, cellular layouts, and fixed position layouts were presented and discussed. The pros and cons of each layout type were emphasized with respect to changes in product variety and volume.

IENG XXX COURSE ASSESSMENT RUBRIC

Final examination

This exam assessed student performance with respect to outcomes 1, 4, and 5

O1 – Outcome 1, O2 – Outcome 2, O3 – Outcome 3, O4 – Outcome 4, O5 – Outcome 5

Scale: Excellent - 5, Good - 4, Satisfactory - 3, Below average – 2, Poor - 1

Student name/Team members	Ability to use facilities planning methodologies (O1)	Ability to use materials handling systems design concepts (O1)	Ability to analyze and interpret system data (O3)	Ability to develop practical and cost effective recommendations (O3)	Ability to conduct an analysis of different alternatives (O3)	Ability to make oral presentation (O3)	Ability to gather information from a variety of sources (O3)	Ability to work in a project team (O4)	Ability to formulate and solve problems (O4)	Ability to communicate in written report (O4)	Ability to develop flow and space requirements to develop activity relationships for developing and/or improving facilities design (O5)

Number of students with a score of 3 or above											
Percentage of students with a score of 3 or above											

Assessment of student performance

This exam was focused on material handling systems design as well as applying facilities planning methodologies. In general some weakness was noticed in the area of students learning to apply facilities planning methodologies learnt in class as well as selecting material handling systems for particular industrial situations. When the problems needed some amount of formulation in order to solve them, some students lacked this key ability. The relatively straightforward problems in the area of flow and space based activity relationships were solved by most of the students. For the key ability "Ability to use materials handling systems design concepts", related to outcome 1, 62% of the students obtained a score of 3 or above, hence requiring corrective actions. For the key ability "Ability to formulate and solve problems" pertaining to outcome 4, 62% of the students obtained a score of 3 or above, hence requiring corrective actions.

Efforts for "closing the loop"

As this was the final exam, the following will be emphasized when the course is taught next time.

1. The students should be exposed to more numerical problems solved in class in order for them to clearly understand facility design concepts and their relationship to various elements of the product, process, and system parameters.
2. The steps in breaking down facility planning and materials handling design problems and determining solutions will be emphasized more using examples in the industrial domain.
3. The importance of effective formulation to obtain good solutions to problems will be emphasized with more examples.

IENG XXX COURSE ASSESSMENT RUBRIC

Project on palletizing and warehousing

This project assessed student abilities for outcomes 1, 3, and 4

Scale: Excellent - 5, Good - 4, Satisfactory - 3, Below average – 2, Poor – 1

O1 – Outcome 1, O2 – Outcome 2, O3 – Outcome 3, O4 – Outcome 4, O5 – Outcome 5

Student name/Team members	Ability to use facilities planning methodologies (O1)	Ability to use materials handling systems design concepts (O1)	Ability to analyze and interpret system data (O3)	Ability to develop practical and cost effective recommendations (O3)	Ability to conduct an analysis of different alternatives (O3)	Ability to make oral presentation (O3)	Ability to gather information from a variety of sources (O3)	Ability to work in a project team (O4)	Ability to formulate and solve problems (O4)	Ability to communicate in written report (O4)	Ability to develop flow and space requirements to develop activity relationships for developing and/or improving facilities design (O5)
Number of students with a score of 3 or above											
Percentage of students with a score of 3 or above											

Assessment of student performance and “closing the loop”

This was the last project in the course and clear improvements are seen to emerge in the students. The project requires the students to synthesize the information learnt in the course and apply it to the design problem. The project required the student to design a warehouse system to accommodate effectively designed unit loads based on product information. Student performance in all the key abilities related to outcomes 1, 3, and 4 is well above the established metric of 70%. Hence no corrective action is required at this time.