DATE: August 9, 2006
TO: Mani Venkatasubramanian
FROM: Patrick Pedrow
SUBJECT: EE 415 Assessment Report for Fall 2005

Introduction

During fall 2005, EE 415 (Design Project Management) had an enrollment of 24 students. The course consisted of two parts. The first part was a series of lectures and a field trip on subjects that prepare students to work on multidisciplinary teams in an industrial environment. Topics included:

- Design Methodology
- Project Management Software: Microsoft Project
- Gantt Tables and PERT Charts
- Introduction to Total Quality Management (TQM)
- Tour of SEL Manufacturing Facility (TQM in action)
- Technical Writing Tutorial and Workshop by WSU Writing Programs
- Team Building
- Understanding Your Customers
- Design and Project Management
- Company Culture
- Video Conferencing with WHETS
- Developing Product Solutions
- Engineering Ethics
- Intellectual Property
- Giving Effective Presentations
- PowerPoint for Presentations and Posters
- The Student’s Career Search
- Electronic Design for Quality and Reliability

The second part of the course was team building and preliminary design work on projects to be completed during EE 416 (Senior Design) in the subsequent semester. The projects (along with sponsors) assigned to student groups during EE415 in fall 2005 semester are listed in Table 1.

Table 1. Design Projects for EE415 during fall 2005.

<table>
<thead>
<tr>
<th>Team Number</th>
<th>Sponsor</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>InnovaTek</td>
<td>&quot;Design of an Integrated Control and Monitoring System for a Fuel Processor using a Single Board Computer&quot;</td>
</tr>
<tr>
<td>2</td>
<td>Avista</td>
<td>&quot;Long Lake Station Service Design&quot;</td>
</tr>
<tr>
<td>3</td>
<td>Avista</td>
<td>&quot;Little Falls Generating Station Grounding Problem&quot;</td>
</tr>
<tr>
<td>4</td>
<td>ISR</td>
<td>&quot;Electro-optical Fluid Level Sensor&quot;</td>
</tr>
<tr>
<td>5</td>
<td>Boeing</td>
<td>&quot;Non-Line-of-Sight Wireless Sequential Still Image and Telemetry System&quot;</td>
</tr>
<tr>
<td>6</td>
<td>WSU Facilities Operations</td>
<td>&quot;Protective Relay System Replacement at WSU&quot;</td>
</tr>
<tr>
<td>7</td>
<td>PNNL</td>
<td>&quot;Development of an Advanced Low-Cost RF Communication Device&quot;</td>
</tr>
</tbody>
</table>

The semester started August 25, 2005 and teams were announced September 8. Early team formation is essential to strengthen team/mentor interactions. Each team had a mentor who was an engineer or scientist. By the end of fall 2005 semester, each team presented a proposal (in two formats: oral seminar
and written document) describing tasks to be completed in EE416 during the following semester (spring 2006).

**Response to Previous EE415 Recommendations**

Note: There are two interleaved cycles of EE415/416 design projects, one cycle taught by P. Pedrow and one cycle taught by C. Cole (with help from S. Campbell). Due to the complicated logistics of design team management including lead time required to solicit projects from industry, these two instructors have been responding to feedback within their own cycle of EE415/416 courses. Specifically, by the time an assessment report is written and circulated, the other instructor is nearly finished with the solicitation and planning phase for the startup of the next offering, leaving insufficient time to incorporate the recommendations into the impending startup of the course. A recommendation given at the end of this assessment report is that future EE415/416 assessment reports should utilize and respond to the most current information from both design cycles so that these two instructors can strengthen their techniques based on data from the other's teaching experience. Future assessment reports will follow that recommendation; however, the present assessment report addresses only the P. Pedrow offering of fall 2005 EE415 and it will consider only the assessment report recommendations appearing in the assessment report written by P. Pedrow for the fall 2004 offering of EE415.

The EE415 assessment report written by P. Pedrow for fall 2004 EE415 contained four recommendations. These are listed here along with adjustments made to improve fall 2005 EE415:

1. *The technical writing tutorial and workshop offered by the WSU English Department should become a permanent part of this course.* Early planning allowed for seven tutors from the WSU Writing Programs to attend one of our lectures and tutor the design teams using an early draft of the team proposal. There was one tutor for each design team. Students received full credit for participating in this exercise, that is, at the request of Writing Programs, the tutor did not "grade" the team's writing but merely gave constructive feedback. So long as the WSU Writing Programs has resources to pay these tutors, the activity will remain a part of P. Pedrow's offering of EE415.

2. *To encourage teams to strengthen their technical background, future teams should be given at least one refereed journal article with their project description. They should read and cite this article in their Technical Background section. They should then be given an assignment to search digital data bases for similar refereed journal articles.* At the course web site there were at least 2 pertinent technical articles in pdf format posted for each design team. For details, select the link "Abstracts of Projects" at: www.ecewsu.edu/~pedrow/classes/ee415/Fall_2005 and then see the column entitled "Resource Papers". As the students wrote various drafts of their proposals, they were instructed to read the papers that applied to their project and place technical details from the papers into their Introduction section. Writing guidelines also instructed the students to use the IEEE Xplore data base and the Science Direct data base to find additional refereed articles pertinent to their design projects. Despite these arrangements come teams are still reluctant to search the literature for additional documents related to their project. In EE415 some students are reluctant to climb the learning curve that relates to their specific topic.

3. *A grading component should be added to the instructor's course syllabus stating that the team has demonstrated mastery of the design algorithm as described in the EE415 text book.* Since there were already 10 distinct weighting components to the grading format for this course, another approach was taken to encourage students to learn the design algorithm as described in the text book: Guidelines for the written proposal, explicitly made statements such as “The bulk of the creative ideas generated during the brainstorming activity will come from team members, not from the professionals helping the team. An effective team will generate ideas not yet considered by professionals helping the team. Convince the grader that the team is skilled at applying the techniques described in Chapter 6.” Teams responded well to these explicit directions to incorporate the design algorithm into their proposals.
4. The WSU class bulletin lists the following prerequisites for EE415: “senior standing” but prerequisites for EE416 read “EE415: Engl 402 or 403.” The following prerequisite should be added to EE415: “Engl 402 or 403 or C.” Technical writing is an essential component in EE415 and many students register ill-prepared for the writing assignments in EE415. This lack of technical writing skills slows the team’s progress and leaves a poor impression on participating mentors. The EE curriculum committee has taken no actions to change the prerequisites for EE415. Lack of technical writing skills continues to slow progress in EE415. Some team documents were very weak with common mistakes being: use of casual language that is more appropriate for a dormitory conversation, spelling errors, grammatical errors, lack of sufficient resolution in figures, and no proof reading of the document. Sharing these early documents with industry mentors can be very embarrassing; however, enforcing cycles of classroom grading and rewrites keeps the mentors out of the design process for too long. It has been suggested that WSU has insufficient capacity to teach technical writing at a pace that allows all of our seniors to complete it before entering EE415. The EECs electrical engineering schedule of studies and the computer engineering schedule of studies both show English 402 (Technical and Professional Writing) being completed during the junior year. Since English 402 is not listed as a prerequisite or even a co-requisite for EE415, students enter this class with very weak technical writing skills. Much of the course time is spent showing the students acceptable quality for technical writing and then giving them opportunities to demonstrate these skills. If they were more skilled at technical writing when entering EE415 then more time could be spent on the technical issues associate with their design projects. Students dwelling on technical issues rather than technical writing issues would be much more productive at interacting with their mentors and assisting the sponsoring companies. Some students for whom English is not their first language posses minimal communication skills which in turn weakens their teaming skills and weakens their communications with their industrial mentor.

Assessment of Fall 2005 EE415

The following paragraphs contain P. Pedrow’s assessment of the student performance with respect to the relevant ABET “criteria 3” outcomes listed in the course syllabus. The outcomes being addressed appear as underlined centered headings in the text that follows.

**3(c) - ability to design a system, component or process to meet desired needs and 3(e) - ability to identify, formulate and solve engineering problems**

Both of these are addressed by the written project proposals that covered the projects listed in Table 1. In addition, in-class group activities and homework assignments allowed the students to practice skills learned in lectures. For example, students were introduced to Microsoft Project by doing a simple paper-design of an item of their choice. Items selected by the students for these in-class design exercises fall 2005 included digital animation software, a water level control system, and a children’s play fort.

Seven teams were formed and assigned to the projects shown in Table 1. Teams were asked to develop a design proposal that was presented both orally and in writing. Mentors, co-mentors, faculty resource persons and their guests were present for the oral presentations. Format for the written proposal followed the initial steps in the design algorithm described in the text book and paraphrased here: identify customer needs, develop product technical specifications, concept generation (brain storming), and concept selection. Additional steps including iterative steps of engineering analysis, modeling, prototype construction, testing, and refinement are emphasized in EE416 when the design projects are completed.
3(d) — ability to function on multidisciplinary team

Each student was assigned to a project team of three to five students (see Table 1.) The ability to function in such a team was evaluated as follows. A peer/mentor grade was established for each student. Each student was required to prepare a peer evaluation of their team members. Each team member assigned a grade to each other team member. Mentors were also invited to grade the individual members of their team. Only the peer grades were used for this grading item if the mentor opted not to participate. Comments were also solicited on the grading forms from peers and the mentor. The peers and mentors were asked to use the following grading criteria taken from the WSU student manual:

A. Student work demonstrates consistently excellent scholastic performance; thorough comprehension; ability to correlate the material with other ideas, to communicate and to deal effectively with course concepts and new material; reliability in attendance and attention to assignments.

B. Student work demonstrates superior scholastic performance overall, reliability in attendance, and attention to assignments; may demonstrate excellence but be less consistent than the work of an A student.

C. Student work demonstrates satisfactory performance overall, as well as reliability in attendance, and attention to assignments.

D. Student work demonstrates minimal, barely passing performance overall; limited knowledge of subject matter.

E. Student work demonstrates unsatisfactory performance and comprehension or unfulfilled requirements. The grade is failing.

The mean peer/mentor score per student was in the range 60-100% for all but one student who received F’s from all of his team members and he subsequently failed to course, primarily due to his inability to function on a team. Written comments from peers and mentors gave important insight into team dynamics. In several cases there was a low grade for only one member of the team. This information was helpful in assigning individual grades but also in pointing out which students needed counseling in EE416 with respect to team participation. Most of the teams showed strong teaming skills.

3(g)- ability to communicate effectively

EE415 students continue to make positive comments with respect to the writing tutors that participate in EE415 by way of the Special Writing Assistance Tutorial (SWAT) presented by the Writing Center at Washington State University. Salient weaknesses observed in the written proposals were:

- Weak proof reading skills.
- Insertion of figures and tables that were not described in the text.
- Improper format for citations in the reference list.
- Weak Background and Introduction sections showing a reluctance to read journal literature and climb the technical learning curve associated with their specific design project.
- Prepositions were placed at the ends of sentences.
- Some paragraphs were made up of only one sentence.

Each student was given a score for their portion of an oral team seminar. Student scores ranged from 85 to 100% with all students demonstrating an ability to communicate effectively via a seminar presentation. Most team seminars were very good and provided the students with practice at making professional presentations. The seminars were video taped and some students made copies for replay and self-improvement. EE415 course grades ranged from A to D with two students receiving grade of D and not being allowed to continue with their team into EE416. In fall 2004 all of the EE415 students passed EE415 and so this result for EE415 in fall 2005 represents a reduction in abilities for this class of students.
Several activities in EE415 were designed to develop written and oral presentation skills. These components are described below.

**WRITTEN COMMUNICATION**

Students had four writing assignments in this class: 1) An introduction to Microsoft Project software; 2) A writing tutorial where Draft #1 of their proposal was critiqued by writing tutors from the campus writing center; 3) Draft #2 of the proposal was graded by the instructor; and 4) The final proposal was graded by the instructor. In addition to grading the technical content of these documents, the instructor graded grammar and writing style.

**ORAL COMMUNICATION**

Each team made a video taped seminar covering their final proposal with mentors and guests present. Each member of the team was required to present a portion of the proposal. Students clearly learned from the lectures they had attended on oral communications and all of the seminars were quite professional in quality.

**Conclusions**

Course grades for all but two students were within the range A to C. One of the D students failed the course primarily due to lack of engineering maturity (took the class too early in his program) and the other D student failed the course primarily due to lack of teaming skills (missed meetings, missed writing deadlines, made team members frustrated with him, etc.)

Some students entered EE415 with insufficient technical prerequisites. For example, some volunteered to be placed on “Power” projects even though they had not yet taken the first power courses EE361 and EE362. These students slowed their teams down due to lack of fundamentals. EECS should require that EE361/362 be completed before a student can register for EE415. The instructor should have several activities early in the semester that are designed to acquaint students with the projects so that they are matched with more compatible design projects.

Many students complained about the work load in EE415 suggesting that their credit hour enrollment was too large. Student files show that about half of the EE415 students took 18 or more “solid” credit hours and about half of them finished the semester with at least one grade below C-. These data support the hypothesis that many students took EE415 as an “overload” and thus were not prepared to invest the proper effort in the class. This attitude leads to poor design results and results in a tarnished EECS reputation with sponsoring companies. Students should be advised that EE415 and EE416 are serious classes that require their full attention.

EE415 and EE416 should be considered classes that are to be taken “just in time” for graduation. That is, students highly likely to graduate in May or August should start EE415 in the fall semester and students highly likely to graduate in December should start EE415 in spring semester.

The WSU class bulletin lists the following prerequisites for EE415: “senior standing” but prerequisites for EE416 read “EE415; Engl 402 or 403.” The following prerequisite should be added to EE415: “Engl 402 or 403 or C/.” Technical writing is an essential component in EE415 and many students register ill-prepared for the writing assignments in EE415. This lack of technical writing skills slows the team’s progress and leaves a poor impression on participating mentors.