School of Industrial Engineering and Management (IE&M)

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Programs: B.S., M.S., and Ph.D.

Assessment Methods

Assessment methods included capstone design project reviews, thesis and dissertation proposals and defenses, TA/RA performance evaluations, Fundamentals of Engineering Exam results, and a review by our Industrial Advisory Board of student work and IE&M activities and plans. Other methods included, exit surveys/interviews, advisory group inputs, course outcome assessments, class grade summaries, and teaching evaluations.

Degree Programs Assessed	Assessment Methods Used	Number of Individuals Assessed
B.S.	Industrial Advisory Board (review of work and activities)	14*
	Fundamentals of Engineering Exam results (national in scope)	14
	Undergraduate Student Advisory Council	6**
	Senior exit surveys/interviews	17
	Capstone projects (with outside clients)	25
	Alumni survey (2002, former undergraduates)	14
	Class grades	All
	Course outcome evaluations	All
M.S., M.I.E., M.M.S.E., and Ph.D.	Industrial Advisory Board	14*
	Graduate Student Advisory Council	6**
	Graduate exit surveys/interviews	11
	Graduate TA/RA performance evaluations (Fall 2002)	24
	Graduate TA/RA performance evaluations (Spring 2003)	29
	Thesis and dissertation proposals	All
	Thesis and dissertation defenses	All
	Class grades	All
	Course outcome evaluations	All

*Number of board members.
** Number of advisory group members.

Analysis and Findings

During the past year IE&M continued to refine its approaches to the Engineering Accreditation Commission/Accreditation Board for Engineering and Technology (EAC/ABET) criteria in preparation for a re-accreditation visit this coming September (2003). The focus of this work is at the undergraduate level. The undergraduate program received the most attention this past year. In the two previous years the graduate program was redesigned and the redesign was implemented. Both programs share the same Industrial Advisory Board and the same faculty and facilities. Hence, many of the approaches described below apply either directly or indirectly to both programs.

IE&M collected information from basic constituencies, which included alumni and employers, students, and faculty members. The Industrial Advisory Board (IAB) represents alumni and employers while student advisory councils represent the students. Survey information was collected on how well students perceive they meet the IE&M program objectives.

IE&M Educational Objectives

The educational program emphasizes the application of technologies and tools in the short term, and the ability to discover, acquire, and adapt new knowledge and skills in the long term, such that our graduates are prepared:

i. To define, analyze, and solve complex problems within and between enterprises.
ii. To discover, understand, and incorporate appropriate new technologies in the design and operation of enterprises.

iii. To lead/manage design, development, and improvement efforts that benefit customers, employees, and stakeholders
iv. To function in culturally diverse teams, communicate in a professional manner, and uphold the ethical standards of the engineering profession.

Graduating students were asked to rate their abilities and their preparation regarding each objective. Results containing averages and ranges from the spring 2003 and fall 2002 exit surveys of BS and MS graduates provided the following information.

Undergraduates (Spring 2003, n=9)

i.	Ability = 2.78 (range = 1)	Preparation = 2.67 (range = 1)
ii.	Ability = 2.33 (range = 1)	Preparation = 2.22 (range = 2)
iii.	Ability = 2.44 (range = 1)	Preparation = 2.33 (range = 1)
iv.	Ability = 3.22 (range = 1)	Preparation = 2.78 (range = 1)

Graduates ((Spring 2003, n=6)

i.	Ability = 2.50 (range = 1)	Preparation = 2.67 (range = 1)
ii.	Ability = 2.17 (range = 1)	Preparation = 2.67 (range = 1)
iii.	Ability = 2.33 (range = 2)	Preparation = 2.83 (range = 2)
iv.	Ability = 3.17 (range = 2)	Preparation = 2.67 (range = 3)

Scale: 0 = poor; 1 = marginal; 2 = good; 3 = very good; 4 = mastery/outstanding

Undergraduates (Fall 2002, n=8)

i.	Ability = 2.25 (range = 2)	Preparation = 2.12 (range = 2)
ii.	Ability = 2.38 (range = 2)	Preparation = 1.62 (range = 3)
iii.	Ability = 2.75 (range = 2)	Preparation = 2.00 (range = 3)
iv.	Ability = 2.62 (range = 3)	Preparation = 2.25 (range = 3)

Graduates (Fall 2002, n=5)

i.	Ability = 2.00 (range = 2)	Preparation = 1.80 (range = 1)
ii.	Ability = 1.80 (range = 2)	Preparation = 1.60 (range = 3)
iii.	Ability = 2.60 (range = 1)	Preparation = 2.60 (range = 3)
iv.	Ability = 2.60 (range = 1)	Preparation = 3.20 (range = 2)

Scale: 0 = poor; 1 = marginal; 2 = good; 3 = very good; 4 = mastery/outstanding

Responses from the previous year (for comparative purposes) for undergraduates are shown below:

i.	Ability = 2.72	Preparation = 2.56
ii.	Ability = 2.28	Preparation = 2.28
iii.	Ability = 2.56	Preparation = 2.41
iv.	Ability = 3.09	Preparation = 2.69

Scale: 0 = poor; 1 = marginal; 2 = good; 3 = very good; 4 = mastery/outstanding

IE&M's target is a "good" rating or above, with minimal variation. In the fall statistics, objective *ii* dipped below our target, but recovered in the spring statistics. We will continue to make improvements in order to move our performance to higher levels. Several improvements are listed in the next section.

We had 14 students sit for the Fundamentals of Engineering (FE) Exam this past year. The display below summarizes our FE exam results since 1998.

Exam Date	Number of Students (IE&M)	Number of IE Students (National)	IE&M Pass Rate	National Pass Rate
1998-2002 (AM section)	52	2,291	87%	70%
1998-2002 (PM section - general)	7	162	86%	60%
1998-2002 (PM section - IE)	45	2,129	87%	71%
April 1999 (AM and PM)	3	216	100%	75%
Oct 1999 (AM and PM)	11	175	100%	75%
April 2000 (AM and PM)	2	300	100%	69%
Oct 2000 (AM and PM)	6	160	83%	74%
April 2001 (AM and PM)	5	291	80%	65%
Oct 2001 (AM and PM)	4	181	75%	70%
April 2002 (AM and PM)	5	327	60%	67%
Oct 2002 (AM and PM)	9	223	78%	69%

About 25% of IE&M students complete the FE exam. These students (semester in and semester out) tend to represent a cross-section of our students in terms of academic achievement and gender. Demonstrated performance typically exceeds our expectations/target of being above the national average – April 2002 was one exception in a number of years. We are unable to explain this data point, but think it was likely a lack of student preparation on the part of a couple of our students.

Although results may vary somewhat from semester to semester on the exam, overall our students appear to be nationally competitive in the FE. In addition to FE examination results which typically fall above the national average, results in general indicate that the current program is solid. For example, [redacted], a 2002 graduate, won the National IIE Student Paper Competition in 2002 with her (team) capstone design work, as presented in Orlando, Florida. [redacted], a 2003 graduate, won the 2003 IIE Student Award for Excellence (first place in national competition, Portland, Oregon). Over the last three years, more than 10 students have been successful in national-level scholarship competition. For example, in 2003 [redacted], an IE&M junior, won the United Parcel Service Scholarship for Minority Students and was recognized for the same at the IIE National Conference in Portland, Oregon. These facts add further evidence that our academic program is solid and meeting professional engineering expectations

Our faculty continues to win numerous educational awards. For example, [redacted] won the College Advising Award for his work in integrating personal attention and database technology within the advising processes. [redacted], and [redacted], together, won over 15 teaching awards of significance within the last three years. In addition, over one-third of our faculty are Fellows within their respective professional societies.

All in all, IE&M contends that our students meet our stated program objectives and outcomes. Nevertheless, we constantly strive to improve in educating our students for professional practice. Our old traditional engineering education approach always yielded several changes and improvements per year. Our new outcome-related approach is helping us locate parts of our program faster and reduce our improvement cycle time, as well as provide a more sound basis for verifying that the changes are indeed improvements. A number of program and course-related improvements have been implemented (or are in the process of implementation). The lists below highlight the most significant programmatic improvements made in the past three years.

Uses of Assessment Results

We collect information at more detailed levels than that reflected in the overall survey and FE exam statistics above. We use open-ended questions on surveys and use the student advisory councils as sources for detailed information. Instructor evaluations of course outcome attainment and suggested improvements regarding the same are collected. This information helps us to locate specific issues and ideas. This information is fed back into the faculty at faculty meetings or at the two work sessions (one full day in the fall and one-half day in the spring) and to the IAB during their semi-annual on-site visits. Improvements are put in place for the next term or after proper approval from the University is obtained. For example, major course/curricular changes require several levels of approval and require at least one year to implement, whereas smaller improvements in a course or the curriculum can be implemented before the next term begins.

We continue to introduce significant changes in the program, courses, and physical resources. Program and course foci have been expanded and sharpened in all areas. A major program redesign project, in collaboration with the Industrial Advisory Board, is in midstream. This redesign is in response to shifts in professional practice as well as internal program assessment.

In general improvements fall in three categories: (1) process, (2) program, and (3) courses. The lists below are a summary of major changes undertaken in IE&M as a result of program and course assessments over the past three years:

Process-related improvements:

- The explicit naming and involvement of constituencies –
  - the reestablishment of the IAB.
  - the formation of the Student Advisory Councils.
- Development of vision, mission, core values, objectives, and outcome statements.
- The Alumni Survey and its alignment with the program objectives statements.
- The Exit Survey and its alignment with the program objectives and outcomes.
- Better student-faculty communications.

Program-related improvements:

- The redesign of the undergraduate curriculum (under way).
- The redesign of the student advisory system.
- The development of course portfolios, course outcomes, and formal instructor evaluations and the sharing of the information therein.
- Major upgrades of student laboratories (under way, and described in the Facilities Section).
- Upgraded presentation support with dedicated color printers for IE&M students.
- Restructuring of the course offerings prior to entry into senior projects (IEM 4913).
- Strengthen project management skills across the curriculum (need identified Fall 2002 and Spring 2003, improvement in progress).
- More student-friendly IE&M Web site.

Course-related improvements:

- Outcome-based course structures and performance surveys (and the improvement of our capabilities in writing course outcomes and assessing the same, related to program outcomes).
- Course topic mappings to program outcomes and objectives.
- Restructuring and coordination of IEM 4913.
- Coordination and action to make STAT 4033 more effective for IE&M students.
- Addition of a research methods course for undergraduates (IEM 4010).
- Numerous course-level improvements.
- Better coordination of Web-based educational materials.

One brief example of a significant change completed this year deals with our capstone design experience. Once we formed our IAB, one of their tasks was to review several of our IEM 4913 senior projects (our capstone design experience). Their findings were that the reports were sound, but could be strengthened with more direct executive summaries and in expanding the students perspectives of the overall impact that the project would likely make in the client's operations. In addition to these detailed comments, the IAB explained that project management was critical to their operations, and that new IEs would likely be working along project lines from day one.

Information collected from the exit surveys (open-ended questions) over the course of one or two semesters indicated that the graduates struggled with time/project management of their capstone projects. For example, they indicated that a time crunch was occurring towards the end of the semester and that their work was not as good as it could be if this time crunch could be avoided. Faculty mentors (one for each project team) also weighted in on the issue. Their contention was that students had difficulty managing their projects and lost time picking up the skills in mid-course.

This information was put on the table in our fall 2002 work session. The result was a redesign for IEM 4913. The new design called for a program manager (one faculty position) and one technical mentor (faculty member) for each project team (of three students). In addition, the IEM 4913 stated outcomes were realigned to address all issues described above. The spring 2003 section worked under this new model, with a mid-term assessment and adjustments. The result was a more level load, more project skills gained earlier, and excellent reception by clients. Results collected from IEM 4913 our capstone design experience (spring 2003) indicate that our students are accomplishing our stated course/program outcomes. Composite ratings (provided by our faculty) on a scale of 0 to 5 (0 – did not satisfy requirements; 5 – satisfied all requirements) run in the 3 to 5 range across the categories of evaluation. Current targets are set at 2.5.

In summary, this improvement was the result of using a number of assessment tools and resources to redesign our most significant undergraduate course. The course will continue to evolve and improve through continuous improvement.

Resources are traditionally tight, however, we have made significant upgrades to our facilities in response to information we gained from our constituents. We have upgraded our office area to accommodate student needs in specialized software and hardware access for project work and communications work. We have converted our primary classroom to a multimedia presentation room. Plans are in the implementation stage to add full-scale CAD/CAM equipment to our manufacturing laboratory, as well as upgrade equipment in our work analysis and ergonomics laboratory. Hence, we are (and will be) better able to provide more hands-on opportunities to our students. Primary characteristics of our graduates are hands-on attitudes and abilities.

Note: The tools and techniques that we are using in our assessment processes were gained in collaboration with the Office of University Assessment. Their work in Alumni surveys (and other surveys) has been helpful in gaining perspectives that are beyond our departmental resource base. Much of the data reported in the first section was gained with their support.