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Executive Summary

This report summarizes the activities related to the Mechanical Engineering Department’s ABET continuous assessment and improvement process for the Academic Year 2005-2006. The highlights of this year’s activities are as follows:

- The department’s BSME Program Objectives and Expected Outcomes were revised during 2004-2005 AY in order to comply with the recent changes in ABET Criterion 2.

- BSME Town Hall meetings were held in both Fall 2005 and Winter 2006 to inform students about changes in the department’s policies, curriculum, and class scheduling, as well as research opportunities for undergraduates. Students were asked to give their feedback, concerns, and suggestions for improvements.

- Prof. Jerry Ku, Director of Undergraduate Studies, led the efforts for preparing the Self-Study Report for the upcoming ABET visit during the Fall Semester 2006, supervising the collection of class material for various courses and getting them arranged in binders for the inspection of ABET visitors.

- New Program Outcomes assessment procedures and questionnaires were developed and implemented in the two senior capstone design courses, ME 4300 and ME 4500 during 2004-2005. The most important result of these changes is that we can now document the evaluations of our Program Outcomes by not only faculty and students, but by practicing engineers from industry. These processes were continued for 2005-2006.

- Program outcomes were also assessed in ME 2210, the introductory thermal course, for the first time starting in Fall Term 2005. This data will be compared with the assessment in capstone design courses to see if there is a longitudinal shift.

- About $72,000 were spent during AY 2005-2006 to upgrade the learning experience in the design courses (by purchasing a 3D rapid prototype printer, $35,000 approx.), to upgrade the equipment for Vibration experiments in the laboratory (about $27,000), to upgrade the software for the Instron Machine, used for testing and validation of designs for prototypes developed for capstone design course ME 4500 ($10,000 approx.)

- The College of Engineering initiated a new on-line alumni survey to assess the extent to which each department’s Program Objectives have been achieved by graduates during the first few years after graduation.

Introduction

In accordance with our department’s recently revised twelve month assessment cycle, the Annual Report to Constituents is written by the department chair during the summer in order to summarize activities related to the department’s continuous assessment and improvement
process for the previous academic year. Such a process is required for accreditation of our BSME program by the Accreditation Board for Engineering and Technology (ABET)

This was also another year of transition for the department following the retirement of its long-time chair, Prof. Ken Kline, in August 2004. Prof. Ron Gibson began serving as Interim Chair in August 2004. He had agreed to be Interim Chair for one year and stepped down in August 2005. Prof. Trilochan Singh was selected as Interim Chair starting August 2005, and Prof. Jerry Ku continued to serve as Director of Undergraduate Studies.

The current program objectives and outcomes (revised during AY 2004-2005 ) are shown in Appendix A.

This report is organized in such a way as to lead the reader naturally through the major ABET-related events of the past year. In the following sections, detailed summaries of the major events in the assessment cycle will be given.

**September 2005 Faculty/IAC Retreat**

The main focus of the Faculty/Industrial Advisor Committee (IAC) retreat on September 30, 2005 (held at Southfield Marriot) was to review the ABET preparation for the ABET visit during the Fall Term 2006. The entire morning session was devoted to it. Prof. Jerry Ku led the discussions. The format of the class syllabus, to be given to the classes on the first day, was approved after lengthy discussion. In addition to the course contents, and grading policy, the syllabi would also include learning objectives for the course, method of assessment for learning objectives and their relationship to program outcomes. This information was included in the syllabi handed out during AY 2001-2005 but the format was not uniform.

Most of the afternoon was devoted to sharing of research work by the faculty. Each faculty member spent about 5 minutes presenting their current research projects.

Most people liked this novel idea and it is good for people to introduce their own areas and this brainstorming may help find the common interests and build some multi-disciplinary research projects, such as energy, acoustics/NVH, MEMS/NEMS/LED, etc.

One of the action items for research was tracking of faculty’s paperwork as it goes through the various offices of the University. A monthly report system, summarizing the status of paperwork and to be sent to the faculty by the front desk, was implemented. This should continue.

Department Seminar: It was agreed that a budget should be provided to bring 2-3 speakers per semester at a cost of about $700-800 per person.

The next Biennial industry day should be held in May 2007. We will have student posters, faculty presentations and lab tours for the visitors from the industry.

The Undergraduate research program should be promoted and undergrad students be encouraged to work with various faculty members.
The Annual Newsletter was sent out at the end of Winter Term 2005. This should continue.

**Fall Semester 2005 BSME Town Hall Meeting:**

The meeting started at about 11:15am on November 17, 2005. Prof. Singh presented some relevant facts relating to research, project activities, student activities etc for the Mechanical Engineering Department. The presentation included various research topics/areas in which ME faculty is actively involved. ME undergraduate students are encourage to participate in various research projects in progress.

Prof. Howard Shapiro, Professor of Mechanical Engineering, Assistant Provost and Vice President for student affairs, discussed the issue of General Education at the University Level and its relevance to the student education, importance of ABET process, outcome based, how it is improving the program etc.

Prof. Ku made a presentation about ABET preparation and how students can help.

A number of concerns/issues were raised by the students;

- Lack of Fluids elective courses at the 5000 level
- Design Methodology in ME 4250
- Use of Technology in Classroom teaching
- Mandatory Laptops for incoming freshmen
- Informal interaction between the students and industry

The details of response are included in the minutes in Appendix B.

**Winter 2006 BSME TOWN HALL MEETING/ Informal Pizza Lunch:**

The BSME town hall meeting started at 11:30 am in the Hall of Fame with Pizza Lunch on Thursday, February 16, 2006

The following issues were raised by students:

* The BSME program does not have enough Tech Electives (only two at present) to have in depth study in one of the ME concentration (such as Solid Mechanics, Acoustic / Vibrations, Thermal-Fluid etc.)

* There is not enough hands-on experience in the Lab. In some labs, students observe the experiment and the TA runs the experiment.

* Co-Op experience is very valuable in linking the classroom material to the hands on real world problems. The Co-op experience or any engineering related work experience helps students to get good starting engineering jobs compared to those with no engineering work experience.

The detailed responses are shown Appendix B.
December 2005 Faculty/IAC meeting:

On December 13, 2005, a Faculty/IAC meeting was co-located with the ME 4300 Thermal System Design Presentations. The agenda included a progress report for ABET Visit preparation, and preliminary discussions on the National Academy of Engineer’s Report entitled: “Educating the Engineer of 2020: Adapting Engineering Education to the New Century, 2005”. The discussion was led by Prof. Ron Gibson. Comments were sought from the Faculty/IAC members as to what actions Department should take for implementing the various recommendations. Only a few recommendations were discussed within the available time. These discussions were continued at the next ME Faculty on February 13, 2006. The recommendations of the faculty/IAC members are shown in Appendix G.

Herb Dobbs, a member of IAC, presented a matrix, showing his vision of changes in machines, manufacturing processes, computer speeds and memories, skills needed by the engineers in the coming decades. There is going to be a continuous increase in the degree of automation, increases in the speed of the computers, decreases in the number of engineering positions, and a significant number of future engineers would be required to tell the machines what to do. This will require more discussions at the future meetings.

Prof. Ku summarized the progress in preparing for the ABET Visit Fall 2006.

The students of ME 4300, Thermal Fluid System Design, presented their final design projects. Each group consisted of 4 students.

Fall Semester 2005 Program Outcomes Assessment:

In Fall 2005, we used new Program Outcomes (Appendix A). The results from these questionnaires are summarized in Appendix C. The program outcome questionnaires were filled out by the students in ME 2210 (in stead of students in ME 4250 as done in previous years), and the students in the senior design course ME 4300 in accordance with the revised assessment cycle (approved during 2004-2005 AY). The program outcome questionnaires were also filled by faculty and practicing engineers present during the student presentations of their design projects in ME 4300.

The results in Appendix C are all acceptable. The senior ME students, IAC members/practicing engineers, and faculty believe that all program outcomes have been achieved. The student scores for the laboratory related outcomes have improved as compared to the Fall Term 2004 results. As already mentioned, new lab equipment worth about $175,000, has been ordered during the last 2 –3 years. Some of the new experiments are operational.

The scores for the various outcomes are less than 4.0/5.0 in ME 2210. These outcomes are evaluated by sophomores/juniors, who are in the beginning stages of taking engineering courses.
Fall Semester 2005 and Winter 2006 Semester Program Exit Interviews:

The results of the Fall 2005 and Winter 2006 exit interviews with graduating seniors are shown in Appendix D. The responses range from 4.0/5.0 to 4.8/5.0, and are quite good, except for question 4 regarding the helpfulness of the undergraduate advisor. A new ME undergraduate advisor, Keith Wadley, was hired in October 2005 and we have received positive feedback from the students dealing with him.

Faculty Course Group Meetings for Academic Year 2005-2006:

One of the most important parts of our assessment cycle is the annual faculty course group meetings during the Winter Semester. In these meetings, faculty review the Instructor’s Assessments for each course in their group and discuss possible improvements in the courses, if needed. In addition, textbook selection, course prerequisite and co-requisite requirements, equipment and software and all other course-related topics are discussed. Each group then submits a report on the outcome of their meeting to the Director of Undergraduate Studies. A brief summary of the major recommendations from the faculty course groups in Winter Semester 2006 follows.

DESIGN GROUP A.B.E.T. Report Winter 2006:

The first item of the agenda is the review of the Instructors’ Assessments reports. All participants to the meeting agree that all learning objectives of the design group courses have been met satisfactorily. The grades obtained by the students were fair and the grade distribution seems quite normal, with one exception in ME 3480 “Design of Machine Elements” (Instructor absent in the meeting). It is hard to believe that in a class of 21 students, 20 deserved A-s and one a B for a 3000 level course. Dr. Trilochan Singh, the interim Department Chair will discuss this matter with the instructor.

The next topic was related to the discrepancy between the number of student enrollment in the winter and Fall Semester. It was noticed that more students tend to enroll in Fall than in Winter (ME 4250, ME 4300 and ME 4500). This situation leads to more student teams to be supervised and guided in the Fall Semester, reducing the available time the instructor and TA could spend with each team. Also, for ME 4500, a heavy load in the machine shop makes it difficult for the shop to cover all the work. It was proposed that the number of students that could enroll in ME 4250, ME 4300 and ME 4500 to be limited to 20 students per semester.

The scheduling of ME 4300 and ME 4500 at the same time, to avoid the simultaneous enrolment in both design classes was further analyzed. The specifics of WSU with its working and commuting students makes it impossible to preserve the student teams for two semesters in a row and introduce a two semester capstone design project. On the other side, the completion of two design project simultaneously as part of two different teams is not possible without creating unequal contributions of the students in the teams a sacrifice in the quality of the work of some students. A proposition to make ME 4300 a prerequisite of ME 4500 should be further analyzed.
Solid Course Group A.B.E.T. Report Winter 2006:

The meeting discussed the teaching matters for ME 2400 and ME 5040, and reviewed the course syllabi and ABET instructor's assessment reports. Below are the main points of the discussion.

**ME2400** was taught by Drs. Gibson (Winter '06), Khalil (Summer '05), and Newaz (Fall '05).

For ME undergraduate students this is the first course in ME major, and it is an integrated course of statics, mechanics of materials and design. This is a difficult course requiring more of students' time and effort. The design part of the course is good to bring real problems into class in the early stage of ME UG program, (which otherwise would have to wait till later stage of senior year to deal with real-world problems). Through this course many students developed their interest in mechanical engineering, but on the other hand a large portion of students failed the course. It has been consistent over last several years that the failing rate is about 1/3 (with a grade below C-). The instructors have made great efforts to improve the teaching, including the posting of lecture notes on web pages, using quizzes and repeated quizzes to enhance homework exercises, opening TA sections, providing extra homework problems for extra credits, using design problems to develop students' motivation etc. It was observed that the attendance for both instructor's lecture and TA sections were low, and rarely did the students come to office hour sessions for questions/discussions, and sometimes the majority of students did not work on the extra-credit design problems (2/3 students did for Win '05 but only 1/3 students did for Fall '05). So it is clear that the high failing rate is associated with (1) the weak background/preparation; (2) lack of motivation. The fact is that this course becomes a filter for students to consider whether they are willing and able to continue in mechanical engineering education. We will continually make our effort to improve the teaching.

**ME 5040** teaching was reported by Dr. Schmueser. He explained the two required ABET documents and teaching matters. This course is designed for fundamentals of FEA, with a certain amount of software exercise and programming of Hypermesh and Nastran. We usually have a few UG students taking this course, and we would like to see this course to be a top ME elective course. The grading policy remained the same. The instructor currently uses the 4th edition of “Concepts and Applications of Finite Element Analysis” (by Cook et al.) and some selected parts of the secondary textbook. Next Fall, we will return to using the 3rd edition of the textbook. The computer lab time needs to increase, but the lack of computer resources is continuously a weakness, especially by the end of semester. If the college can solve the license problem for student laptop use, it will provide more chances for students to do exercises. Staff support on upgrading software is good. Due to time constraints, the fluid and thermal parts are not included.

Thermal Group A.B.E.T. Report Winter 2006:

The Learning objectives for ME 2210, 3300, 4300, and 4210 were reviewed. The course learning objectives were found to be satisfactory to meet the desired outcomes of the ME undergraduate program.
The student assessment results for ME 2210, 3300, 4210, and 4300 were also reviewed and were found to be satisfactory. The copies of instructor’s assessments for individual courses are attached.

The concerns and suggestions for improvement from last year (2005) were reviewed. One of the concerns in 2005 was the different textbook and grading disparity due to the course being taught by more than one instructor; e.g., Fluid Mechanics ME 3300, was taught by different instructors: Prof. Joon Lee and Prof. Victor Berdichevsky. The adaptation of a common textbook was achieved this year. Winter 2005, for example, has many students failing the class; however, it was also noted that the students who repeated the course may have resulted in the better class grades for the Fall 05 semester. The PRE (pre-requisite) test also forces the student to review the Mathematics and Thermodynamics needed to be successful in Fluid Mechanics.

A new part-time faculty, Laura Genik joined us in teaching ME 2210 and ME 4210 this year. The issues of using simulated experimental data included in the textbook CD as compared to real experimental measurements in the Laboratory were also discussed. Students’ comments will also be solicited on the ASME faculty-student pizza luncheon meeting. It appears that the hands-on experience is needed, although more simulated experimental data also help with understanding the physics. In ME 4210 seven simulated experimental data analyses were carried out. We have made plans to incorporate the Flowlab software (by Fluent Inc.) as virtual experiments for ME 3300 fluid mechanics and ME 4210 heat transfer.

The adequacy of only 4 courses of Thermal-Fluid courses including one dedicated on thermal-fluid design was discussed. It is preferable to have a continuous two-semester senior Thermal-Fluid Design as an option within the Senior Capstone Mechanical Design. The constraint of part-time student population, faculty teaching load and ABET criteria was discussed, but not reaching a conclusion.

This past year, the Mechanical Engineering Department has made the upgrade of thermal-fluid related labs its highest budget priority. We have upgraded almost all the sensors, data acquisition boards and software (LabView), and dedicated computers at a cost of $106,334. The details are shown in the appendix. We have purchased a new turn-key type air-conditioning experimental rig for thermodynamics (ME 2210). We have also purchased a particle image velocimetry (PIV) system, which arrived last summer. But the implementation of the PIV in ME 3300 experiments suffered from equipment problems, as both the laser and the driver were shipped back to the vendor for repair, and we should receive the complete checked-out equipment in March this year. The design of the PIV for Internal Pipe Flow and Jet flow is on track. The facility people will finish the water and air connection for the test station at the end of February.


Our meetings discussed the teaching matters for ME 3400, ME 4410, ME 5410, ME 5440 and ME 5540, and reviewed the course syllabi and ABET instructor's assessment reports. The major points of our discussions are as follows.
ME3400 – Dynamics, was taught by Dr. Raouf Ibrahim (Fall '05).

This course is the first undergraduate ME course in Dynamics, and is therefore quite important as an introduction to fundamental concepts of the motion of practical bodies. The course requires the foundations of statics and mechanics of materials, which are taught in the precursor course ME 2400. The students performed at the level of about 70% pass over all the examinations, although this had been weighed down by the low grades (45% to 60%) in the first-treated topics of planar particle kinematics and planar particle kinetics. A substitution of gyrodynamic for introductory vibrations had been made because the same vibration material is again covered in ME 4410, and the results show that this change was well received and the material well assimilated. Fall 2005 semester was the first time the instructor used the tablet computer and production of the lecture presentation as pdf file for immediate end-of-class distribution. It is proposed to continue this practice and also start placing the course materials on blackboards so that absentee students can also have access. It is also proposed to introduce the computer project at an earlier stage of the course, and allocate 15 minutes per week to discuss computer projects.

ME 4410 – Vibration: Theory and Laboratory, was taught by Dr. Raouf Ibrahim (Fall '05).

This is the first dedicated course on vibration in the ME sequence. The instructor specializes in this area and has taught vibration courses for a long time. Usually, at the time of starting this course the concepts involved are still new to the students, hence the course must foster fundamental understanding and progress the students to applications. The students’ examination performance across the six theory-type course objectives averaged over 77%, and for five out of those six ranged between 70% and 97%. Two objectives focused on laboratory skills, and a low grade of about 46% was registered in the first objective treated – characterization of undamped single-degree-of-freedom systems. Again, Fall 2005 semester was the first time the instructor used the tablet computer and PowerPoint for the lecture presentation. It is proposed to continue this practice and also start placing the course materials on the University’s Blackboard facility so that absentee students can also have access. It is also proposed to assign and collect the design project earlier in the course to alleviate the heavy load of the last week of the course, according to student input. It is also proposed to reflect the eight revised Learning Objectives in the students’ survey questionnaire from next semester onwards.

ME 5410 – Vibration II, was taught by Dr. Chin-An Tan (Fall ’04,'05).

This is a more advanced course which takes the students into substantial work in modeling of practical vibratory systems. The modeling sets up the system for solution. The course also covers various solution methods. It had become established over the years that the area of modeling, which requires a good sense of physical understanding of the problem, has been a tough area for students. A major reason has been the wide diversity of academic background and preparation, with most of them weak. Accordingly, the instructor has been spending time reviewing basics and presenting both laboratory and other instructional materials to help overcome this deficiency. Across the course objectives, students’ homework and quiz performances were average at about 62% - 68%, mean examination performance ranged above average at about 63%-77%, while laboratory performance was good at about 81% average. It is proposed to increase the time
allocated to vibration problem modeling and solution expertise. It is also proposed to put more weighting grade on computer methods in vibrations, especially MATLAB, with the aim of forcing the students to put more effort in this area. The newly introduced Ginsberg textbook (Mechanical and Structural Vibrations: Theory and Applications) will continue to be used because it supplies many more modeling techniques than other common textbooks. Suggestion was made to the department to upgrade vibration equipment, computing and software, and this has been done. Much better outcomes are therefore envisaged.

**ME 5440** – Industrial Noise Control, was taught by Dr. Sean Wu (Winter, Fall ’05).

This course is an elective in ME, designed to impart to the students both the principles and practice of Industrial Noise Control. The objectives are met by coursework and intensive laboratory exercises. The instructor noticed significant improvement in the large majority of students from the beginning to the end of the course, and noted student enthusiasm, manifested in such ways as their voluntary repeat of experiments, etc. Besides the low (54%) average performance in one experiment (which was skewed by the zero scores earned by a handful of defaulting students), average score in the other five laboratory exercises ranged between 65% and 82%. It is proposed to acquire an updated National Instrument data acquisition hardware to work with the upgraded StarAcoustics software that the department bought. The department has indicated its willingness and readiness to buy this too. We therefore expect the envisaged improvement to be realized quite soon. It is also proposed to split the examination into two exercises evenly spaced across the term and the six experiments to improve monitoring and feedback. In order to make the design project even more meaningful and realistic, design modification at the source, rather than only of the acoustic transmission path is necessary. Such an approach normally requires funding to effect the target source design changes involved, and it is proposed to acquire this funding for the enrichment of the course.

**ME 5540** Dynamic Modeling and Control of Engineering Systems, was taught by Dr. Nabil Chalhoub (Fall ’05)

This is a required ME course that focuses on the development of mathematical models for linear, time-invariant dynamical systems, with skills acquisition in the areas of transient behavior, stability and compensation design for such systems. Extensive use of MATLAB and its Simulink extension is an integral part of this course. On account of the widespread unfamiliarity of students with this computational software prior to this course, a two-week grounding in MATLAB basics is built into the course. Almost a dozen homework assignments demand use of the software to solve problems on practically all the salient aspects of the course. Average student performance in the mid-term examinations was about 80 %, and in the comprehensive final examination 70%. In order to improve learning and performance in this course, it is proposed to make comprehensive handouts or a complete course-pack and allocate more teaching time to the design of controllers and their real-life applications.
April 2006 Faculty/IAC/SAC Meeting:

On April 18, 2005 a Faculty/IAC (Industrial Advisory Committee)/SAC (Student Advisory Committee) meeting was co-located with the ME 4500 Machine Design II (capstone design) Presentations. The agenda was concerned with the progress report for the ABET Visit Fall 2006 preparation, and soliciting the input of the IAC and SAC.

The meeting started with a presentation of the Department preparations for ABET visit by Prof. Ku. He discussed the two loop EC (Engineering Criteria) 2000 process. Improvements in the curricula in recent years were discussed. He expressed some concerns about the following:

- the extent to which students are learning computer skills in BE 1200 (Int. to Design) and BE 2550 (Numerical Methods)
- BE 2100- Statistics and Probability- How well it is serving the ME students
- Number of Labs associated with ME 2210, 3300, 4210, and 4410 (Thermodynamic, Fluid Mechanics, Heat Transfer, Vibrations): Each of these courses have two to three labs associated with them

Some faculty felt that the number of labs associated with these courses is on the low side compared to University of Michigan, Ann Arbor and Michigan State Lansing.

The members of student advisory committee commented as follows:

- ECE 3310, Circuits, has 6 labs and they do not remember much about what they learned.
- With two labs, they remember what they learned in these labs, as it was done in depth.
- Number of experiments need not be many. Each lab should add some value to the learning process and be done in depth.
- Hands on labs are more helpful than simulated experiments.

CAPSTONE DESIGN COURSE:

Prof. Ku initiated the discussions about the desirability of having a year long capstone design course as compared to the one semester course.

One IAC member was opposed to the idea of a single year long capstone design course. He mentioned that Wayne State is primarily a commuter school and caters to the needs of students who are working people and some have family responsibilities also. It would have been very difficult for him to complete his BSME requirements with a two semester capstone design course. A good job can be done in a one semester capstone design course, if managed properly.

Some students suggested that the Department should look into the possibility of offering a two semester capstone design course.

Action item: the ME Undergraduate Committee should make a recommendation for offering a two semester capstone design course by requiring students to take ME 4250 and ME 4500
sequentially in two consecutive semesters. The instructor who starts ME 4250 would also be the instructor for ME 4500 in the next semester.

Some students suggested that Capstone design projects should be tied to some industry sponsored projects.

Action item: the College of Engineering has hired Dr. Tom Khalil as Director of Student Development and Industry Outreach. One of his responsibilities is to solicit design projects from the local industries.

**Technical Communication Skills:**

There was a discussion about the importance of developing good communication skills. IAC member Bob Banasik suggested that we should look into the possibility of hiring an English Major with a specialty in Technical Communication. He/she should help in reviewing the design project/lab reports.

Some other members remarked that persons belonging to different specialties in science and engineering such as Chemists, Physicists, Physicians/Medical Professionals, and Engineers have different styles of writing their technical reports. So it is not easy to find a person who makes his/her living by editing engineering technical reports.

There was a break of 30 minutes, which gave time to the Faculty/IAC members to review the hardware of various ME 4500 design projects on display in the lobby outside the meeting room. This was followed by presentations by the students of their final projects in ME 4500.

The feedback of the audience was very positive and they were impressed by the caliber of the projects and their communication skills. This is supported by the results of ME 4500 outcomes (Appendix C) evaluated by faculty, students and practicing engineers.

**Dean Kummler’s Remarks:**

Dr. Ralph Kummler, Dean of the College of Engineering came to the meeting and welcomed the IAC members. He had just come back from a 10 day trip to China a day earlier. The College of Engineering is trying to develop exchange programs with various schools in China. One of the programs is a joint Master Degree Program, in which students start their Master Degree Program in a Chinese School, complete 12 credits of graduate course work, then transfer to WSU for the completion of remaining 20 credits.

Dean Kummler remarked that due to outsourcing and development of Information technologies, the skills required by engineers are being affected by the global developments. Maybe the mission of college will include being a global supplier of students with time. New initiatives are needed in the ME Department and the College to enhance its role in the global market. Some new areas are Prosthetic developments and ME could contribute to the controls aspects of the system, mechanical properties of the materials being used, growing limbs/bones, wireless transmission of smart sensor signals to the brain etc. We need to think at the system level rather than just putting some parts together.
One of the top schools in China already has an exchange program in place with a German School. 30 Chinese students go to Germany and 30 German students go to China every year. All the courses are conducted in English in this program.

WSU students can have opportunities to study in China. There are a limited number of engineering schools in China where the medium of instruction is English. Those schools would provide a good opportunity for WSU students to study in China.

At the conclusion of the meeting, participants were asked to fill out questionnaires to help us assess the outcomes of the meeting, and the results are shown in Appendix E. The overall results were encouraging. With regard to ABET, perhaps the key statement on this questionnaire is “The ME Department’s BSME program has improved this year as a result of its ABET assessment cycle”. The Industrial Advisory Committee members gave the most affirmative response to this statement (4.75/5.0), followed by faculty members (3.75/5.0) and Student Advisory Committee members (3.66/5.0).

**Winter Semester 2006 Program Outcomes Assessment:**

In Winter Semester 2006, we used new Program Outcomes (Appendix A). The results from these questionnaires are summarized in Appendix F. The program outcome questionnaires were filled out by the students in ME 2210 (instead of students in ME 4250 as done in previous years), and the students in the senior design courses ME 4500 in accordance with the revised assessment cycle (approved during 2004-2005 AY). The program outcome questionnaires were also filled out by faculty and design engineers present during the student presentations of their design projects in ME 4500. This will help us assess the longitudinal movement in the program outcomes throughout as ME 2210 is taken early in the program and ME 4300 and 4500 are taken near the end of the program.

The results for ME 2210 and ME 4500 are shown in Appendix F. It is encouraging that both the direct evaluation (i.e., practicing engineers) and the indirect evaluations (i.e., students and faculty) show strong support for the conclusion that our BSME Program Outcomes were achieved during this semester.

**Alumni Evaluation of Achievement Level for Program Educational Objectives:**

A key measure of the achievement of the Program Educational Objectives is the response to our alumni survey, and the results are summarized in the following table. There were 21 responses to the survey from the graduates (2000 to 2005).
Table: Results of Alumni Survey on BSME Program Educational Objectives

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Agree</th>
<th>Strongly Agree</th>
<th>Response Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) successfully pursue entry level engineering positions or additional degrees;</td>
<td>0% (0)</td>
<td>5% (1)</td>
<td>38% (8)</td>
<td>57% (12)</td>
</tr>
<tr>
<td>2) apply broad, fundamentals-based knowledge and up-to-date skills to perform professional work in mechanical engineering and related disciplines;</td>
<td>0% (0)</td>
<td>0% (0)</td>
<td>52% (11)</td>
<td>48% (10)</td>
</tr>
<tr>
<td>3) apply comprehensive design methodology pertaining to mechanical engineering, incorporating the use of design standards, realistic constraints, and consideration of the economic, environmental, and social impact of the design;</td>
<td>0% (0)</td>
<td>5% (1)</td>
<td>62% (13)</td>
<td>33% (7)</td>
</tr>
<tr>
<td>4) engage in professional service such as participation in professional societies, and to always consider professional ethics;</td>
<td>0% (0)</td>
<td>0% (0)</td>
<td>76% (16)</td>
<td>24% (5)</td>
</tr>
<tr>
<td>5) be committed to life-long learning activities through self-reliance, creativity and leadership.</td>
<td>0% (0)</td>
<td>5% (1)</td>
<td>67% (14)</td>
<td>29% (6)</td>
</tr>
</tbody>
</table>

Total Respondents: 21

The average score for each objective is more than 3.2/4.0 (80%). This supports the conclusion that program objectives are being met.

**Laboratory Equipment Upgrades:**

During the AY 2005-2006, the ME Department continued to upgrade its undergraduate laboratory equipment. About $72,000 were spent during AY 2005-2006 to upgrade the learning experience in the design courses (by purchasing a 3-D rapid prototyping printer, $35,000 approx.), to upgrade the equipment for Vibration experiments in the laboratory (about $27,000), to upgrade software for the Instron Machine, which is used for testing and validation of designs for prototypes developed for the capstone design course ME 4500 ($10,000 approx.). Most of this equipment will be operational by Fall 2006.

During the AY 2004-2005, the ME Department purchased new thermal/fluid lab equipment valued at over $100,000, in response to concerns expressed by both faculty and students that our existing lab equipment in this area was outdated and/or in need of repair. The new equipment consists of a particle imaging velocity (PIV) system for ME 3300 and ME 4210 labs, a new air conditioning apparatus for ME 2210 lab, new computers and data acquisition system, new temperature and velocity sensors. The air conditioner experiment was functional during the Fall Term 2005. PIV experiment is ready for use for the Fall Term 2006.
**Strategic Plan:**

The final document for the Strategic Plan is shown in Appendix H. The document lists Missions and Strategies in Education and Research, along with the relevant strengths, weaknesses, opportunities and threats, the responsible groups or persons, and the timelines for implementation. This document was discussed during 2004-2005 AY and approved on February 18, 2005 by ME faculty.

Of particular significance to the undergraduate program are the top four strategies that we chose to list in the revised Strategic Plan under Education, which are: 1. Implement continuous assessment and improvement cycle to maintain highest ABET accreditation status and academic standards, 2. Invest in upgrades of laboratory equipment, 3. Develop and implement Honors and other challenging programs for outstanding students, and 4. Increase interaction with industry for collaboration and sponsorship of design projects.” These strategies show clearly that the ME Department places a high priority on its undergraduate education program.

The Department is making every effort to follow the strategic plan. The actions include assessment of every required undergraduate course by the students, the course instructor and course group. The recommendations arrived at through this process are being implemented in various courses (continuous assessment and improvements). The Department has invested close to $175,000 in the last three years to upgrade the lab equipment and data acquisition systems. The Honors program for the undergraduate students in Engineering has been approved effective Fall Term 2005 . The college has hired Dr. Tom Khalil, a retired GM Engineer, as Director of Student Development and Industry Outreach. One of his job functions is to establish liaisons with industry for industrial problems, which may be used as design projects for capstone design courses.

The comments, suggestions and other inputs of the students, alumni, employers and other constituents, for improvements/modifications in the BSME Degree Program, are appreciated.

**Appendix A. Revised Program Objectives and Outcomes**

Program Educational Objectives (revised Jan. 28, 2005 – effective Fall 2005)*
The objectives of the undergraduate program in Mechanical Engineering at Wayne State University are to provide the education and training that will enable its graduates to:

1. successfully pursue entry level engineering positions or additional degrees;
2. apply broad, fundamentals-based knowledge and up-to-date skills to perform professional work in mechanical engineering and related disciplines;
3. apply comprehensive design methodology pertaining to mechanical engineering, incorporating the use of design standards, realistic constraints, and consideration of the economic, environmental, and social impact of the design;
4. engage in professional service such as participation in professional societies, and to always consider professional ethics;
5. be committed to life-long learning activities through self-reliance, creativity and leadership.

Expected Program Educational Outcomes (revised May 2, 2005 – effective Fall 2005)*
It is expected that by the time of graduation, our BSME students will:

A. be able to understand scientific principles and apply them to the practice of engineering;
B. be able to communicate effectively;
C. possess the problem-solving skills, background, and confidence necessary to educate themselves continually throughout their careers;
D. be able to apply computers as tools for engineering;
E. be able to apply the basic principles of measurement, data analysis, and design of experiments, learned through “hands-on” laboratory experience;
F. be able to practice engineering with ethical standards and a responsibility to society;
G. be able to develop creative solutions to engineering problems;
H. be able to work well as part of a team;
I. be able to apply the design process to engineering problems, including the consideration of different technical alternatives while bearing in mind cost, environmental concerns, safety, and other constraints;
J. be able, based on their first-hand design experience, to analyze, construct, test, and evaluate an engineering design;
K. be able to connect engineering solutions and designs with contemporary issues, and consider engineering solutions and designs in a global and societal context.

Appendix B:

BSME Town Hall Meeting Fall Term 2005 and Winter Term 2006 Minutes:

The meeting started at about 11:15am on November 17, 2005. Prof. Singh presented some relevant facts relating to research, project activities, student activities etc for the Mechanical Engineering Department. The presentation included various research topics/areas in which ME faculty is actively involved. ME undergraduate students are encourage to participate in various research projects in progress.

Prof. Howard Shapiro, Professor of Mechanical Engineering, Assistant Provost and Vice President for student affairs, discussed the issue of General Education at the University Level and its relevance to the student education, importance of ABET process, outcome based, how it is improving the program etc.

Prof. Ku made a presentation about ABET preparation and how students can help.

The following issues were raised by the students:
B1): Lack of fluid courses at 5000 level:

- Dept has not been able to do it because of lack of faculty expertise after Prof. John Yu left. Now Prof. Joon Lee has joined the Dept and hopefully he will be able to offer ME 5300 once in two years.

B2): Design Methodology in ME 4250:

- According to one student, ME 4250 does not cover Design Methodology. It emphasizes the technical aspects of design for components/subassemblies.
- A student of ME 4500 said that those issues are covered in ME 4500

B3): The issue of Technology use in course presentation in the classroom:

- Does it help in the understanding of basic concepts of the subject?
- Technology (computer) should be used as a tool, fundamentals must be emphasized.
- Some students prefer that instructors should write on the blackboard as they make power point presentations in the class. It is hard to follow, when only power point presentation is used to lecture.
- Junior/Senior students in the Design courses said that use of computer and CAD software is a great help for design process.
- So it was a mixed reaction.

B4): Should every incoming freshman be required to buy/lease a lap top starting Fall 06?

- If the software programs needed for courses are loaded on lap top, it will be helpful. If student versions of software cannot be loaded on the laptops due to licensing issues etc., then laptop are not much use.
- A straw vote showed that majority were in favor of it

B5): Students raised the concern that there is very little informal interaction between the faculty and students. Very few faculty participated in Welcome back activities. Faculty/student softball game, baseball game etc. should be arranged.

Singh suggested that he would arrange an informal Pizza lunch for the students and faculty, where students can discuss their concerns with the faculty freely once a semester.

**BSME TOWN HALL MEETING/ Informal Pizza Lunch Winter 2006:**

The BSME town hall meeting started at 11:30 am in the Hall of Fame with Pizza Lunch on Thursday, February 16, 2006.
In addition to students, 8 ME faculty members (T. Singh, R. Gibson, V. Berdichevsky, N. Chalhoub, M.C. Lai, E. Ayorinde, D. Taraza) and Ralph Kummler, Dean College of Engineering participated.

The following issues were raised by students:

**C 1:** The BSME program does not have enough Tech Electives (only two at present) to have in depth study in one of the ME concentration areas (such as Solid Mechanics, Acoustic / Vibrations, Thermal-Fluid etc.)

**Response:** Debate has been going on in the Engineering Community for a long time regarding breadth vs. depth. One school of thought wants more breadth by exposing the students to the fundamentals of all aspects of Mechanical Engineering. For in-depth study, it is recommended that students should pursue the Master Degree program.

The second school of thought requires students to pick up a depth area, say Solid Mechanics or Thermal Fluid. The students in each concentration take different sets of advanced courses after completing a set of basic courses.

A report issued by the National Academy of Engineers entitled “Educating the Engineers of 2020” recommends that BS degree in engineering should be broad based and in depth study should be done at the Master Degree Level.

**C 2): There is not enough hands-on experience in the Lab. In some labs, students observe the experiment and TA runs the experiment.**

**Response:** TAs for all labs would be instructed to demonstrate the experiment and explain the experiment. The actual experiment should be done by the students.

Funds are being sought continuously to improve the existing experiments and buy new ones.

**C3): Co-Op experience is very valuable in linking the classroom material to the hands on real world problems. The Co-op experience or any engineering related work experience helps students to get good starting engineering jobs compared to those with no engineering work experience.**

**Response:** The Co-op office should be approached and find out what they can do to get additional co-op positions or engineering related work positions for our students.
Appendix C.: Results from Fall Semester 2005 Program Outcomes
Assessment for ME 2210:

Based on 21 student responses using the scale 1-5, where 1= strongly disagree, 5= strongly agree, and the average scores are given in parenthesis, the course has improved:

A. the ability to understand scientific principles and apply them to the practice of engineering (3.81/5.0)
B. the ability to communicate effectively (3.52/5.0)
C. the ability for the problem-solving skills, background, and confidence necessary to educate themselves continually throughout their careers (3.95/5.0)
D. the ability to apply computers as tools for engineering (3.38/5.0)
E. the ability to apply the basic principles of measurement, data analysis, and design of experiments, learned through “hands-on” laboratory experience (3.33/5.0)
F. the ability to practice engineering with ethical standards and a responsibility to society (3.62/5.0)
G. the ability to develop creative solutions to engineering problems (3.90/5.0)
H. the ability to work well as part of a team (3.66/5.0)
I. the ability to apply the design process to engineering problems, including the consideration of different technical alternatives while bearing in mind cost, environmental concerns, safety, and other constraints (3.42/5.0)
J. the ability, based on their first-hand design experience, to analyze, construct, test, and evaluate an engineering design (3.09/5.0)
K. the ability to connect engineering solutions and designs with contemporary issues, and consider engineering solutions and designs in a global and societal context (3.76/5.0)

Appendix C (continued): Evaluator Assessments of BSME Program
Outcomes in ME 4300 – Fall 2005

(All scores out of 5.0 points, with 1.0 = Strongly disagree, 5.0 = Strongly agree)
The results are based on 6 student responses, 6 practicing engineers responses, and 4 faculty responses for two different design projects

<table>
<thead>
<tr>
<th>The members of the design teams have demonstrated:</th>
<th>Faculty</th>
<th>Students</th>
<th>Practicing Engineers</th>
<th>Overall</th>
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<tbody>
<tr>
<td>A. the ability to understand scientific principles and apply them to the practice of engineering.</td>
<td>4.25</td>
<td>4.65</td>
<td>4.25</td>
<td>4.29</td>
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<tr>
<td>B. the ability to communicate effectively.</td>
<td>4.12</td>
<td>4.65</td>
<td>4.00</td>
<td>4.26</td>
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<tr>
<td>C. that they possess the problem-solving skills, the background, and the confidence to educate themselves</td>
<td>4.37</td>
<td>4.83</td>
<td>3.75</td>
<td>4.31</td>
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continually throughout their careers.

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<tr>
<td><strong>D.</strong></td>
<td>the ability to apply computers as tools for engineering.</td>
<td>4.46</td>
<td>4.46</td>
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<tr>
<td><strong>E.</strong></td>
<td>the ability to apply the basic principles of measurement, data analysis, and design of experiments, learned through hands-on laboratory experience.</td>
<td>NA*</td>
<td>NA*</td>
</tr>
<tr>
<td><strong>F.</strong></td>
<td>the ability to practice engineering with ethical standards and a responsibility to society.</td>
<td>4.50</td>
<td>4.55</td>
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<tr>
<td><strong>G.</strong></td>
<td>the ability to develop creative solutions to engineering problems.</td>
<td>4.00</td>
<td>4.83</td>
</tr>
<tr>
<td><strong>H.</strong></td>
<td>the ability to work well as a part of a team.</td>
<td>4.62</td>
<td>4.55</td>
</tr>
<tr>
<td><strong>I.</strong></td>
<td>the ability to apply the design process to engineering problems, including the consideration of different technical alternatives, while bearing in mind cost, environmental concerns, safety and other constraints.</td>
<td>4.62</td>
<td>4.83</td>
</tr>
<tr>
<td><strong>J.</strong></td>
<td>the ability to, based on first-hand design experience, to analyze, construct, test and evaluate an engineering design.</td>
<td>NA*</td>
<td>NA*</td>
</tr>
<tr>
<td><strong>K.</strong></td>
<td>the ability to connect engineering solutions and design with contemporary issues, and consider engineering solutions and designs in a global and social context.</td>
<td>4.25</td>
<td>4.65</td>
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</tbody>
</table>

* Course learning objectives for ME 4300 are not linked to these outcomes

**Appendix D:**

**Results from Fall 2005 Exit Interview Questionnaires**

Based on 10 student responses using the scale 1-5, where 1 = strongly disagree, 5 = strongly agree, and the average scores are given in parentheses

1. My BSME program has prepared me to learn the new things that will be necessary to learn for a successful life-long career in engineering *(4.00/5.0)*
2. ME professors provided effective instruction *(4.20/5.0)*
3. ME professors were available to answer my questions *(4.60/5.0)*
4. The ME undergraduate advisor was helpful in answering my questions and providing guidance *(2.70/5.0)*
5. I am confident that I am prepared for engineering practice *(4.40/5.0)*
6. Experience gained working on design projects was a valuable component of my BSME program *(4.60/5.0)*
7. My written, oral and graphic communications skills are adequate for engineering practice *(4.80/5.0)*
8. I am able to work well as a member of a team *(4.80/5.0)*

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Results from Winter 2006 Exit Interview Questionnaires:

Based on 16 student responses using the scale 1-5, where 1 = strongly disagree, 5 = strongly agree, and the average scores are given in parentheses

1. My BSME program has prepared me to learn the new things that will be necessary to learn for a successful life-long career in engineering (4.31/5.0)
2. ME professors provided effective instruction (4.12/5.0)
3. ME professors were available to answer my questions (4.12/5.0)
4. The ME undergraduate advisor was helpful in answering my questions and providing guidance (2.87/5.0)
5. I am confident that I am prepared for engineering practice (4.25/5.0)
6. Experience gained working on design projects was a valuable component of my BSME program (4.18/5.0)
7. My written, oral and graphic communications skills are adequate for engineering practice (4.43/5.0)
8. I am able to work well as a member of a team (4.81/5.0)

Appendix E: Results from Participant Assessment of ME Faculty/IAC/SAC meeting: Winter Term 2006

Based on 4 faculty responses, 4 IAC member responses, and 3 SAC member responses, using the scale 1-5, where 1= strongly disagree, 5= strongly agree, and the average scores are given in parenthesis. The 3 sets of average numbers in parenthesis represent response of faculty, IAC members, and SAC members, respectively.

A. I now have a clear understanding of the ME Department’s ABET cycle (4.75/5.0, 4.0/5.0, 4.66/5.0)

B. The ME Department’s ABET cycle is both achievable and appropriate (4.75/5.0, 3.75/4.0, 4.0/5.0)

C. The ME Department is following the ABET assessment cycle faithfully (4.75/5.0, 4.0/5.0, 4.66/5.0)

D. The ME Department’s BSME program has improved this year as a result of its ABET assessment cycle (4.75/5.0, 3.75/5.0, 3.66/5.0)

E. The ME department does a good job of soliciting input from its constituents (4.50/5.00, 4.75/5.00, 3.66/4.00)
Appendix F. Results from Winter Semester 2006 Program Outcomes Assessment for ME 2210:

Based on 18 student responses using the scale 1-5, where 1= strongly disagree, 5= strongly agree, and the average scores are given in parenthesis. This course has improved:

A. the ability to understand scientific principles and apply them to the practice of engineering (4.44/5.0)

B. the ability to communicate effectively (4.05/5.0)

C. the ability for the problem-solving skills, background, and confidence necessary to educate themselves continually throughout their careers (4.44/5.0)

D. the ability to apply computers as tools for engineering (3.61/5.0)

E. the ability to apply the basic principles of measurement, data analysis, and design of experiments, learned through “hands-on” laboratory experience (4.22/5.0)

F. the ability to practice engineering with ethical standards and a responsibility to society (4.00/5.0)

G. the ability to develop creative solutions to engineering problems (4.27/5.0)

H. the ability to work well as part of a team (4.44/5.0)

I. the ability to apply the design process to engineering problems, including the consideration of different technical alternatives while bearing in mind cost, environmental concerns, safety, and other constraints (4.05/5.0)

J. the ability, based on their first-hand design experience, to analyze, construct, test, and evaluate an engineering design (4.05/5.0)

K. the ability to connect engineering solutions and designs with contemporary issues, and consider engineering solutions and designs in a global and societal context (4.2/5.0)

Evaluator Assessments of BSME Program Outcomes in ME 4500 – Winter 2006
(All scores out of 5.0 points, with 1.0 = Strongly disagree, 5.0 = Strongly agree)
The results are based on 8 student responses for project #1, 9 student responses for project #2 and #3, three practicing engineers responses, and 5 faculty responses for project #1 and 4 faculty responses for project #2 and 3

<table>
<thead>
<tr>
<th>The members of the design teams have demonstrated:</th>
<th>Faculty</th>
<th>Students</th>
<th>Practicing Engineers</th>
<th>Overall</th>
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<tbody>
<tr>
<td>A. the ability to understand scientific principles and apply them to</td>
<td>4.55</td>
<td>4.72</td>
<td>4.55</td>
<td>4.60</td>
</tr>
<tr>
<td>the practice of engineering.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B. the ability to communicate effectively.</td>
<td>4.60</td>
<td>4.62</td>
<td>4.44</td>
<td>4.55</td>
</tr>
<tr>
<td>C. that they possess the problem-solving skills, the background, and</td>
<td>4.05</td>
<td>4.76</td>
<td>4.44</td>
<td>4.41</td>
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<tr>
<td>the confidence to educate themselves</td>
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continually throughout their careers.

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<tbody>
<tr>
<td>D. the ability to apply computers as tools for engineering.</td>
<td>3.91</td>
<td>4.76</td>
<td>4.16</td>
</tr>
<tr>
<td>E. the ability to apply the basic principles of measurement, data analysis, and design of experiments, learned through hands-on laboratory experience.</td>
<td>4.23</td>
<td>4.69</td>
<td>4.17</td>
</tr>
<tr>
<td>F. the ability to practice engineering with ethical standards and a responsibility to society.</td>
<td>3.75</td>
<td>4.53</td>
<td>3.16</td>
</tr>
<tr>
<td>G. the ability to develop creative solutions to engineering problems.</td>
<td>4.29</td>
<td>4.58</td>
<td>4.16</td>
</tr>
<tr>
<td>H. the ability to work well as part of a team.</td>
<td>4.59</td>
<td>4.66</td>
<td>4.66</td>
</tr>
<tr>
<td>I. the ability to apply the design process to engineering problems, including the consideration of different technical alternatives, while bearing in mind cost, environmental concerns, safety and other constraints.</td>
<td>4.82</td>
<td>4.55</td>
<td>4.11</td>
</tr>
<tr>
<td>J. the ability to, based on first-hand design experience, to analyze, construct, test and evaluate an engineering design.</td>
<td>4.31</td>
<td>4.72</td>
<td>4.44</td>
</tr>
<tr>
<td>K. the ability to connect engineering solutions and design with contemporary issues, and consider engineering solutions and designs in a global and social context.</td>
<td>4.01</td>
<td>4.65</td>
<td>3.50</td>
</tr>
</tbody>
</table>

* Course learning objectives for ME 4300 are not linked to these outcomes

**APPENDIX G:**

**Educating the Engineer of 2020: Adapting Engineering Education to the New Century, National Academy of Engineering, 2005**

**ENGINEER OF 2020 PROJECT:** driven by “concern that engineering students of today may not be appropriately educated to meet the demands that will be placed on the engineer of 2020 and that, without refocusing and reshaping the undergraduate engineering learning experience, America’s engineering preeminence could be lost.”

**RECOMMENDATION 1 (SEE ALSO RECOMMENDATION 2):**

The baccalaureate degree should be recognized as the “pre-engineering” degree or bachelor of arts in engineering degree, depending on course content and reflecting the career aspirations of the student.

**Motivation:**

- Exploding body of science and engineering knowledge cannot be accommodated within context of traditional 4 yr BS program
- Nontechnical subjects also essential to enable engineers to communicate, to engage in global engineering marketplace, and train to be a lifelong learner
What should we do as a department?

- Already offer A Grade program to outstanding students for combined BS/MS
- Need to educate BS students on importance of additional education/advance degrees
- Trend in industry towards hiring engineers with specialized knowledge/advanced degrees
- Need for broader engineering exposure than is possible in 4 yrs
- Invite industry speakers to inform BS students on importance of "forever" continuing education as well as advanced degrees
- 3 year BAE, 4 year BS, 5 year MS – possible?
- Restructure/expand (instead of reduce!) curriculum required for BS degree to allow for a "broader" engineering overview as well incorporating specialized focuses of study

RECOMMENDATION 2 (ADDITION TO RECOMMENDATION 1):
ABET should allow accreditation of engineering programs of the same name at the baccalaureate and graduate levels in the same department to recognize that education through a “professional” master’s degree produces an AME, and accredited “master” engineer.

Motivation:
- Need to recognize and reward the distinction between entry-level engineer and an engineer who masters an engineering discipline’s “body of knowledge”
- Baccalaureate degree provides “liberal” engineering education provides needed background for other career pursuits, such as business, medicine or law.
- Adequate depth in a specialized area of engineering cannot be achieved in baccalaureate degree

What should we do as a department?
- See Recommendation 1
- Make a recommendation, through the ASME, to petition ABET to allow accreditation of both BS and MS

RECOMMENDATION 3:
Engineering schools should more vigorously exploit the flexibility inherent in the outcomes-based accreditation approach to experiment with novel models for baccalaureate education. ABET should ensure that evaluators look for innovation and experimentation in the curriculum and not just hold institutions to a strict interpretation of the guidelines as they see them.

Motivation:
- Increased robustness of IT and rapidly expanding number of educational models
- Need to explore unconventional (but outcomes-based) approaches
- Promising approaches have been developed by various coalitions

What should we do as a department?
- Need for innovation in combining electronics and mechanical aspects
- Find out what innovative things other schools are doing
- Get freshmen involved in higher level design courses
- Solicit more design problems from industry in all design courses
• Year-long design projects for more depth
• Speakers from industry in design classes to motivate students, including “non-traditional”
• Brainstorming approach to establish where dept wants to be in 2020
• Familiarize ourselves with alternative approaches that seem to work
• Hire a competent ex-engineering educator/consultant to provide counsel and recommendations on new approaches

RECOMMENDATION 4:
Whatever other creative approaches are taken in the four-year engineering curriculum, the essence of engineering – the iterative process of designing, predicting performance, building, and testing – should be taught from the earliest stages of the curriculum, including the first year.

Motivation:
• Evidence from NSF Coalitions Program that students who are introduced to engineering design, engineering problem solving, and concept of engineering as a servant of society early in their UG education are more likely to pursue their engineering programs to completion
• This approach is also particularly appealing to women and minority students
• Treating the freshman year as a “sink or swim” experience and accepting attrition as inevitable is unfair to students and wasteful of faculty resources and faculty time

What should we do as a department?
• Already introducing design in 1st year (BE 1200) and 2nd year (ME 2400)
• Let 1st year students function as “shadow” members of the capstone design teams. Much of what they do will be “gophering” but for many this will be a first exposure to a situation where the answer is not in the back of the book
• Involve freshman/sophomores in the student competitions like SAE’s Super Mileage and Formula programs.

RECOMMENDATION 5:
The engineering education establishment, for example, the Engineering Dean’s Council, should endorse research in engineering education as a valued and rewarded activity for engineering faculty as a means to enhance and personalize the connection to undergraduate students, to understand how they learn, and to appreciate the pedagogical approaches that excite them.

Motivation:
Courses that connect engineering design and solutions to real-world problems appear to be successful in retaining students, but more research on learning needed

What should we do as a department?
• Investigate NSF opportunities in funded education research
• College-wide issue, addressed by Dean
• Hire undergrads as interns, summer or otherwise or as university research assistants during the summer
• Hire a competent ex-engineering educator/consultant to provide counsel and recommendations on new approaches—especially one from a tier one research school or someone with good connections in this arena
- Establish collaboration with a school which already has established a reputation for innovative approaches to curricula (i.e., Rose Hulman)

**RECOMMENDATION 6:**
Colleges and universities should develop new standards for faculty qualifications, appointments and expectations, for example, to require experience as a practicing engineer, and should create or adapt development programs to support the professional growth of engineering faculty.

**Motivation:**
- Growing disconnect between engineering education and practice
- Need for industry leaders and a new generation of faculty able to bridge the gap more effectively
- Not all engineering faculty need to have practical experience, but departments need to examine the mix of skills and experiences possessed by their faculty

**What should we do as a department?**
- Attract adjunct faculty who focus on education
- Publicize areas of expertise of adjunct faculty (ME web site, etc.). Practical experience of adjunct faculty is a big advantage of WSU over other schools
- Industrial, or national labs experience should be weighted more heavily in hiring decisions than it appears to be now. However this may also lead to hiring at a more senior (and more expensive) level than is currently done and as a result may raise other issues.
- Involve more of Wayne’s current adjunct faculty in the ME Industrial Advisory Committee

**RECOMMENDATION 7:**
As well as delivering content, engineering schools must teach engineering students how to learn, and must play a continuing role along with professional organizations in facilitating lifelong learning, perhaps through offering “executive” technical degrees similar to executive MBAs.

**Motivation:**
- Half-life of cutting-edge technical knowledge today is on the order of a few years
- Globalization of the economy accelerating and international marketplace for engineering services is dynamic
- In this environment, the engineer must be involved in continuous learning

**What should we do as a department?**
- Develop (i.e. encourage faculty to develop and teach) one-week, three day etc. summer short courses.
- Limited by lack of support infrastructure – approach College of Lifelong Learning to ask for their help
- Develop “how to learn” recipes for handout to incoming freshman students
- Partner with industry to develop more courses of interest to practicing engineers
RECOMMENDATION 8:
Engineering schools should introduce interdisciplinary learning in the undergraduate environment, rather than having it as an exclusive feature of graduate programs.

Motivation:

- Real-world problems rarely defined along narrow disciplinary lines
- Undergraduate students would benefit from at least cursory learning about the interplay between disciplines embodied in real-world problems

What should we do as a department?

- Runs counter to program time constraints. Possible to make students aware of need for it through projects which cut across multiple engineering disciplines
- National design competition projects like Formula SAE are interdisciplinary, but student participation is voluntary
- Include interdisciplinary perspective in the broad engineering overview curriculum (see Recommendation 1)

RECOMMENDATION 9:
Engineering educators should explore the development of case studies of engineering successes and failures and the appropriate use of a case-studies approach in undergraduate and graduate curricula.

Motivation:

- Lessons from failures often not learned, so future engineers doomed to repeat same mistakes
- Need to separate real elements of success from marketing “spin” for product or services

What should we do as a department?

- We already do this in some courses, but could do more. We teach the things that work and ignore those (like phlostigen, cold fusion, etc.) which have not passed the test of time. While some case-studies might be useful actual participation is the key to this.
- ME 4300 Thermal Systems Design now has limited coverage of case studies, and will consider introducing full case studies
- ME/AET 5120 Alternative Energy makes use of full case studies
- A new vibroacoustics course with more case studies is being considered

RECOMMENDATION 10:
Four-year engineering schools must accept it as their responsibility to work with their local community colleges to ensure effective articulation, as seamless as possible, with their two-year programs.

Motivation:

- Approximately 40% of BS engineers have had some community college experience
- Community colleges provide a vital pathway for engineering education for lower income students
- Facilitating articulation between two-year and four-year programs is critical
• Ironically, the greater flexibility provided to four-year schools by ABET EC 2000 complicates such articulation

What should we do as a department?

• Department should reach out to and work more closely with community colleges
• Associate Dean already does this to some extent
• Need to develop a complete table showing WSU-community college course equivalences
• Better understand the ABET EC 200 criteria issue—if a problem, solicit corrective action from ABET through ASME
• Develop a formal collaboration with at least one Detroit-area community college if this isn’t already in place

RECOMMENDATION 11:
U.S. engineering schools must develop programs to encourage/reward domestic engineering students to aspire to the M.S. and/or Ph.D. degree.

Motivation:

• Rapidly increasing competition for international Ph.D. students in U.S. engineering schools
• Cannot afford to neglect domestic students
• Improvements in undergraduate engineering education may encourage more domestic students to pursue advanced degrees

What should we do as a department?

• See Recommendation #1
• For most American students, the return on investment for a Ph.D. is inadequate. This is a societal problem which we may not be able to impact in any meaningful way
• Need better statistics on tracking of our domestic BS students to see what they do after graduation
• Need a college-wide strategy for attracting domestic graduate students
• Graduate assistant salaries must be more competitive with salaries of domestic BS students in industry
• Have ME and PhD students (and former students) address freshman and sophomore classes to learn about their work and why they believe it’s worth the time and effort to get their degrees
• Scout for more scholarship monies to attract more graduate students
• Work with companies to encourage BS graduates working in industry to return to school for advanced knowledge and degrees

RECOMMENDATION 12:
Engineering schools should lend their energies to a national effort to improve math, science, and engineering education at the K-12 level.

Motivation:

• Need to recruit the most highly qualified, best-prepared students from the nation’s secondary school system
• Need to help secondary school students understand the nature of engineering

What should we do as a department?

• More interaction with K-12 education - should help recruitment too
• Many NSF education programs (i.e., REU program) require K-12 involvement
• Invite outstanding high school students to work in our labs during summers
• Offer more short courses during weekends and/or summers to high school students (e.g., DAPCEP)
• Sign up seniors and grad students to volunteer as classroom mentors in the SAE “A World In Motion” (AWIM) program. The SAE Detroit Section is very active with AWIM and would be very willing to help set up a special initiative at Wayne
• Set up a study group to take a close look at all of the statements coming from the White House, dealing with the science and engineering crisis and try to develop a constructive response
• Work with selective K-12 students in local open Public and Charter Schools

RECOMMENDATION 13:
The engineering education establishment should participate in a coordinated national effort to promote public understanding of engineering and technology literacy of the public.

Motivation:

• It is in the enlightened self-interest of engineering schools to help the public understand what engineers do and the role that engineering plays in ensuring their quality of life.
• A country weak in technological literacy will have increasing difficulty competing in the technology-driven global economy of the 21st century

What should we do as a department?

• Focus on community colleges and K-12 education – adults more difficult
• Develop a grant proposal to promote science and engineering in the Detroit area school system
• Contact ASEE for ideas and programs to emulate in this arena and information on Federally funded initiatives
• Contact local K-12 schools and community colleges to begin discussions.

RECOMMENDATION 14:
NSF should collect and/or fund collection, perhaps through ASEE or the Engineering Workforce Commission, of comprehensive data by engineering department/school on program philosophy and student outcomes such as, but not exclusively, student retention rates by gender and ethnicity, common reasons why students leave, where they go, percent of entering freshman that graduate, time to degree, and information on jobs and admission to graduate school.

Motivation:

• Unlimited number of different engineering curricula structures and attendant engineering education schemes offered by engineering programs across the country
• Unlikely that high school students, their guidance counselors or parents can understand the alternatives and deduce which scheme and school might be most appropriate
• ASEE web site has statistical profiles of undergraduate programs, but more information needed on program philosophy, outcomes, retention, years to degree completion, securing jobs at graduation

What should we do as a department?

• Wait for NSF or ASEE to initiate generation of database, then decide whether the rewards will be worth the paperwork. One point will be to ensure that the terminology is consistent. How many descriptions of ‘program philosophy’ could we generate among ourselves?
• Find scholarship monies for needy females and minorities
• Work with existing initiatives relating to gender and minority participation such a the Sally Ride Camp for Girls program
• Tie into the Detroit school system and the City of Detroit to encourage minorities to do engineering at Wayne. (WSU has low minority involvement, particularly in engineering, for a university located in a city with a large minority population)

Work with local chapters of Engineering Societies such as American Society of Mechanical Engineers (ASME), National Society of Black Engineers (NSBE), Society of Women Engineers (SWE), Society of Hispanic Professional Engineers (SHPE), Society of Automotive Engineers (SAE), Michigan Society of Professional Engineers (MSPE), and the Engineering Society of Detroit (ESD), to name a few.

Appendix H: Updated Mechanical Engineering Department Strategic Plan
February 18, 2005

<table>
<thead>
<tr>
<th>MISSION</th>
<th>STRATEGIES</th>
<th>RELEVANT S/W/O/T</th>
<th>RESPONSIBLE GROUP/PERSON</th>
<th>TIMELINE</th>
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</thead>
<tbody>
<tr>
<td>EDUCATION PROGRAMS</td>
<td>Implement continuous assessment and improvement cycle to maintain highest ABET accreditation status and academic standards</td>
<td>S3, 6, 8, 15,16, O9, 18, T6</td>
<td>UG Committee, Faculty Course Groups, Dept. Chair</td>
<td>Continuous</td>
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<td></td>
<td>Invest in upgrades of laboratory equipment</td>
<td>S3, 6, 9, W3, 8, 16, 20, O3, 4, 15, 17, T2, 6</td>
<td>Lab instructors, UG committee, Industrial Advisory Committee, Budget Committee</td>
<td>Annually</td>
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<td>Develop and implement Honors and other challenging programs for outstanding students</td>
<td>S1, 3, 5, 6, 8, 9, W1, 2, 6, 8, 9, 13, O1, 3, 4, 5, 18, 19, T2, 5, 6</td>
<td>UG Committee, Dept. Chair</td>
<td>AY 05-06 and beyond</td>
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<tr>
<td>MISSION</td>
<td>STRATEGIES</td>
<td>RELEVANT S/W/O/T</td>
<td>RESPONSIBLE GROUP/PERSON</td>
<td>TIMELINE</td>
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<td>Increase interaction with industry for collaboration and sponsorship of design projects</td>
<td>S4, 9 W8, 19 O2,11,17,19,20 T2</td>
<td>Design instructors, Industrial Advisory Committee, Dept. Chair</td>
<td>Continuous</td>
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<td>Identify changing market needs at both undergraduate and graduate levels</td>
<td>S1, 3, 5, 7, 8, 9 W4,15,18,19,23 O4, 11,12,14,15 T1, 2,3,4,5,8</td>
<td>UG and Graduate Committees, Dept. Chair</td>
<td>Winter 05</td>
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<td>Expand into niche areas and alternative course delivery mechanisms</td>
<td>S1, 4, 6, 7, 8, 9 W2, 18,19,23 O4, 10,11,12,15 T1, 2,3,4,5,6,9</td>
<td>UG and Graduate Committees, Dept. Chair</td>
<td>Continuous</td>
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<td>Offer graduate courses related to emerging technologies and WSU research thrust areas</td>
<td>S1, 2, 4, 6, 7, 8,9 W3, 7, 12, 16,19 O2,4, 7, 11,19,21 T1,2,3,4,5,6,7,9</td>
<td>Graduate Committee, Faculty Course Groups, Dept. Chair</td>
<td>AY 05-06</td>
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<tr>
<td>Recruit outstanding students locally and globally</td>
<td>S1,2,3,4,6,7,8,9 W1,4,9,10,13,18,19,20 T1,2,3,4,5,6,8,9,10</td>
<td>UG Committee, Graduate Committee, Dept. Chair</td>
<td>AY 05-06</td>
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<td>Encourage and reward students who enter national competitions</td>
<td>S2, 4, 6, 10 W2, 9, 17,19 O10, 19,22,23 T6, 7</td>
<td>Dept. Chair, Budget Committee</td>
<td>Continuous</td>
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<td>Encourage faculty involvement in student activities</td>
<td>S2,4, 6,9 W9, 13 O1,4, 7, 18,19 T1,2,3,4,5</td>
<td>ASME Advisor, SAE Advisor, Dept. Chair</td>
<td>Winter 05</td>
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<td>MISSION</td>
<td>STRATEGIES</td>
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<td>RESEARCH PROGRAMS</td>
<td>Encourage faculty and graduate students to publish in quality refereed journals</td>
<td>S2, 4 W2,3,7,17,18,19 O10 T2,7,10</td>
<td>Salary Committee, Promotion &amp; Tenure Committee, Dept. Chair</td>
<td>Annually</td>
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<td>Provide improved departmental tracking of paperwork to free up faculty time for research</td>
<td>S2, 4 W2, 7, 21 O9, 21, 23 T1,5, 6</td>
<td>Dept. Chair, Office staff</td>
<td>Winter 05</td>
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<td>Provide extra departmental support to productive faculty and their graduate students</td>
<td>S2, 4, 10 W2, 7, 17, 19 O9,10,16,20,21 T1, 6, 7</td>
<td>Dept. Chair, Budget Committee</td>
<td>Continuous</td>
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<td>Seek corporate support for endowed chair positions</td>
<td>S2, 4, 9 W8, 15, 18,19 O4, 7, 8, 9, 11,16 T 2, 5, 6</td>
<td>Endowed Chair Proposal Development Committee, Dept. Chair</td>
<td>Winter 05</td>
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<td>Promote formation of multidisciplinary research consortia</td>
<td>S2, 4, 9 W2, 7, 11,12, 15 O4, 5, 7, 8, 10,14 T1, 2, 3, 6, 7</td>
<td>All faculty, Dept. Chair</td>
<td>In response to RFPs from funding agencies</td>
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<td>Maintain high quality ME seminar series</td>
<td>S2, 4, 8, 9 W1, 5,14, 18, 19 O4, 7, 10, 22, 23 T1, 2, 6</td>
<td>Seminar Coordinator, faculty hosts, office staff</td>
<td>Each semester</td>
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<td>Organize biannual Industry Days with graduate student posters and lab tours</td>
<td>S2, 4, 5, 9, 10 W1, 8, 12, 18, 19 O2,3,4,10,11,20 T1, 2, 3, 6, 7,10</td>
<td>Volunteers, Dept. Chair, Graduate Committee, office staff</td>
<td>Biannually beginning in Fall 05</td>
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<td>Create and update research group websites on ME web site</td>
<td>S2, 4 W1,2,4,18,19 O10, 12, 20 T1,2,4,6,9</td>
<td>Web site Enhancement and Maintenance Committee</td>
<td>Continuous, beginning AY 04-05</td>
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<td>Publish department newsletter</td>
<td>S2,3,4,7,9 W1,2,4,8,18,19 O3,4,5,7,10,11,16 T2, 3, 4, 5, 6</td>
<td>Dept. Chair, office staff</td>
<td>Annually beginning Winter 05</td>
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