10 June 2005

Industrial and Manufacturing Engineering Department
NCA Accreditation Report
For The Degree of Bachelor of Industrial Engineering

Introduction

The Industrial and Manufacturing Engineering Department, Cleveland State University, Fenn College of Engineering, awards only one undergraduate degree. The title of the degree as it appears on the student's transcript is, Bachelor of Industrial Engineering. There are no degree options.

The Industrial and Manufacturing Engineering Department strives to and to a significant level is responsive to the needs of our students, the employers of our students, our industrial visiting committee, our alumni, the department faculty, the college, and the university, all of whom are our constituents. Through the process of evaluation and assessment, we endeavor to improve our responsiveness by continuous review and development of our program, our metrics, and our evaluation and review process.

Goals

The program goals (1 through 6, listed below) have evolved from those previous stated prior to Cleveland State University's conversion to the semester system. At that time, the undergraduate curriculum was recreated with the aid of a review half a dozen national respected IE programs, and the Institute of Industrial Engineers (IIE) and the Society of Manufacturing Engineers (SME) definitions of Industrial Engineering and Manufacturing Engineering. The goals were last revised and approved in October 2002.

It is the intention of the Industrial and Manufacturing Engineering Department to prepare students to be successful professionals in society. To accomplish this we recognize that engineering education involves not just the knowledge of the technical aspects of the discipline, but also the ability to function within the real world environment, considering the physical, social, ethical, economic, safety, and environmental factors. This means that the student must not only be able to create designs and solutions to engineering problems, but also to understand the impact of their designs and problem solutions and be able to communicate their ideas to a variety of audiences.

The goals of the Bachelor of Industrial Engineering degree program are to produce graduates who are able to:

1. Practice Industrial Engineering in one or more of the following enterprise areas such as: manufacturing systems, quality systems, operations analysis, production planning, or facilities planning and design.
2. Define and diagnose problems from an industrial engineering perspective, and implement solutions in an enterprise-wide environment.
3. Communicate effectively with technically and professionally diverse audiences at all levels of the enterprise.

4. Collaborate with others as a member or as a leader of an engineering or cross-functional enterprise team.
5. Continue to pursue life-long learning to develop knowledge professionally and keep current with the latest advancements in industrial engineering.
6. Pursue graduate studies leading to graduate degrees.

Outcomes

The above listed goals are met by the achievement of the following 11 program outcomes:

a. Ability to apply principles of mathematics, science & engineering to problems and situations
b. Ability to collect and analyze experimental data
c. Ability to analyze a system, construct a model of it, and design a new system
d. Ability to lead or participate in multidisciplinary team work
e. Ability to identify, formulate, and solve engineering problems
f. Understanding of professional and ethical responsibilities
g. Effective communication skills
h. Understanding of the global/social impact of engineering solutions
i. Commitment to engage in lifelong learning
j. Knowledge of contemporary issues
k. Ability to apply techniques, skills and modern engineering tools and practices to IE problems and situations.

The program outcomes are achieved through a variety of means; among other things the program curriculum, the integrated design experience (the two course senior design sequence IME480 and IME 481), and the student/alumni participation in professional societies and activities.

The program outcomes contribute to the achievement of the goals (the objectives), as shown in the Outcomes-Objectives Form, on the next page.

The goals have been determined by a review of the Institute of Industrial Engineers and the Society of Manufacturing Engineers definition of Industrial and Manufacturing Engineering, comments from IE alumni, and visiting committee members, and discussions with employers.

Educational Objectives \ Program Outcomes	(a) Ability to apply principles of mathematics, science and engineering to IE problems and situations	(b) Ability to collect and analyze experimental data	(c) Ability to analyze a system, construct a model of it, and design a new system	(d) Ability to lead or participate in multidisciplinary team work	(e) Ability to identify, formulate, and solve Industrial Engineering problems	(f) Understanding of professional and ethical responsibilities	(g) Effective communication skills	(h) Understanding of the global/social impact of engineering solutions	(i) Commitment to engage in lifelong learning	(j) Knowledge of contemporary issues	(k) Ability to apply techniques, skills and modern engineering tools and practices to IE problems and situations
1. To produce graduates who are able to practice Industrial Engineering in enterprise areas such as: manufacturing systems, quality systems, operations analysis, production planning, or facilities planning and design	E	E	A		A		E				E
2. To produce graduates who are able to define and diagnose problems from an industrial engineering perspective, and implement solutions in an enterprise-wide environment			A		A	E		E		E	
3. To produce graduates who are able to communicate effectively with technically and professionally diverse audiences at all levels of the enterprise				E			A				
4. To produce graduates who are able to collaborate with others as a member or as a leader of an engineering or cross-functional enterprise team				A			E				
5. To produce graduates who are able to continue to pursue lifelong learning to develop professionally and keep current with the latest advancements in industrial engineering						E		E	A	E	
6. To produce graduates who are able to pursue graduate studies leading to graduate degrees	A	A	E		E						A

This table shows the influence of the IME Department's Program Outcomes (columns (a) through (k)) on the contribution to or confirmed achievement of the Educational Objectives (rows 1. through 6.)

The table entries represent the level of influence of the outcome on the objective on a ranked scale from highest to lowest: A, E, I, O, U, and X where the character definitions are: A – Absolutely influential; E – Especially influential; I - Influential; O - Occurrence somewhat influential; U – Un-influential; X – no attempt or means to determine influence Note: to avoid clutter, O and U ratings are NOT shown in the table

Industrial and Manufacturing Engineering   Form_Outcomes_Objectives2.doc   05/25/04

To assure continuous improvement of the industrial engineering program, each course is evaluated relative to the achievement of its specific program outcomes itemized in each course syllabus. The evaluation is accomplished by the instructor who files an ABET Course Instructor Reflection Form each time the course is taught. These forms are reviewed by the assigned instructor, prior to the next offering of the course, with the aim of improving the achievement of the program outcomes.

10 June 2005

See the Course Instructor Reflection Form below.

ABET Course Instructor Reflection Form

Course number and name______________________________ **Term and year:**______________

For the outcomes listed below, place a check mark ✓ for the items that are specified for this course. Then for each outcome that is checked, evaluate and check the level to which you believe that outcome was met.

Check outcomes for this course:	Not met	somewhat	mostly	completely
a. ☐ Ability to apply principles of mathematics, science & engineering to problems and situations	☐	☐	☐	☐
b. ☐ Ability to collect and analyze experimental data	☐	☐	☐	☐
c. ☐ Ability to analyze a system, construct a model of it, and design a new system	☐	☐	☐	☐
d. ☐ Ability to lead or participate in multidisciplinary team work	☐	☐	☐	☐
e. ☐ Ability to identify, formulate, and solve engineering problems	☐	☐	☐	☐
f. ☐ Understanding of professional and ethical responsibilities	☐	☐	☐	☐
g. ☐ Effective communication skills	☐	☐	☐	☐
h. ☐ Understanding of the global/social impact of engineering solutions	☐	☐	☐	☐
i. ☐ Commitment to engage in lifelong learning	☐	☐	☐	☐
j. ☐ Knowledge of contemporary issues	☐	☐	☐	☐
k. ☐ Ability to apply techniques, skills and modern engineering tools and practices to IE problems and situations	☐	☐	☐	☐

In the space below, provide an explanation to support your evaluation given above. If relevant, also provide an assessment of the students' knowledge of the prerequisite topics. Provide recommendations on how you should change the course in order to better meet the program outcomes. Please print or type. (Attach additional pages as needed.)

Course evaluated by:______________________________
Print name(s)

Signature:______________________________ Date:____________________

To assure that all program outcomes are tracked, the department also maintains the Outcomes-Curriculum Map, shown below. In the map the entries of '*X*' cross reference the specific program outcomes to the specific program courses.

Bachelor of Industrial Engineering Program Outcomes – Curriculum Map

An X in a cell indicates that the course contributes to, or has an effect on the outcome

Approved Oct 18, 2001
Last revision 4/13/2004

Program Outcomes:
- a — Ability to apply principles of mathematics, science, and engineering to IE problems and situations
- b — Ability to collect and analyze experimental data
- c — Ability to analyze a system, construct a model of it design a new system
- d — Ability to lead or participate in multidisciplinary team work
- e — Ability to identify, formulate, and solve industrial Engineering problems
- f — Understanding of professional and ethical responsibilities
- g — Effective communications skills
- h — Understanding of the global/social impact of engineering solutions
- i — Commitment to engage in lifelong learning
- j — Knowledge of contemporary issues
- k — Ability to apply techniques, skills, and modern engineering tools and practices to IE problems and situations

Semester	Course No.	Course Name	a	b	c	d	e	f	g	h	i	j	k
1st Year—Fall	ENG 101	English I							X				
	MTH 181	Calculus I	X										
	CHM 261/66	Gen. Chem. I w/lab	X	X									
	ESC100	New Student Orientation											
	IME 101	Introduction to CAD											X
1st Year—Spring	ENG 102	English II							X				
	MTH 182	Calculus II	X										
	PHY 243	University Phy. I w/lab (wac)	X	X									
	ENG 105	Writing Center I							X				
	CSC 121	Career Orientation—co-op											
		GenEd Elective								X	X		
2nd Year—Fall	MTH 284	Matrices for Engineers	X										
	PHY 244	University Phy. II w/lab (wac)	X	X									
	ESC 250	Diff. Eq. For Engineers	X				X						
	ESC 270	Materials Science	X				X						
	ESC 151	ANSI C Programming	X				X						X
	ESC 203	Statics & Dynamics	X				X						
2nd Year—Spring	ESE 310	Engr. Stat. and Probability	X	X									X
	ESC 321	Thermodynamics I	X				X						
	COM 242	Public & Professl Speaking							X				
		GenEd Elective								X	X	X	
3rd Year—Fall	IME 330	Operations Analysis I	X		X		X						X
	IME 320	Engr. Exp. Design	X	X									X
	IME 304	Work Meas. and Methods	X	X									X
	IME 305	Work Meas. & Meth. Lab.	X	X									X
	ESC 282	Engineering Economy	X	X						X			
	IME 250/251	Materials Processing/Lab	X	X									X
3rd Year—Spring	IME 331	Operations Analysis II	X		X		X						X
	IME 405	Industrial Ergonomics	X	X	X								X
	IME 410	Statistical Quality Control	X	X			X						X
	IME 477	Facility Planning	X		X		X						X
	IME 478	Facility Plan. Laboratory	X		X								X
	PHL 215	Engineering Ethics (wac)						X		X		X	
4th Year—Fall	IME 475	Systems Simulation	X		X		X						X
	IME 465	Mfg. Systems Engineering	X		X		X						
	IME 480	Engineering Design (wac)				X		X	X				X
		Technical Elective											X
		GenEd Elective								X	X	X	
4th Year—Spring	IME 481	Senior Design (wac)	X	X		X			X		X		
	IME 470	Prod. Plan. and Control	X				X						X
		Technical Elective											X
		GenEd Elective								X	X	X	
		GenEd Elective								X	X	X	
Technical Electives	IME 440	App. of Prog. Logic Controllers	X										
	IME 450	Industrial Automation	X										
	IME 451	Industrial Automation Lab.	X										
	IME 474	Expert Systems for Engineers											
	IME 471	Operational Level Scheduling	X										
	IME 476	Law for Engineers						X					

The Outcomes-Curriculum Map is reviewed by the department each time a program course is added or modified.

Research

The goals are met for the most part, by the curriculum. The Industrial and Manufacturing Engineering Department maintains a Curriculum Sheet and a corresponding Prerequisite Flow Chart, show in the next two figures.

As the program is modified, the curriculum sheet and prerequisite flow chart are updated to reflect the program changes.

Name__________ Advisor__________

I. D. No.__________ Entering Term__________

INDUSTRIAL ENGINEERING
Semester Curriculum Sheet

Fall Semester - 1st	Cr.	Grade	Spring Semester - 2nd	Cr.	Grade
ENG 101 English I	4	___	ENG 102 English II	3	___
MTH 181 Calculus I	4	___	ENG 105 Writing Center I	2	___
CHM 261 Gen. Chemistry I	4	___	MTH 182 Calculus II	4	___
CHM 266 Gen. Chem. Lab I	1	___	PHY 243 Univ. Physics I with Lab (Writing)	5	___
ESC 120 Introduction to Engineering Design	2	___	*CSC 121 Career Orientation**	1	___
ESC 100 New Student Orientation**	1	___	Gen Ed Elective___	3	___

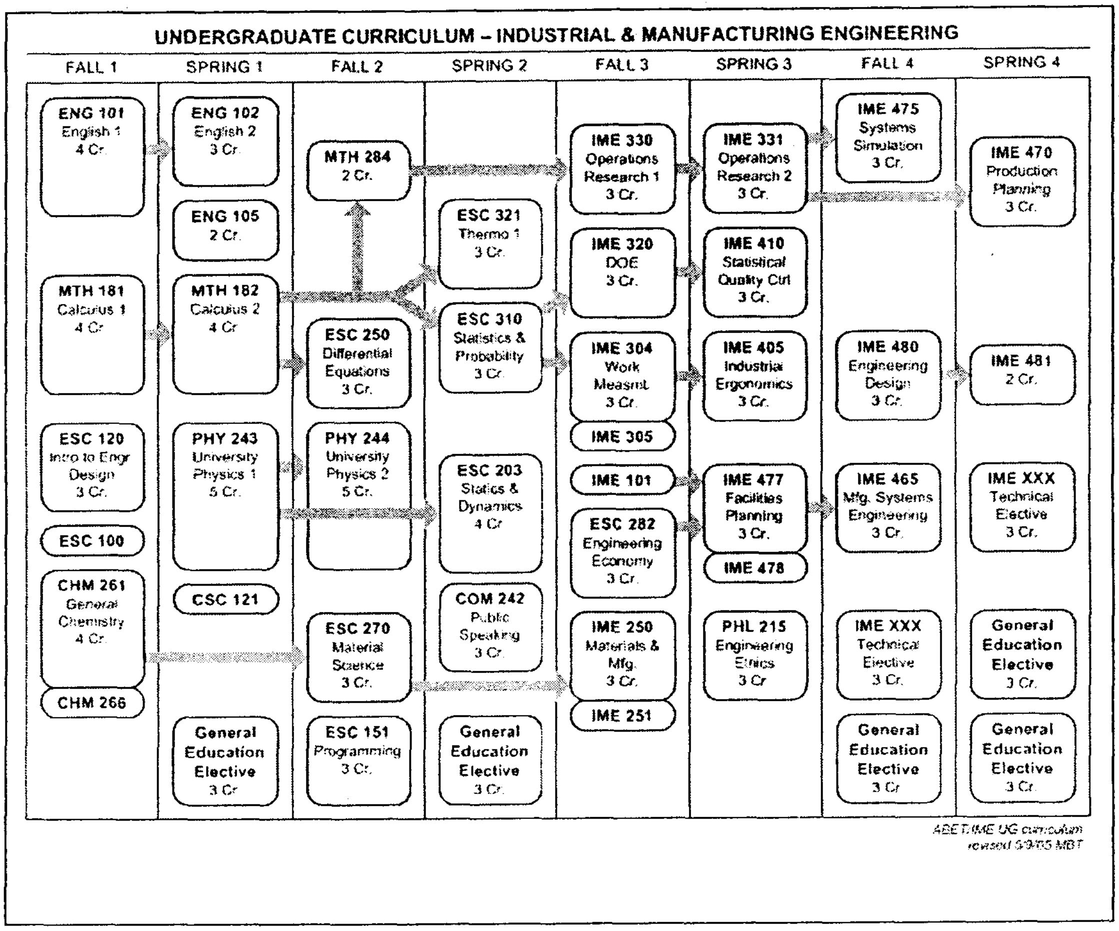
Fall Semester - 3rd	Cr.	Grade	Spring Semester - 4th	Cr.	Grade
MTH 284 Matrices for Engineers	2	___	ESC 203 Statics & Dynamics	4	___
PHY 244 Univ. Physics II with Lab (Writing)	5	___	ESC 310 Engr. Statistics and Probability	3	___
ESC 151 ANSI C	3	___	ESC 321 Thermodynamics I	3	___
ESC 250 Diff. Equations for Engineers	3	___	COM 242 Public & Professional Speaking	3	___
ESC 270 Materials Science	3	___	Gen Ed Elective___	3	___

Fall Semester - 5th	Cr.	Grade	Spring Semester - 6th	Cr.	Grade
IME 101 Introduction to AutoCAD	1	___	IME 331 Operations Research II	3	___
IME 250 Material Processing and Methods	3	___	IME 405 *Industrial* Ergonomics	3	___
IME 251 Material Processing and Methods Lab	1	___	IME 410 Statistical Quality Control	3	___
IME 304 Work Methods and Measurements	3	___	IME 477 Facility Planning	3	___
IME 305 Work Methods & Measurements Lab	1	___	IME 478 Facility Planning Lab	2	___
IME 320 Engineering Experimental Design	3	___	PHL 215 Engineering Ethics (Writing)	3	___
IME 330 Operations Research I	3	___			
ESC 282 Engineering Economy	3	___			

Fall Semester - 7th	Cr.	Grade	Spring Semester - 8th	Cr.	Grade
IME 465 Manufacturing Systems Engineering	3	___	IME 470 Production Planning and Control	3	___
IME 475 Systems Simulation	3	___	IME 481 *Senior Design (Writing)*	2	___
IME 480 Engineering Design (Writing)	3	___	Tech. Elective___	3	___
Tech. Elective___	3	___	Gen Ed Elective___	3	___
Gen Ed Elective___	3	___	Gen Ed Elective___	3	___

*Required for all IME students
**Not required for transfer students
Minimum number of credits required for degree: 128 (excluding ESC 100 New Student Orientation)

curriculum sheet_4.doc 5/24/2004 8:47 AM



Refer to the first four semesters on the curriculum sheet. The chemistry (CHM), and physics (PHY) courses as well as the engineering science courses, ESC 270 – Material Science, ESC 203 – Statics and Dynamics, and ESC 321 – Thermodynamics, provide the student with knowledge of the physical world and the laws of nature and engineering. The mathematics (MTH) courses, along with the engineering science courses ESC151 – ANSI C, ESC 250 – Differential Equations, and ESC 310 – Engineering Statistics and Probability, provide the student with the tools to enable them to solve engineering problems.

We believe that the ability to communicate is so important, we require COM 242 – Public and Professional Speaking, as a program course. Note that the course is taught by professionals in the Communications Department, the people who know it best. We also believe instruction in technical writing would enhance the student's ability to communicate. Currently the only department in the university to offer a course in technical writing is the Mechanical Engineering Department. This course is taught by a professional technical writer and we will work to include this course in our curriculum.

The university general education (GenED) requirements and PHL 215 – Engineering Ethics are intended to provide the student with an understanding and appreciation of the social, cultural, ethical, and environmental factors they will have to consider.

Beginning in the third year and continuing to the end of the program (fifth through the eight semester) a working knowledge of the technical aspects of Industrial Engineering is provided through the various Industrial Engineering (IME) courses; IME 250/251-Material Processing & Methods and Lab, IME 304/305 - Work Analysis and Measurement, IME 320 – Engineering Experimental Design, IME 405 - Industrial Ergonomics, and others.

The courses ESC 270 – Material Science, IME 250/251 – Material Processing & Methods and Lab., IME 465 – Manufacturing Systems Engineering, and the department technical electives IME 450/451 – Industrial Automation/Lab., and IME 447 – Applications of PLCs (Programmable Logic Controllers) provide emphasis on manufacturing.

Finally, the ability to analyze systems and synthesize solutions to real world problems, with their myriad of influencing factors and constraints is accomplished, in part, by the laboratory exercises, projects, and designs, and by the primarily design courses of IME 475 – Systems Simulation, and IME477/478 – Facility Planning and Lab. The truest experience and test of the students' ability to apply their knowledge and skills to real world problems is the two course capstone experience, IME480 – Engineering Design and IME481 – Senior Design.

Up to this time, the department has reviewed the program and program courses as problems have become apparent. The process of program review will be made more systematic and a task to be conducted during the annual department retreat.

Currently each course is assessed by the instructor each time the course is offered. This assessment is not currently reviewed by the department faculty as a whole. The review process for doing this is planned, and will become an activity at the annual department retreat.

<u>Integrated Design Experience</u>

Probably the most valuable means of evaluating our program and process is the senior design instructor assessment. Here the instructor has the opportunity to observe first hand, the graduating seniors' abilities to work as a professional in a real-world environment; to see their strengths and weaknesses and relate that to our program.

This assessment is done by the instructor who teaches the two course senior capstone experience courses IME 480 – Engineering Design and IME 481 – Senior Design. This instructor has the challenging task of not only finding projects for the students; most often in the local organizations and industries. The instructor not only finds the projects, but also organizes the students into teams, matching if possible the individual personalities with their industrial mentors. The instructor then coordinates and continuously monitors the progress of the senior design projects. This effort culminates in a senior design project presentation and report. Following the completion of the senior design project reports and presentations, the instructor for the senior capstone experience, evaluates each team by the quality of their work on their project. He also files an Outcomes Assessment Survey Questions form for the entire class, which shows his evaluation of their performance as a class, relative to the outcomes a. through k.

Senior exit survey

At the conclusion of each spring semester, the graduating seniors are asked to complete the senior exit survey. The survey has a general part, a part which queries the student's evaluation of each of the eleven program outcomes a-k, and a section where students are asked to make comments. These have given us valuable insight into the shortcomings of the program.

Alumni survey

The alumni survey is conducted by Fenn College every two years, on alternating years with the employer survey. (The first page of the survey form is shown on the next page.)

Although this survey does not specifically query the eleven program outcomes a-k, the first 19 questions can be directly mapped to the eleven program outcomes. This mapping is shown in the "Alumni Survey Outcomes Map" which follows the Alumni Survey Form.

Questions, 20 and 21, of the Alumni Survey (shown below) solicit information about the alumni's professional work.

Participation in Professional Activities

By these last two questions 20, and 21 of the alumni survey, we have an indication of whether the program has addressed the needs of our alumni and their employers. We conclude the program was a success if the alumnus is working in an engineering capacity, in the areas (e.g. manufacturing) for which the program has been designed.

Fenn College of Engineering Alumni Survey

All individual responses will be kept confidential. Only statistically analyzed results from the entire population will be shared.

The section in this box is optional, and will be used to update our database:

Name ______________________________ Email address ______________ Phone ______________
Last First Middle Initial

Address (if different from that on envelope):

Street Address ______________________________ City ______________ State _____ Zip ______________

Employer Name ______________________________ Position Title ______________________________

From which engineering program did you receive your bachelor degree at CSU?

☐Chemical ☐Civil ☐Electrical ☐Industrial ☐Mechanical ☐Electronic Engnrg. Tech. ☐Mechanical Engnrg. Tech.

Year of graduation with bachelor degree: ☐1997 ☐1998 ☐1999 ☐2000 ☐2001 ☐2002

How well did your undergraduate studies at Cleveland State University prepare you in the following areas?

	Poor	Fair	Moderate	Very Well	Excellent	N/A
1. Ability to apply knowledge of mathematics	☐	☐	☐	☐	☐	☐
2. Ability to apply knowledge of science	☐	☐	☐	☐	☐	☐
3. Ability to apply knowledge of engineering	☐	☐	☐	☐	☐	☐
4. Ability to design experiments	☐	☐	☐	☐	☐	☐
5. Ability to conduct experiments	☐	☐	☐	☐	☐	☐
6. Ability to analyze and interpret data	☐	☐	☐	☐	☐	☐
7. Ability to design a system, component, or process to meet a need	☐	☐	☐	☐	☐	☐
8. Ability to work in a multi-disciplinary team	☐	☐	☐	☐	☐	☐
9. Ability to identify, formulate, and solve engineering problems	☐	☐	☐	☐	☐	☐
10. Understanding of ethical and professional responsibility	☐	☐	☐	☐	☐	☐
11. Ability to communicate effectively in oral presentations	☐	☐	☐	☐	☐	☐
12. Ability to communicate effectively in writing	☐	☐	☐	☐	☐	☐
13. Understanding the impact of engineering solutions in a global and societal context	☐	☐	☐	☐	☐	☐
14. Knowledge of contemporary issues	☐	☐	☐	☐	☐	☐
15. Ability to use the up-to-date techniques necessary for engineering practice	☐	☐	☐	☐	☐	☐
16. Ability to use computers and modern software as problem-solving tools	☐	☐	☐	☐	☐	☐
17. Ability to use reference materials to solve problems	☐	☐	☐	☐	☐	☐
18. Knowledge of advanced topics in my discipline	☐	☐	☐	☐	☐	☐

19. Since graduation, have you (check all that apply):

- ☐ Enrolled in graduate course(s)
- ☐ Joined a professional association
- ☐ Attended workshops or short courses
- ☐ Subscribed to or regularly read a technical or professional journal

20. Your current position is (select only one):

- ☐ Within the engineering field corresponding to your degree
- ☐ Within another engineering field
- ☐ Outside engineering
- ☐ Unemployed

21. Your type of position (select only one):

- ☐ Consulting
- ☐ Product Design
- ☐ Product Support
- ☐ Customer Service/Support
- ☐ Manufacturing/Production
- ☐ Software Development
- ☐ Research or Development
- ☐ Marketing/Sales
- ☐ Operations/Maintenance
- ☐ Management
- ☐ Testing
- ☐ Other

22. Overall, the education that you received at Cleveland State was of:

☐ Low quality ☐ Moderate quality ☐ High quality

Please Turn To Other Side →

no.	outcome	survey question
		Alumni survey question to outcomes map
1	(a)	Ability to apply knowledge of mathematics
2	(a)	Ability to apply knowledge of science
3	(a)	Ability to apply knowledge of engineering
4	(b)	Ability to design experiments
5	(b)	Ability to conduct experiments
6	(b)	Ability to analyze and interpret data
7	(c)	Ability to design a system, component, or process
8	(d)	Ability to work in a multi-disciplinary team
9	(e)	Ability to identify, formulate, and solve engineering problems
10	(f)	Understanding of ethical and professional responsibility
11	(g)	Ability to communicate effectively in oral presentations
12	(g)	Ability to communicate effectively in writing
13	(h)	Understanding impact of engineering solutions in global & societal context
14	(j)	Knowledge of contemporary issues
15	(k)	Ability to use up-to-date techniques necessary for engineering practice
16	(k)	Ability to use computers and modern software as problem-solving tools
17	(k)	Ability to use reference materials to solve problems
18	(c)	Knowledge of advanced topics in my discipline
19	(i)	Enrolled in graduate course(s)
	(i)	Joined a professional association
	(i)	Attended workshops or short courses
	(i)	Subscribed to or regularly read a technical or professional journal

Table 3.1-1 Alumni Survey-Outcomes Map

Findings and Review

The analysis involves both qualitative evaluations and numeric measures of the outcomes. Regarding the qualitative evaluation, we consider the comments from the students' course evaluations, the senior exit surveys, the comments from the visiting committee, and the instructor's course reflections responses.

Regarding the numeric measures, we use primarily the senior exit survey, and the alumni survey data. Both surveys use a 5 point scale for rating. We consider 3.00 on a 5 point scale as an acceptable level of achievement.

We consider a change of 1.00 or more for a 5 point scale as significant.

The level of achievement for an outcome is calculated as the weighted average of the scores. For example, suppose 10 respondents all score an outcome as 5 on a 5 point scale. Then the score for the outcome is calculated as

$$level = \frac{5*10+4*0+3*0+2*0+1*0}{10} = 5.00$$

We assess each outcome in turn. In this assessment, note that the number of respondents in the last four senior classes (2002, 2003, 2004 and 2005) were respectively 9, 10, 13, and 8 and the number of respondents in the last two alumni surveys (2001 and 2003), were respectively, 6 and 3. although the alumni survey is due to be done this year, the results are not yet available for this report. Therefore, the entry of NA (for Not Available) is entered in all of the reported results that follow.

Outcome (a): Ability to apply principles of mathematics, science & engineering to IE problems and situations

Knowledge of the principles of mathematics and science depends on the courses taught by the Mathematics, Chemistry and Physics departments, and is generally not within our control. However, the application of these principles are accomplished through the ESC (Engineering Science) courses, designed, reviewed, maintained, and taught by the Fenn College. These courses are for the most part within our control, since the Industrial and Manufacturing Engineering department participates in this process. In fact the department has primary responsibility to teach two of the ESC courses (ESC282 – Engineering Economy, and ESC310 – Engineering Statistics and Probability).

Results:

Response in

Senior exit survey for year	2002	2003	2004	2005
compare to a perfect score of 5	4.22	3.90	4.43	4.00

Alumni survey for year	2001	2003	2005
compare to a perfect score of 5	4.06	4.11	NA

The numbers in the alumni table above are the average of the responses to the questions 1, 2, and 3 from the previous Table 3.1-1 Alumni Survey-Outcomes Map.

Conclusions and recommendations:

The outcome appears to be achieved to an acceptable level since all scores are above 3.00. Both the students and alumni consider that they have the ability to apply the principles of mathematics, science & engineering in the senior exit and alumni surveys.

No changes are required at this time.

Outcome (b): Ability to collect and analyze experimental data

Instruction relative to this objective is addressed primarily in ESC310 – Engineering Statistics and Probability, and IME320 – Engineering Experimental Design, and to some extent, IME410 – Statistical Quality Control. There are many opportunities for the student to use their abilities in the IME design courses, and particularly in the senior capstone experience, IME480 and IME 481.

Results:

Response in

Senior exit survey for year	2002	2003	2004	2005
compare to a perfect score of 5	4.22	3.90	4.57	4.38

Alumni survey for year	2001	2003	2005
compare to a perfect score of 5	3.11	3.11	NA

The numbers in the alumni table above are the average of the responses to the questions 4, 5, and 6.

Conclusions and recommendations:

The outcome appears to be achieved to an acceptable level since it is above 3.00. Both the students and alumni consider that they have the ability to collect and analyze experimental data in the senior exit and alumni surveys.

No changes are required at this time.

Outcome (c): Ability to analyze a system, construct a model of it, and design a new system

This outcome is addressed directly by the design courses of IME475 – Systems Simulation, IME477/478 – Facility Planning and Laboratory, and the senior capstone experience, IME480 and IME481.

Results:

Response in

Senior exit survey for year	2002	2003	2004	2005
compare to a perfect score of 5	4.11	3.30	4.43	3.88

Alumni survey for year	2001	2003	2005
compare to a perfect score of 5	3.67	4.00	NA

The numbers in the alumni table above are the average of the responses to the questions 7, and 18.

Conclusions and recommendations:

The outcome appears to be achieved to an acceptable level since all scores are above 3.00. Both the students and alumni consider that they have the ability to analyze a system, construct a model of it, and design a new system in the senior exit and alumni surveys.

No changes are required at this time.

Outcome (d): Ability to lead or participate in multidisciplinary team work

This is a somewhat difficult objective to address. Teamwork is regularly prescribed in four program courses. They are, ESC120 – Introduction to Engineering Design, IME475 – Systems Simulation, and IME480 Engineering Design and IME481 – Senior Design. It is unlikely that teamwork with other IME students as in IME475 satisfies the letter of this outcome. However, the other three likely do satisfy this outcome since the students most often work in teams consisting either of students from various disciplines, or as in the case of the senior capstone experience with people from industry or organizations outside the university. For example, in the two course sequence, IME480 and IME 481, students work in teams with mentors and employees of companies on projects in a real-world environment.

The college struggles with this objective as well, and is looking at finding projects which require interaction with students of business, mathematics, economics, computer science or other engineering disciplines.

Results:

Response in

Senior exit survey for year	2002	2003	2004	2005
compare to a perfect score of 5	4.11	4.00	4.57	4.25

Alumni survey for year	2001	2003	2005
compare to a perfect score of 5	3.33	4.67	NA

The numbers in the alumni table above are the average of the responses to question 8.

Conclusions and recommendations:

The high scores by the seniors and the 2003 alumni survey are attributed to the superb job being done by Dr. L. Kenneth Keys who began teaching IME480/481 in 2001. Note that the alumni responding to the 2001 survey (who reported a lower level of achievement) took their engineering and senior design sequence in 1999 prior to Dr. Keys' tutelage. For the past three years, the senior design projects and presentations have been among the best the department has accomplished.

The outcome appears to be achieved to an acceptable level since all scores are above 3.00. Both the students and alumni consider that they have the ability to lead or participate in multidisciplinary team work.

No changes are required at this time.

Outcome (e): Ability to identify, formulate, and solve engineering problems

This outcome is primarily addressed by the courses IME330 – Operations Research I, IME331 – Operations Research II, IME410 – Statistical Quality Control, IME465 – Manufacturing Systems Engineering, IME470 – Production Planning and Control, IME475 – Systems Simulation, and IME477 – Facility Planning.

Results:

Response in

Senior exit survey for year	2002	2003	2004	2005
compare to a perfect score of 5	4.56	3.70	4.43	4.25

Alumni survey for year	2001	2003	2005
compare to a perfect score of 5	3.67	5.00	NA

The numbers in the alumni table above are the average of the responses to question 9.

Conclusions and recommendations:

The outcome appears to be achieved to an acceptable level since it is above 3.00. Both the students and alumni consider that they have the ability identify, formulate, and solve engineering problems.

No changes are required at this time.

Outcome (f): Understanding of professional and ethical responsibilities

This outcome is directly addressed by the GenED course, PHL215 – Engineering Ethics, but is also included to some degree in IME480 – Engineering Design.

Results:

Response in

Senior exit survey for year	2002	2003	2004	2005
compare to a perfect score of 5	3.78	4.00	4.86	4.50

Alumni survey for year	2001	2003	2005
compare to a perfect score of 5	3.83	4.00	NA

The numbers in the alumni table above are the average of the responses to question 10.

Conclusions and recommendations:

The outcome appears to be achieved to an acceptable level since it is above 3.00. Both the students and alumni consider that they have an understanding of professional and ethical responsibilities.

However, we note that there have been comments by students (one documented in the 2004 senior exit survey) that the instructors in the Philosophy department do not understand the issues engineers must face and so this outcome could be better addressed if taught by an experienced engineer.

This issue remains as a future action item.

Outcome (g): Effective communication skills

Instruction relative to this objective is indirectly addressed by ENG101 – English I, ENG102 – English II, and ENG105 – Writing Center I. It is directly addressed by the curriculum in the required program course COM242 – Public and Professional Speaking. Practical application comes in IME480 – Engineering Design, and IME481 – Senior Design. The course COM242 – Public and Professional Speaking, is taught by professionals from the Communications department. Here, students get practice in selecting and researching a topic for presentation, writing an outline, and paper, preparing the presentation and delivering it to the class. The students' topic, outline, paper, and presentation are critiqued, revised and redone as many times as the instructor believes necessary. The effectiveness of this experience on the ability of our students to make good organized presentations has been profound, as is evidenced in the outstanding good senior design presentations over the past three years (2002 through 2004).

Results:

Response in

Senior exit survey for year	2002	2003	2004	2005
compare to a perfect score of 5	3.67	4.01	4.71	4.38

Alumni survey for year	2001	2003	2005
compare to a perfect score of 5	3.33	4.00	NA

The numbers in the alumni table above are the average of the responses to questions 11 and 12.

Conclusions and recommendations:

We conclude that the good performance and increase in achievement level in 2003 are due in part to the inclusion of COM242 in the curriculum, and the excellent job being done by the instructor of IME480 and IME481. Note that the lower score for 2001 alumni is attributed to the fact that none of these students 2001 had the COM242 course, and none had the most recent assigned instructor of senior design.

In the next program revision, we will work to include the technical writing course in the curriculum. Until then, no changes are recommended.

Outcome (h): Understanding of the global/social impact of engineering solutions

This outcome is primarily addressed by the five university required GenED electives. It is also addressed to some extent in ESC282 – Engineering Economy, and PHL215 – Engineering Ethics.

Since the students have over 100 courses to choose from to satisfy their GenED requirements, it is difficult for us to have a direct impact on this outcome. The best we can do is to recommend to our students, those courses that appear to address the issues.

Results:

Response in

Senior exit survey for year	2002	2003	2004	2005
compare to a perfect score of 5	3.33	3.90	4.71	3.50

Alumni survey for year	2001	2003	2005
compare to a perfect score of 5	4.17	3.33	NA

The numbers in the alumni table above are the average of the responses to question 13.

Conclusions and recommendations:

Since all scores are above 3.00, the outcome appears to be achieved at an acceptable level. As students, they take two human diversity classes, and western civilization and nonwestern civilization courses so they should at least know something about impact of events (though not necessarily engineering) on society.

With the relatively lower scores in 2003, and 2005 we need to find better ways to impact this outcome. This will remain an item for future action.

Outcome (i): Commitment to engage in lifelong learning

This outcome is considered to be addressed by the university GenED electives and to some extent by IME480 – Engineering Design.

However, to date we have not found a direct way to influence this outcome, although a measure that this is being accomplished is the number of students and alumni who belong to professional societies and participate in professional activities.

Results:

Response in

Senior exit survey for year	2002	2003	2004	2005
compare to a perfect score of 5	3.89	3.90	4.57	4.00

Also, the majority of our Industrial Engineering students belong to the IIE (Institute of Industrial Engineers), and several belong to the other student organizations of SME (Society of Manufacturing Engineers), ASQ (American Society for Quality), and APICS (American Production and Inventory Control Society). There are student chapters of IIE (sponsored by the IME Department) and APICS (sponsored by the OMS Department in the Business School), but there are no student chapters of SME, or ASQ on campus at this time.

The alumni survey has no numeric response to this outcome, so no numerical scores are reported. However, the alumni survey does have qualitative questions (responses to the four part question 19) that map to this outcome. They are presented below.

The number of respondents in the last two alumni surveys (2001 and 2003), were respectively, 6 and 3. The majority of these were engaged in activities related to lifelong learning. The following table shows the percentage of the respondents who participated in the learning activities.

2004

Activities	% of 2001 respondents	% of 2003 respondents	% of 2003 respondents
• Enrolled in graduate courses	50	33	NA
• Joined a professional association	33	100	NA
• Attended workshops or short courses	50	67	NA
• Subscribe/read technical /professional journals	50	67	NA

Conclusions and recommendations:

Since the percentages of participation by our alumni is relatively high, and the outcome is perceived by the students to be achieved at an acceptable level, no changes are planned at this time.

We will continue to look for ways in which to affect this outcome, and continue to track the progress of our students and alumni. we also look forward to viewing the 2005 alumni survey to be conducted later this summer.

Outcome (j): Knowledge of contemporary issues

With the myriad of issues that impact and are impacted by engineering, it is difficult to keep abreast of what to introduce, except when an issue is brought to attention through the journals such as Industrial Engineering. Issues such as environmentally green buildings, RFID (radio-frequency identification) as stressed by WalMart, and sustainability of products and technologies are topics discussed in IME 477 – Facility Planning, and IME 480 – Engineering Design, but there is no systematic effort to address contemporary issues in the curriculum.

Once again, we rely on the university GenED electives, and PHL215 – Engineering Ethics to address this outcome to some extent.

Results:

Response in

Senior exit survey for year	2002	2003	2004	2005
compare to a perfect score of 5	3.78	3.30	4.71	3.88

Alumni survey for year	2001	2003	2005
compare to a perfect score of 5	3.83	2.67	NA

The numbers in the alumni table above are the average of the responses to question 14.

Conclusions and recommendations:

Scores of 3.00 or above are acceptable but the 2003 alumni survey response appears significantly lower than other scores. Without a rational basis for affecting this outcome, we do not know why the significant drop in the assessment score, and are unable to affect an improvement. Should these relatively low scores continue, we will focus on new ways to measure and affect this outcome.

We will continue to search for ways to bring contemporary issues to the students, particularly in the design courses.

Outcome (k): Ability to apply techniques, skills and modern engineering tools and practices to IE problems and situations

Instruction and practice in the application of modern industrial tools and concepts is addressed primarily in all of the 400 level IME courses and particularly the ARENA Simulation language in IME475 - Systems Simulation, MiniTAB in IME 410 – Statistical Process Control, and IME320 – Design of Experiments, FlowPATH Calculator, and ProPLANNER in IME477 – Facility Planning, and IME478 – Facility Planning

Laboratory, and Project Management tools such as MS Project in IME480 – Engineering Design, and IME 481 – Senior Design.

Results:

Response in

Senior exit survey for year	2002	2003	2004	2005
compare to a perfect score of 5	3.33	4.00	4.57	4.00

Alumni survey for year	2001	2003	2005
compare to a perfect score of 5	3.44	3.50	NA

The numbers in the alumni table above are the average of the responses to question 15, 16, and 17.

Conclusions and recommendations:

The scores are all above the acceptable level and we attribute this at least in part, to the IME480/IME481 experience.

We have no plans for any changes, at this time.

Integrated Design Experience Assessment

Elements of engineering design are integrated throughout the curriculum through the student homework, projects, and especially thorough design courses such as IME475 – Systems Simulation, and IME477 – Facility Planning.

But the ability to perform as an engineer in a real world environment is culminated in the two course sequence IME480 – Engineering Design, and IME481 – Senior Design, which constitute the senior capstone experience.

Thus, the outcomes assessment by the faculty teaching IME481 – Senior Design, is of paramount importance. IME 480/481 – Senior Design has been taught by Professor L. Kenneth Keys for the past three years and he has been very successful in obtaining good design projects for the seniors in the local service organizations and industries, and matching student teams with company mentors.

The instructor uses the Outcomes Assessment Survey Questions Form (Appendix I.D exhibit 9) for his/her assessment. The assessment consists of an appraisal of achievement of the program outcomes a through k, and any corresponding comments. The assessment results for 2002 though 2004 follow. The assessment values are calculated by the same weighted average equation as in section 3.1 Outcomes Assessment. Four of the outcomes, f. Understanding of professional and ethical responsibilities, h. Understanding of the global/social impact of engineering solutions, i. Commitment to engage in lifelong learning, and j. Knowledge of contemporary issues were considered "No Basis for judgment" by the instructor, and so do not contribute to the level of achievement. Thus the maximum possible score is 35.

10 June 2005

<u>Instructor's Outcomes Assessment</u>

Year	Assessment
2002	27
2003	35
2004	35
2005	32

<u>Instructor's Comments</u>

Class of 2002:

- Most of the senior students are still completing their program on the old (quarter or semester) curriculum. We won't begin to see the benefits from our new curriculum until about 2003-2004.
- The students need more project management experiences, project planning, teaming.
- I will strengthen the course with new text, syllabus, and required team experiences.
- Require use of project management (Primavera) now available in the CAD Lab.

Class of 2003:

- This year's students performed admirably as demonstrated by the Projects, Project Reports, Presentations and outside company PI's assessments.

Class of 2004:

- This years students in general performed exceptionally well as demonstrated by the completeness of the projects, project presentations, project reports, and outside agency partner comments.
- Based on my discussions with the students, and their feedback over the past two years, I have decided to change the first semester (IME480) text and the nature of this course. I will make it more of a discussion of the engineering profession, practice, their expectations, and their role in an organization, as well as reflecting on the specific IE roles and opportunities.

Class of 2005:

- These students did quite well but could use a better understanding of systems analysis and project management to better prepare them for an increasing complex technological world.

Conclusions and recommendations:

The instructor has made the IME480/IME481 capstone experience a good one for the students, but it appears that the essential topic of project management does not appear early enough in the curriculum to be helpful in their senior design project.

We also note that the metric for measuring the success of the senior design capstone experience remains not as discriminating as it could be. Observe that the assessment score for 2003 and 2004 is 35 (the maximum possible) indicating the unlikely condition that no improvement is possible.

We will attempt to refine this assessment method in the future.

Visiting Committee Evaluation and Comments

The IME department's 2004 visiting committee members consisted of professionals from a variety of companies and organizations. In 2003 the members numbered 13, from organizations including Lorain Community College, Nestlé, Lincoln Electric, Parker Hannifin, KERBY Vacuum, Roadway Express, Xerox, Castle Metals, and Ford Motor Company.

However, the visiting committee must to be reconstituted for 2005-2006. Six of the current members have changed jobs, been promoted or moved out of Ohio. This will be an item for action this academic year.

In 2002 the department held two visiting committee meetings, one each in the fall semester and one in the spring. At those meetings, the committee reiterated the need for the program to include formal instruction on the topics of Simulation, and Human Factors. The department had already changed the curriculum to require the two previously elective courses (IME475 – Systems Simulation, and IME405 – Industrial Ergonomics) as required courses.

Since the attendance at the spring meeting in 2002 was very low, the department decided to call only one meeting per year rather than two, and call that meeting in the spring in concert with the day of the Senior Design Project Presentations.

The 2003 meeting was held on May 2, 2003 and was attended by only five visiting committee members. Some attended the senior design project presentations and were favorably impressed.

Members of the committee commented on the need for students to have a good knowledge of logistics, and to remain on the cutting edge of technology; because of the competition and off-shore sourcing. Also emphasized were the importance of cost competitiveness; lean manufacturing, robotics, and automation. Competitiveness is forcing companies to look beyond traditional means of reducing costs.

No visiting committee meeting was held in spring 2004. Furthermore, since the time the last committee was constituted several of the members have been promoted, or moved on to other companies. Therefore, the visiting committee needs to be reconstituted. This will be done during the forthcoming academic year.

Actions

The information obtained through the assessment process is reviewed by the faculty and discussed in department meetings throughout the year as the data become available.

Through our observation of the students and comments made by our alumni, we became aware of shortcomings in our program and therefore have made revisions to the program. These revisions are:

- ENG106 – Writing Center was added, to strengthen the student's communication skills.
- The department course, IME 300 – Introduction to Industrial Engineering, was removed from the curriculum. The original intention of this course was to attract students to study Industrial Engineering. However, it did not work since only Industrial Engineering majors took the course.
- Changes in the curriculum by the Mechanical Engineering Department, resulted in changes in an ESC course where elements of linear algebra were taught. Since Industrial Engineering students need instruction on this topic as a prerequisite for IME330 – Operations Research I, the department added MTH284 – Matrices for Engineers, as a required program course.
- To keep the number of credits for the Bachelor of Industrial Engineering to under 130 semester hours, and yet strengthen our student's ability to communicate, the department dropped ELE315 – Electrical Concepts from the curriculum and added COM242 – Public and Professional Speaking.

In retrospect, this does not seem to be a good idea since the students now have no course where they gain knowledge of AC circuits. A basic understanding of AC circuits is necessary for students who go onto work with sensors and automation. We will be working to revise the curriculum, possibly reorganizing and combining some of our courses so we can reinstitute ELE315 as a required course.

- At the recommendation of our alumni, and the visiting committee, who recommended that the program include courses on Simulation and Ergonomics, two of the four technical elective courses were removed, and replaced with two required courses: IME 475 – Systems Simulation, and IME405 – Human Factors Engineering.
- Due to a change in curriculum by the Mechanical Engineering Department, and during the 2001-2002 academic year, the Fenn College stopped offering ESC101 – Graphical Concepts. This was of great concern to the Industrial and Manufacturing Engineering Department, since a knowledge of AutoCAD is necessary to be able to use FlowPATH Calculator (an AutoCAD software add-on package) in IME478 – Facility Planning Laboratory.
- Therefore, in Fall of 2003 the department added the one credit laboratory course: IME101 – Introduction to CAD, where basic instruction and practice of AutoCAD is given.

- Also in 2002, the name of IME405 – Human Factors, was changed to IME405 – Industrial Ergonomics, and two courses previously taught under the generic department number of IME499 – Special Topics, were instituted as regular technical electives. These courses are: IME471 – Operational Level Scheduling and IME474 – Expert Systems for Engineers.

No other major changes have been made since Fall 2003.

Summary of Assessment Results 2002-2005

The department uses six methods to assess the achievement of our program outcomes. They are:

1. Curriculum review
2. Integrated design experience
3. Participation in professional organizations and activities
4. Senior exit survey
5. Alumni survey
6. Visiting committee assessment

By our standards for acceptability (3.0 on a 5 point scale) we have achieved all the outcomes and therefore meet all program goals.

Conclusions

The industrial engineering program is adequate to achieve the educational objectives but it can be improved. Regarding the assessment process itself, the benchmark level of achievement (3.0 on a 5 point scale) is probably not high enough since it does not discriminate between high-quality and average performance. The rationale is that although we have achieved all program outcomes to an acceptable level, there are some outcomes whose level of achievement can be higher.

In particular, the outcomes

(f) – Understanding professional and ethical responsibilities

(g) – Effective communication skills

(h) – Understanding of the global/social impact of engineering solutions

(i) – Commitment to lifelong learning

(j) – Knowledge of contemporary issues

All could be improved by addressed them with better metrics and judicious programmatic changes. We will work to refine the assessment process, to develop better metrics, and find ways to implement and track changes.

Regarding the program, it is apparent through this assessment process that some changes are needed. In next program revision we will work to include a technical writing course, preferably taught by a professional technical writer, and we will work to restore ESC315 – Electrical Concepts, as a required course. To accomplish this, we will conduct a critical review of the content of the courses and replace less important topics and methods with topics deemed to be more relevant, and perhaps consolidate some courses. This could lead to the repackaging of the program into predominately 4 credit courses as has been done by some departments in Fenn College.

Finally, to improve the achievement of outcome (f) – Understanding of professional and ethical responsibilities, we will collaborate with other departments in the college to get a practicing engineer to teach engineering ethics, possibly as an ESC course.