Chapter 2

Assessment Report for the Engineering Program

Executive Summary

The Engineering Program at Roger Williams University provides a strong foundation for students seeking an engineering career or further graduate study. Students are extremely well prepared to pursue a number of alternative paths with an engineering degree from Roger Williams University. External validation through student job placement and resulting offer packages, graduate school acceptance and financial support, nationally normed results from the Fundamentals of Engineering exam, regional, national and international engineering competition results, and feedback from employers, professional societies and past graduates support the claim that our engineering students are among the best in the country.

This engineering report documents the AY 2010-2011 findings from our multi-faceted engineering assessment system. This system is grounded in a continuous improvement philosophy that gathers feedback from multiple constituencies, analyzes the feedback, and then implements strategies and mechanisms to effectively address the feedback. A critical component of the system is a process that allows for continual and formal assessment of implemented changes and an evaluation of their efficacy. This process directly responds to fulfilling the requirements found in our accrediting body's Criterion 4, Continuous Improvement.

Presented in six sections, this report includes:

- Section 1: Introduction
- Section 2: Analysis of Collected Evaluation Data
- Section 3: Program Objectives Assessment
- Section 4: Engineering Program Educational Outcomes Assessment
- Section 5: Assessment of Previously Implemented Program Changes
- Section 6: Discussion of Recommended Engineering Program Changes

The present engineering assessment system is extremely effective at identifying those areas where potential changes will make the program even stronger. The major engineering findings and recommendations generated from the AY2010-2011 assessment system are presented below. The final section of this report provides a discussion of each finding.

1. Need for a review of software used and taught in engineering classes especially discipline specific software

Recommendation: Undertake a review of all of the engineering lab software, correlate this software with engineering course offerings and identify gaps. Discuss available software in the labs and determine where students are learning how to use specific programs.

2. Lack of elective courses and variety of instructors in the civil and mechanical engineering specialization areas

Recommendation: Continue to review and study of the engineering curriculum with respect to the program of study and how well it fits the needs of our students, alumni, industry and graduate programs. If agreed upon and justified, introduce additional electives into the civil and mechanical specializations. Furthermore, propose additional faculty lines in engineering as a result of increased enrollment.

3. Review the adequacy of engineering lab equipment and computer lab areas

Recommendation: Further study benchmark engineering programs and state-of-the art practices and procurements with respect to engineering lab equipment. Initiate a study of the computer lab areas to determine usage and adequacy.

4. Continue to implement strategies that improve oral and written communication skills among engineering students

Recommendation: Continue to explore ways in which writing and communication might be better integrated into engineering courses that traditionally do not include these requirements while recognizing the differential advantage this skill set provides to our graduates.

5. Increase FE pass rate

Recommendation: Investigate best practices of other institutions for FE pass strategies. Benchmark our practices against these institutions. Discuss with faculty the most appropriate way to deliver the review course for students. Determine through faculty discussions whether the use of the FE exam remains a good assessment tool with respect to our program.

Section 1: Introduction

The engineering program at Roger Williams University was founded on an educational philosophy that encourages exploration and discovery while focusing on the development of the whole person. Students study the art of engineering in an environment unconstrained by disciplinary restrictions. While designed to develop the essential knowledge, skills and abilities needed for professional practice or graduate study, the curricular structure of the program, coupled with the strong influence of the liberal arts (as evidenced by the core curriculum) equips our graduates with a “holistic” educational experience that is designed to prepare graduates to succeed in a world marked by rapidly increasing technology, growing complexity and globalization.

The engineering program is designed to encompass six categories of courses:

- general engineering
- basic mathematics and science
- engineering proficiency
- professional development
- advanced mathematics
- core education.

Each of these categories provides the student with an essential component of their overall educational experience and in turn, ensures that students are prepared for engineering practice as required by our accrediting body.

Section 2: Analysis of Collected Evaluation Data

A number of different evaluation instruments and processes are used in the assessment of the engineering program. Each instrument generates specific data that collectively measures achievement of program objectives and/or learning outcomes. Table 2.2-1 shows the instruments and materials used to assess and refine educational objectives and outcomes.

Table 2.2-1. Instruments and Materials Used to Assess and Refine Educational Objectives and Outcomes

Instruments/Materials Used to Assess and Refine Educational Objectives	Information Collected
Engineering Student Exit Survey (Student Outcomes, also refine Program Objectives)	Program quality Curricular strengths and weaknesses Resource deficiencies Benchmark out the door Personal and professional development Educational environment
Faculty Course Assessment Report (Student Outcomes)	Student rating of course objectives and outcomes Faculty rating of course objectives and outcomes Time and GPA analysis Faculty subjective evaluation Identification of deficiency area if any
Course Student Survey (Student Outcomes)	Numerical and subjective evaluation of course content Numerical and subjective evaluation of instructor performance Educational value
Alumni Survey (Program Educational Objectives)	Curricular review Professional preparation Success metrics Licensure Life-long learning Gap analysis
Graduate Employers (Student Outcomes and Program Educational Objectives)	Recruitment and hiring Feedback on preparation for the workplace Feedback on program strengths and weaknesses of present students and graduates)
Professional Advisory Board Meetings (Review of Student Outcomes and Program Educational Objectives)	Review of curriculum Review of program educational objectives and student outcomes Evaluation of student projects and presentations Evaluation of industry trends impacting program Determinants of engineering success in the workplace Preparation of students for the workplace
Fundamentals in Engineering Examination (Student Outcomes and Program Educational Objectives)	Curricular strengths and weaknesses National comparative benchmarking Licensure of graduates
RWU Academic Showcase (Student Outcomes)	Review of professional component Monitor industry trends Assessment of workplace readiness Assessment of communication skills

Instruments/Materials Used to Assess and Refine Educational Objectives	Information Collected
Senior Skills Inventory (Student Outcomes and refine Program Educational Objectives)	Assess workplace readiness Identify skill/knowledge gaps in curricula preparation Determine requirements for personal career plan
Senior Job Placement Survey/Graduate School Survey (Student Outcomes)	Identify number of job offers Derive benchmark data on job placement Identify gaps in career advising and placement services Identify gaps in student preparation and graduate school requirements
Transcript Review (Student Outcomes)	Rate of progress statistics Prerequisite checks Course flow
Student Competitions/Conferences (Student Outcomes)	Student participation statistics Student performance statistics

The timeline associated with the evaluation of Engineering Program Objectives and Outcomes is presented in Table 2.2-2 below.

Table 2.2-2. Timeline for Assessment Activities Associated with Engineering Program Objectives and Outcomes

Instruments/Materials Used to Assess and Refine Educational Objectives	AY 2005-2006		AY 2006-2007		AY 2007-2008		AY 2008-2009		AY 2009-2010		AY 2010-2011	
	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring
Engineering Student Exit Survey		✓		✓		✓		✓		✓		✓
Faculty Course Assessment Report	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Course Student Survey	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Faculty Program Assessment Report*	✓	✓	✓	✓								
Alumni Survey (summer into fall)				✓				✓				✓
Graduate Employers		✓		✓		✓		✓		✓		✓
Professional Advisory Board	✓		✓		✓		✓	✓	✓	✓	✓	✓
FE Examination		✓		✓		✓		✓		✓		✓
RWU Academic Showcase		✓		✓		✓		✓		✓		✓
Senior Skills Inventory	✓		✓		✓		✓		✓		✓	
Senior Job Placement Survey		✓		✓		✓		✓		✓		✓
Transcript Review		✓		✓		✓		✓		✓		✓
Student Conferences/ Competitions		✓		✓		✓		✓		✓		✓

* Survey discontinued in 2007.

Analysis of Data Gathered from Each Assessment Instrument

- Senior Exit Interview

Each graduating engineering senior completes a student exit survey prior to graduation. Questions focus on areas such as program quality, personal and professional development, perceived proficiency levels associated with each program outcome, and the educational environment. In addition, overall impressions of the collegiate experience are solicited. Summary data from the AY 2010-2011 Senior Exit Interview is presented below.

The first section of the exit survey asks students whether they can specifically name any courses and/or instructors at Roger Williams University, either in the SECCM or outside the School that have prepared them especially well for their eventual career.

Students were given the opportunity to mention up to four courses and professors that best prepared them for their eventual career. Of the 32 students responding, 41% stated that Dr. Linda Riley and the Senior Design course best prepared them for their eventual career. Additionally, 22% of the students mentioned Dr. Charlie Thomas and his course Fluid Dynamics and Dr. Potter (22%) and his courses in both Thermodynamics and Heat Transfer. The remaining faculty members account for the remaining percentage.

Alternatively, students were also asked to state what classes they felt did not contribute to their eventual career. In many cases, core classes were most often mentioned by the students as not contributing to their eventual careers.

Next, students were asked to rank on a scale of 1 to 10, where 1 means totally unprepared, and 10 means totally prepared, how well that their education at Roger Williams University prepared them to enter the workforce or to begin graduate school. Students generally felt well-prepared to enter the workforce or to begin graduate school. The average score for the 2010-2011 graduating class on a ten point scale was 8.22 with a standard deviation of 1.26. Table 2.2-3 shows the longitudinal scores for this question since the 2006-2007 academic year.

Table 2.2-3. Perceived Preparation by the Engineering Program

Academic Year	Rating
2010-2011	8.22
2009-2010	7.68
2008-2009	7.94
2007-2008	7.83
2006-2007	7.70

In analyzing the drop in overall preparation score reported by the 2009-2010 class compared to 2008-2009 class, it appears that there was an outlier in the students with one student reporting a "3" for overall perceived level of preparation. In this case, the student reported a single negative experience while at RWU that impacted her entire assessment of the program. Other than that anomaly, we have seen a steady increase by students in the perceived preparation of the Engineering Program for the workforce or graduate school, most notably in the 2010-2011 survey results.

From an assessment perspective, it is important to understand what experiences, activities and encounters most impacted students' development as a person while at RWU. Students reported a number of experiences that impacted their development. Students overwhelmingly included the senior design project as one of the most significant experiences in their college careers. Selected responses are presented below.

Experience	Why?
Internship	It helped get my foot in the door.
Senior Design	Helped me prepare for my job.
Overall Engineering Program	Prepared me to become a practicing engineer.
Senior Design Competition	Helped me get into graduate school.
Working with fellow classmates	Learned a lot and bonded.
Senior Design	The competition and what we accomplished.
NCUR	Another conference that I attended and got to listen to various fields of undergraduate and graduate level projects.
Women's Soccer	The team helped me transition into the college life and became sort of a family to fall back on when needed.
Senior Design	Developed problem solving and presentation skills.
Engineering Program	Leadership skills.
Leaving Home	Allowed me to become an independent person.
Senior Design	Worked in a team and accomplished a goal, and had a great time doing it.
Meeting New People	
ENGR 490	It taught me to work as a project developer in a team environment and had a real life working atmosphere.
Freshman Design	Good start to an engineering degree, hands on.
Mechatronics	Tough course.
Senior design	Good wrap up to program.
Senior Design Project	It drastically increased my communication skills, allowing me to work better in a group setting, as well as preparing me for the real world.
RA	Learned how to deal with people in an appropriate manner.
Being an Engineering Student	Learned how to get through the challenging times.
Senior Design	Learned how to prepare for my future.
Study Abroad	I learned more than I ever would have in a classroom.
Senior Design	Changed my outlook on working with/ managing teammates and schedules. Most stressful experience by far, but it has changed by leadership style.
Senior Design	Made me work successfully with a group.

The Senior Exit Survey also asked students about activities or courses that were not offered at RWU that would have better prepared them for the future. In general, students offered suggestions for activities and new courses such as:

- C programming
- .NET and SQL
- BIM
- A co-op program similar to Northeastern's would have been extremely beneficial.
- Possibly more business oriented classes.

A major portion of the survey asks the students to assess how well the Engineering Program provided them with the education and experiences that contribute to developing proficiency in student outcome areas. Table 2.2-4 shows their responses to our outcomes areas. Overall, students felt that they were strongest in their ability to function on teams (1.16) and their ability to formulate and solve engineering problems (1.21). In addition, they rated their recognition of the value for life-long learning (1.26) as well as the ability to apply knowledge of mathematics, science, and engineering (1.32) very high. Overall, all outcome areas were rated favorably with improvement in every area. This is especially the case in knowledge of contemporary issues, an outcome that has had specific strategies directed toward it over the past three years because of its lagging rating.

Table 2.2-4. Student Reported Proficiency in Outcome
Engineering Outcomes - On a scale of 1 to 5 where 1 means proficiency achieved and 5 means proficiency not achieved, please evaluate the following outcomes

Student Reported Proficiency in Outcome	AY 2006-2007 Mean	AY 2007-2008 Mean	AY 2008-2009 Mean	AY 2009-2010 Mean	AY 2010-2011 Mean	AY 2010-2011 StDev
Ability to apply knowledge	1.09	1.47	1.28	1.35	1.32	.58
Ability to design/conduct experiments	1.91	1.76	1.61	1.47	1.37	.50
Ability to analyze/interpret data	1.36	1.65	1.50	1.35	1.37	.50
Ability to design system	1.45	1.76	1.67	1.58	1.47	.51
Ability to function on teams	1.27	1.71	1.50	1.35	1.16	.37
Ability to identify, formulate engineering problems	1.18	1.44	1.39	1.47	1.21	.42
Understanding of professional/ethical responsibility	1.64	1.82	1.56	1.76	1.47	.70
Ability to communicate effectively	1.27	1.65	1.35	1.70	1.37	.50
Broad education	2.00	1.88	1.61	1.88	1.37	.50
Recognition of need/ability to life-long learning	1.55	1.76	1.56	1.35	1.26	.45
Knowledge of contemporary issues	2.27	2.00	1.83	2.29	1.58	.51
Ability to use technical skills	1.82	1.88	1.71	1.64	1.58	.61
Effective leadership skills	1.37	1.94	1.47	1.64	1.37	.50

Graduating seniors were also asked to evaluate the quality of RWU programs and services on a scale of 1 to 5 where 1 means extremely high quality and 5 means extremely low quality. Many of the programs and services contribute to reaching proficiency in one way or another on each of the outcomes. Students gave highest scores to the helpfulness of SECCM staff, engineering faculty and courses in major. Alternatively, programs and services receiving the lowest scores were University Core Courses, the Registrar's Office and the Career Center.

Table 2.4-5 shows the reported quality of the programs and services at Roger Williams University.

Table 2.4-5. 2007-2011 Student Reported Quality of RWU Programs and Services

Student Reported Quality	2007-2008 Mean	2008-2009 Mean	2009-2010 Mean	2010-2011 Mean
SECCM lab equipment	2.65	2.67	2.00	1.95
Advising on courses/academics	1.91	1.89	1.70	1.93
Advising on career/future through SECCM	2.29	1.83	1.94	1.95
Advising on career/future through Career Center	2.29	2.72	2.58	2.15
Courses in major	1.94	1.78	1.35	1.65
University core courses	2.53	2.94	3.17	2.80

Student Reported Quality	2007-2008 Mean	2008-2009 Mean	2009-2010 Mean	2010-2011 Mean
University core concentration courses	2.35	2.39	2.47	2.00
Helpfulness of SECCM staff	1.41	1.28	1.29	1.25
Faculty	1.76	1.50	1.35	1.30
Admissions office	2.00	2.17	2.23	2.15
Registrar's office	2.12	2.28	2.47	2.30
Bookstore	2.65	2.50	2.76	2.05
University computer facilities	2.41	2.06	2.70	2.20
SECCM computer facilities	2.53	1.83	2.11	1.85
Health Center	2.35	2.33	2.11	2.20
Career Center	2.29	2.71	2.47	2.25
SECCM Engineering Labs	2.81	2.35	1.82	2.15

Once again, we were satisfied with the results because they show improvement in areas such as SECCM and University computer facilities and the Career Center. All of these areas have been the target of directed improvement strategies.

We also query students with respect to their perceptions on the greatest strength of the Engineering Program. Overwhelmingly, they report the greatest strengths are the small class sizes, accessibility of faculty, helpfulness of staff, and requirement/support for the FE exam. Below are several excerpted verbatim responses from students regarding the Engineering Program's greatest strengths.

What is the Engineering Programs greatest strength?

- The faculty student interaction. The low ratio allows one to seek aid easily and effectively.
- Probably the fact that we must take the FE exam as a requirement to graduate.
- The size of the program; the small size is great because there is always access to the facilities and one-on-one help with professors.
- The number of professors to students. That is invaluable I think to experience and education.
- It is multidisciplinary and all students have a wide range of knowledge in many different fields.
- The professors are always ready to help you. Students can ask for help at any time.
- Small classes and approachable professors.
- The knowledge and enthusiasm of the faculty and, in most cases, their desire and willingness to teach to their best ability.
- Faculty availability, by senior year, the students all know the faculty well enough to get any help they need from them, including letters of reference and job opportunities.
- Faculty and staff willing to go the extra distance for their students.
- The teachers' amount of involvement and enthusiasm in their teaching.
- Teacher availability whenever you need it because it makes the classes and work so much easier.
- The diverse courses and overall faculty involvement helps make learning enjoyable.
- We have the privilege to work close with all the professors.
- The greatest strength would be the professors. In each class taken the professor showed genuine care towards me being the best at what I was doing.

In addition, students were asked what area needs the most improvement in the Engineering Program. In their own words, students responded the following.

- Labs and more space for students to study.
- Better lab equipment.
- Bigger computer lab and work area.
- I had the same teachers far too many times. It would have been nice to have a variety of teachers rather than the same ones over and over again.
- Computers and printers used for classes.
- I think there needs to be more course offered for the mechanical and electrical majors.
- More classes offered.
- The lack of some important classes that should be offered.
- We need more computer programs integrated into classes.
- More selection of engineering courses.

- Faculty Course Assessment Report

One of the most important instruments of the assessment process is the course assessment report. Course assessment is the process of measuring and evaluating the performance of a course against published course objectives and Program Outcomes. Integral to the process is the identification and implementation of strategies designed to improve the course.

Course assessment reports for AY 2010-2011 offer a number of suggestions for continuous process improvement for individual courses. Faculty actively incorporate feedback from course surveys, student performance in the course and assessment of learning objectives to improve and update course material. Areas where improvements to a course may impact other courses or prerequisites are discussed in detail at the semi-annual planning meeting. Binders containing individual faculty assessments for all courses offered each semester in engineering are maintained in our document room.

- Course Student Survey

Course student survey results are compiled each semester. Instructors receive results for each of their courses and aggregate data are made available to the SECCM allowing the instructor to compare his or her course performance to the SECCM average. In AY 2010-2011, the course student survey was conducted on-line and the results were provided to each faculty member. Faculty also use these results to make improvements in course delivery and content. This action directly addresses Criterion 4, Continuous Improvement of the Engineering Accreditation Standards.

- Alumni Survey

The Engineering Alumni Assessment Survey queries engineering graduates on a number of topics involving their preparation for the workplace, the program's preparation of them for the workplace, and their level of success.

The SECCM Alumni Assessment survey is conducted every other year. The most recent alumni survey was conducted in the summer of 2009. The survey follows a similar pattern to the exit survey with graduates of the program reporting their perceptions of program preparation and assessment of their ability to function successfully in the workplace. We also query our alumni with respect to our SECCM objectives. The Alumni Survey Results from the 2009 survey are included in section 3 of this chapter. In addition, both the University and the Career Center conduct an Alumni survey every year. We also use these results as a component of our continuous improvement philosophy.

- Graduate Employers

Employers who hire Engineering Program graduates provide a valuable source of feedback on the quality of program and its graduates. This feedback comes in two primary forms: informal discussion with engineering faculty members and employer willingness to hire additional graduates.

As the employment prospects for students continue to improve, employer feedback for the AY 2010-2011 timeframe included discussions with employers at career fairs and formal meetings. We also use national resources associated with the ASEE Engineering Dean's forum in assuring the our engineering program addresses employer expectations of student skill levels.

- Professional Advisory Board

The Engineering Professional Advisory Board provides an important source of program assessment. One of the important roles of the advisory boards is to periodically assess the curriculum to ensure its relevancy with regards to current industry needs and trends.

The Professional Advisory Board has been continually strengthened over the past year by the addition of new board members, establishment of a Board charter and handbook, and election of a Chair. The Board meets formally at RWU twice a year in Fall and Spring.

- Fundamentals in Engineering Examination

Beginning in the spring 2004, all graduating seniors were required to sit for the Fundamentals in Engineering Examination. The SECCM provides the students with financial and educational support in pursuit of the first step toward professional certification.

This national examination provides Engineering Program with an excellent opportunity to assess the program and its graduates not only against graduates from other programs, but also against practicing professionals.

For the April 2011 offering of the FE exam, a total of 47% of our students passed the exam on the first attempt, 15 students out of 32 taking the exam. This was the second year that students were able to select either the "other" afternoon exam or the "civil" afternoon option. Review sessions were held for only the "other" and "civil" afternoon exams.

All students with the exception of the Civil engineering students took the afternoon other exam. The breakdown for specific disciplines show that 33% of students specializing in Electrical Engineering passed the exam, 50% of the Civil Engineering students passed, 42% of the Mechanical Engineering students passed and of students reporting a general engineering major, 50% passed the exam.

RWU requires that all seniors take the FE exam, potentially impacting the overall pass rate. This year was also unique in that there were some December graduates included in the exam group. In some cases, students were missing certain classes necessary for Civil afternoon exam.

Since we offer our students a 45 hour FE preparation course as well as facilitate the application process, we were very interested in determining what factors most affect FE pass rates. Therefore, we perform extensive analysis on the role that GPA and attendance at review sessions play in contributing to pass/no pass decision. In 2011 attendance at review sessions was again a strong predictor of FE performance.

There were a total of 20 review sessions. The average number of sessions attended regardless of FE pass/no pass status was 14 sessions. For those students passing the FE exam, the average number of sessions attended was 16 sessions while for those not passing the FE exam the average number of sessions attended was 8. There were four students that chose not to attend any of the review sessions at all. They all failed. The average GPA of students passing the exam was 3.08, while for those not passing the exam, the average GPA was 2.75.

Table 2-2.6. 2011 Average GPA of Students Passing the FE Exam Compared to GPA of those not Passing the FE Exam

Pass FE	Mean	N	Std. Deviation
No	2.76	17	.37
Yes	3.08	15	.45
Total	2.90	32	.44

In addition to a means analysis, an ANOVA statistical procedure was performed on the data. The results of this analysis produced F statistics indicating a significant correlation between GPA, attendance at review sessions and FE pass/no pass status.

- Senior Design/Academic Showcase

Since the Spring of 2004, the Senior Design/Academic Showcase provides RWU students with an opportunity to showcase their academic and research projects. In 2011, seven student groups presented their senior design work in a combination of poster sessions and presentations to members of the RWU community as well as to representatives from companies and institutions. Feedback from Showcase attendees was extremely positive. Organizers of the event as well as judges commented on the professionalism of the student presentations and posters.

- Senior Skills Inventory

The senior skills inventory is a survey administered at the beginning of each engineering student's senior year of study. The objective of the survey is to allow seniors to self-assess their preparation for the workplace or for graduate study. The results from this survey are used to refine the Engineering Design class content to address any perceived technical/tool gaps among students. Secondly, the results of the survey allows faculty to assist students with the development of a personal plan for career or graduate school as well as closing knowledge and skill gaps.

Similar to previous years, skill gap areas for the AY 2010-2011 group of seniors involved perceived gaps in technical computer/programming as well as soft skills such as leadership and teaming skills, understanding the societal context of engineering, effective communication skills and presentation skills. As a result of these findings, the senior design class incorporated even more formal presentations specifically involving the Professional Advisory Board and other outside audiences. In addition, more opportunities for the students were provided to attend professional society meetings and attend conferences. For the third time in offering the class, students were also provided a recommended reading list of over ten books that specifically addressed some of the aspects of the societal context of engineering. Last, a number of new software programs were made available to the students. There were able to get exposure to the software through self-directed tutorials, special educational versions of software and conference workshops.

- Senior Job Placement Survey

The senior job placement survey assesses how well the School of Engineering as well as the Roger Williams University career center assists our students in the preparation for their job search or graduate school. The survey also collects job offer information, offer acceptance information and solicits input for improving the system.

As of August, 2011, all students graduating in May had accepted employment or committed to graduate school. Five students were accepted into and enrolled in graduate school,. The average salary for students graduating in May, 2011 was $52,000. For those students receiving offers, benefits packages were extensive and most included a profit sharing or pension participation plan.

- Student Competitions

In AY 2010-2011, engineering students participated in a number of competitions including the 21th Annual International Environmental Engineering Competition sponsored by WERC: A Consortium for Environmental Education and Technology located at New Mexico State University, the Eighth Annual Seismic Design Competition, the ASCE Concrete Canoe Competition, the EPA P-3 Competition, the RICC Robotics Competition and the ASEE Student Poster competition. Overall, the students' performance was excellent with four student groups taking top national prizes. Specifics of the competitions are presented in the next section, Major Design Experience.

- Major Design Experience

Since the senior capstone design class provides a major assessment opportunity that responds to each of the a-k learning outcomes, it is important to analyze this mechanism separately. Our students are prepared for engineering practice through a well-planned curriculum that culminates in a major design experience during their senior year of study. The two-semester class, ENGR 490 Engineering Design I (Fall), and ENGR 492 Engineering Design II (Spring) provides experience in the integration of math, science, engineering and computer science principles into a comprehensive engineering client-based design project. An open-ended design problem that emphasizes a multi-disciplinary approach to total system design provides the focus for the two semester course. Incorporated into the design problem are multiple alternative design paths encompassing a number of feasible and acceptable solutions. These solutions are subject to numerous realistic constraints involving performance, economic, social, manufacturability and quality requirements. Multidisciplinary design teams of students with different engineering concentration areas are required to generate alternatives, make practical approximations, perform appropriate analysis to support the technical feasibility of the design and make decisions leading to an optimized system design.

As students refine their design alternatives, they are expected to produce a working prototype. Working closely with an advisor team usually composed of a faculty member knowledge expert, a faculty member project expert, mentors from the project sponsor, and external mentors, student teams conduct periodic review presentations for their client ensuring the design meets the clients' needs and expectations. The primary goal of the course includes the delivery of a successful project to the client by the end of the second semester course. This is accomplished by each student fully participating in a multi-disciplinary, team-oriented, design project.

The types of projects that the Engineering Design classes undertake are similar to those commonly found in industry. These projects are typically characterized by participation of cross-functional employees working together in sharing a range of specializations (e.g., various disciplines within engineering, writing, science, management, and marketing). In participating in this design experience, students are provided with a forum for the synthesis of knowledge and skills acquired over the course of their college careers, and provided opportunities for the application of these competencies in undertaking a design project sponsored by a client partner.

Feedback and results from a number of assessment instruments and methodologies are used to both refine and improve the Senior Engineering Design class as well as to systematically monitor student's performance to assure learning outcomes are met. Students evaluate themselves, their team members, their mentors and the design experience as a whole. The instructor evaluates individual student performance, group performance, project deliverables, quality and mentor relations. External and internal evaluators assess group performance, presentation quality and prototype design. Last, external validation is derived from competition performance, student awards and student publications.

Overall, the AY 2010-2011 senior design students faired very well in terms of the external validation of their work.

Externally Validated Student Successes

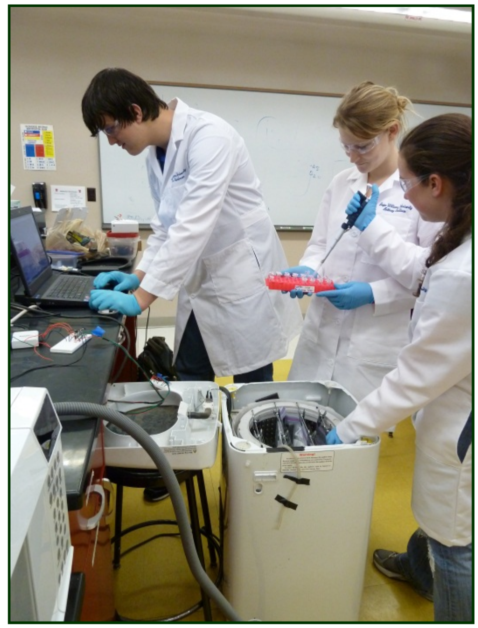
Students were widely recognized in several different competitions and events. Eight senior design teams participated in the 2010-2011 academic year. Their accomplishments are included on the following pages.

1. Eighth Undergraduate Seismic Design Competition Held in San Diego, CA

This was our fourth year participating in this competition.   After submitting a preliminary design solution to the competition organizers, the team was invited to present their solution at the competition in San Diego. They received a $900.00 travel grant to attend the 63rd Annual Earthquake Engineering Research Institute Meeting and make several presentations on their structure and design solution. The team performed very well at the competition beating teams such as Purdue, Georgia Tech and UCLA. They received high scores and bonuses in all categories while being awarded one of the top scores in architecture, a 9.5 on a 10 point scale. Below are photos of the final structure design, a rendering of the structure in the Chilean skyline where they sited their structure and a team photo.

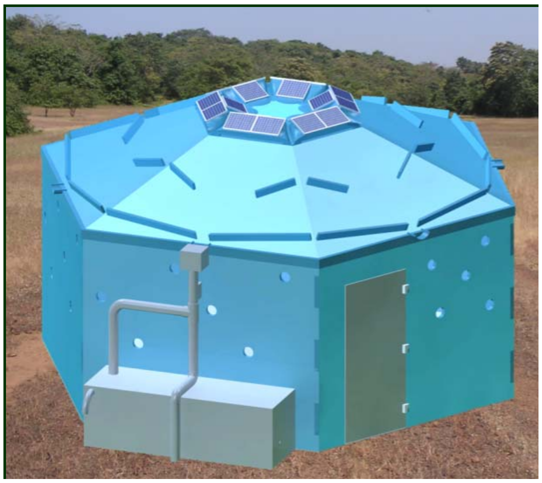
2. 21st International Design Competition sponsored by the Institute for Energy and the Environment in New Mexico.

This year, the senior team undertook a project sponsored by the FDA titled "The Design and Demonstration of a System to Duplicate Manual Massage of Leafy Greens." This project addressed the need for an automated system that could quickly and accurately detect e coli contamination in spinach. The team took second place overall for their project from among 20 teams at the competition and first place for their technical paper submission. The team received an $800.00 award to travel to Las Cruces, New Mexico and prize monies of $1,500.00. In Las Cruces, they participated in a four day competition demonstrating the solution to the task. Below are photos of the students and their solution to the task problem statement, the Pathogen Recovery Hydropulsator.



3. HOME Project – Presented at the American Society for Engineering Education Conference

The goal of this project was to create a transportable living environment for displaced populations that included water collection and filtration and energy storage and generation. This group was sponsored by an external client and worked primarily on the design and engineering analysis of the water and energy systems. The team performed extremely well taking first place among 30 undergraduate entries at the American Society for Engineering Education North East Conference Poster Competition. In addition, they had an original article, “Electrical Design of the HOME Structure” accepted for publication in the ASEE Conference Proceedings. They also won third prize in the undergraduate research publication competition at the ASEE conference. Last, they took a first place award at the RWU Academic Showcase.

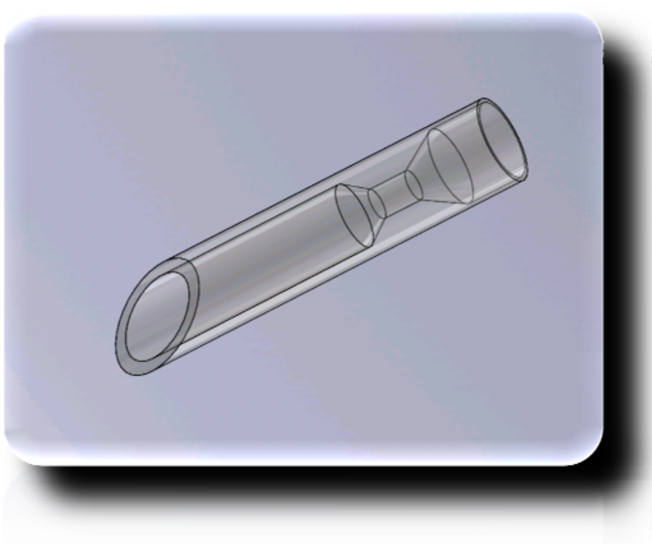


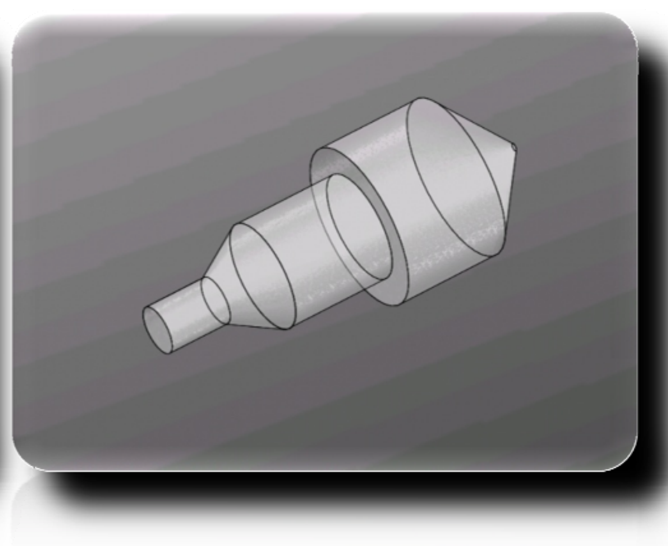
4. 2011 ASCE Concrete Canoe Competition

The 2011 Concrete Canoe Competition was sponsored by the University of Rhode Island and held in Charlestown, Rhode Island this year. The team accomplished some remarkable work with respect to the design and experimentation associated with the canoe. They engaged over 20 engineering students on the extended team used for canoe construction. In addition, they partnered with MouldCAM to utilize the largest CNC machine in the U.S. to construct their one piece mold. The team also was awarded a second place at the RWU Academic Showcase. Below are photos of the team and in Hawkworks with their extended team.

5. Bioengineering Project – Micro-Centrifuge Test Tube Design - Presented at the American Society for Engineering Education Conference

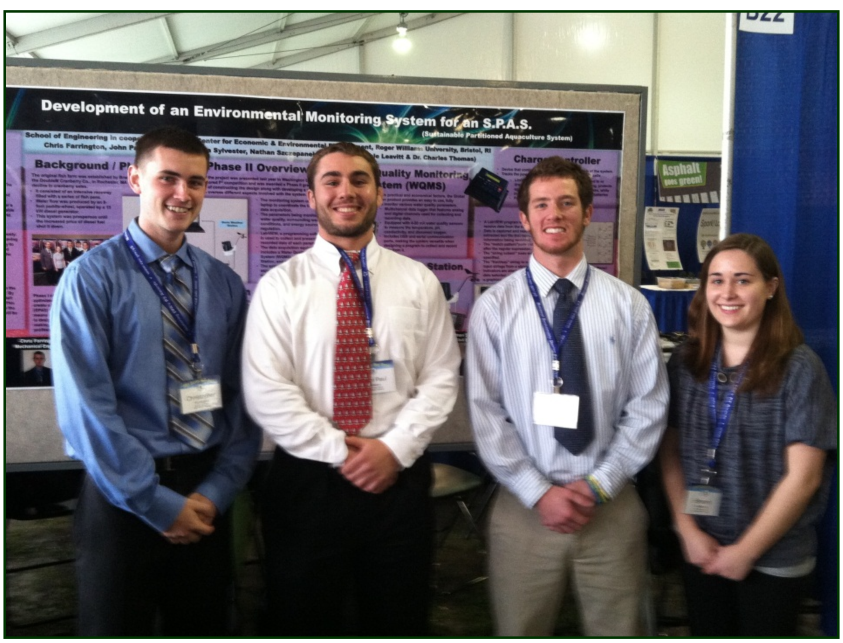
The Micro-Centrifuge Test Tube Design project was sponsored by the biology department at RWU. The project involved designing and fabricating a new test tube design that would allow for the measurement of cell adhesion between cells and various surfaces. The team fabricated a number of test tube prototypes and finally achieved a design that met the sponsor's specifications and was an entirely new entrant to the market. Consequently, the team is in the process of applying for a provisional patent on the design. Last, the team presented their work at the ASEE NE Regional conference and received an honorable mention for their poster presentation. Below are photos of the team and a rendering of their prototype test tube and cap.





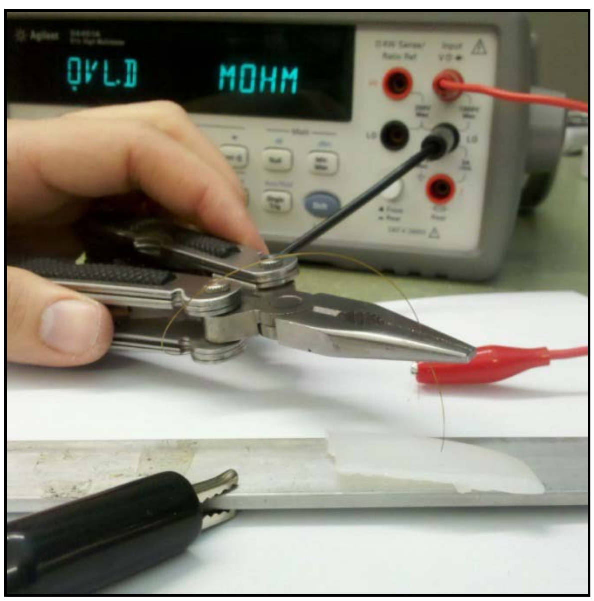
6. EPA P3 Competition

For this project, a team of four engineering students worked on Phase II of a design problem associated with an EPA grant. This work was a continuation of the Phase I project started last year that involved designing an alternative powered fish grow-out system. From the work of the Phase I senior design group, the project was awarded $75,000 to implement the system. The Phase II team worked on the design and implementation of a control system for the Sustainable Partitioned Aquaculture System. The students presented their design at the 7th Annual National Sustainable Design Expo in Washington D.C. Below are photos of the team in Washington.



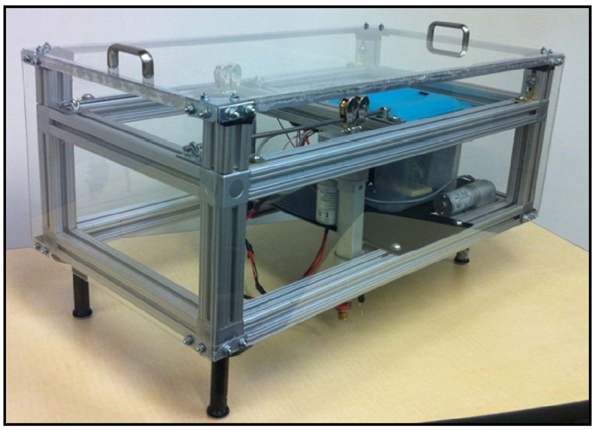
7. Pratt & Whitney Project – Blocked Hole Detection System

This project was sponsored by Pratt & Whitney and involved addressing one of the company's manufacturing challenges. The primary objective of the project was to develop and test three options for a system that could detect a blocked hole in a turbine blade without burning out the polyfil backing material. The client also included several additional design considerations. In the end the team created a solution to the challenge using continuity testing that achieved superior results to what Pratt & Whitney is currently using in practice. This team presented their research in a poster presentation at the ASEE North East Conference and was awarded a second place for their work at the competition. Below are photos of the group at the competition and of experiments with continuity testing of their system.



8. Robotics Innovation Conference and Competition – LADIMR (Linear Actuator Driven Ice Mule Robot)

The final team participated in the RICC (Robotics Innovation Conference and Competition). This competition charged the students with designing a robot that used unconventional means for mobility. The team's entrant, LADIMR (Linear Actuator Driven Ice Mule Robot) used four-linear actuators, two horizontal and two vertical, that moved in unison to pull itself across the surface of a frozen body of water. At the ends of the two vertical actuators were custom fabricated heating elements composed of disassembled car cigarette lighters, copper plumbing fixtures, and modified ceramic fuses. The team performed very well at competition as the only undergraduate team winning an award. The team took third place winning $1,000.00 for their robot, presentation and technical paper. Below are photos of LADIMR, the team and their display at the competition.



Finally, at the Roger Williams University Academic Showcase, our students were recognized with three school awards. In first place was the HOME group, in second place was the Concrete Canoe team and in third place was the WERC team.

Section 3: Program Objectives Efficacy Assessment

Engineering program objectives are listed in Table 2.3-1, RWU Engineering Program Educational Objectives. Program objectives indicate what we expect our graduates to achieve three to five years after graduation.

Table 2.3-1. RWU Engineering Program Educational Objectives

Objectives – Three to Five Years After Graduation, We Expect Our Graduates To:
1. Possess an inquisitive mind, demonstrate excellence in technical knowledge and skills, achieve success as a practicing engineer or graduate student, and apply the highest ethical standards in all pursuits.
2. Value the concept of, and demonstrate through practice, activities and actions that contribute to continual intellectual growth.
3. Advance the engineering profession by becoming actively involved in professional associations and societies, serving in professional and community volunteer positions, acting as a role model for the future generation of engineers, and assisting the SECCM Engineering Program in achieving its mission and goals.

These three program objectives are consistent with the mission and goals of the School of Engineering, Computing and Construction Management.

According to the Alumni Survey conducted in summer 2009, substantive evidence that the Engineering Program educational objectives are being accomplished was gathered. That evidence is presented below.

- **Objective 1, Success as a Practicing Engineer**

One construct necessary for defining “success as a practicing engineer,” is the determination of what our alumni, employers and professional societies deem as the most important factors impacting success as engineers in the workplace. When asked to report the factors most impacting their success in the work, graduates had some very interesting responses as presented verbatim below.

Technical skills - Need to be able to perform calculations in order to do your job.

Productivity - As a grad student, you are the only one that works on your project - you have to be productive if you want to succeed.

Breadth of knowledge - The fact that I have a foundation in more than one discipline make me all around valuable.

Knowing how to learn on your own - Very little of what is taught is actually applied in structural engineering. You must apply your ability to learn on your own.

Confidence - People come to me for direction. Confident people also ask questions to get the answer even if they don't know. People trust someone who is confident.

Organization - Keep track of projects/calculations/clients and tasks. Important for communication. Can't waste time looking for materials.

Dedication - Success is directly proportional to how dedicated and how hard I work.

Willing to learn new things - I've had 2 jobs in which I used very little of the material I learned in school. RWU taught me how to learn.

Experience - Like what you do. It's important to enjoy work if it's going to be a big part of your life.

Working with others - There are many people with input and requirements with projects we work on.

Communication skills - You need to be able to communicate within your office to clients and to contractors.

Organization - Must be organized to keep yourself on track as well as anyone else you may be working with.

Professionalism - In preliminary design, presentation of ideas is critical for the image of your company.

Knowing AutoCAD - Though I don't draft it is imperative to be proficient in this area.

Problem solving - Every design or every system is one giant problem to be solved.

Hard work/ passion - Your work needs to be "made with love". Must constantly back-check assumptions. If you don't like or want to check, your work suffers, this means more dollars spent.

People skills/ Communication skills - Daily interaction with peers, management, workers, etc. requires this factor.

Public speaking - Not many engineers are very good speakers. If you can learn the material and speak well, you are ahead of many others.

Problem solving - Co-workers respect your opinion/ideas/work. Confirms positive job performance and teamwork.

Communicate - No communication will lead to failure.

Management Skills - Time management of yourself as well as fellow employees as a way to stand out amongst peers.

Motivation - You have to want to succeed. Success just doesn't happen on its own.

Ethics - When it comes to big dollars, this is paramount.

Communication - 80% of my day is phone calls, meetings, and emails.

Interpersonal skills - The more people that work well with you the more you can ask questions. Lots of time spent dealing with people requires excellent interpersonal skills.

Multi-task - Swap between jobs. Must fill down time with smaller tasks. Multiple people need things "yesterday."

Focus - Eliminating distractions and focusing effort adds to success.

Good writer - All jobs require a lot of writing and many people aren't that good at it (some of them).

Completing projects with desirable results - Builds confidence and a sense of pride knowing you're doing your job well.

Furthermore, to determine if we are accomplishing program objective one, we ask our graduates to report to us how well we prepared them in each area they consider important to their success.

From the 2009 alumni survey, on a scale of 1 to 5 where five means not important at all and 1 means extremely important, our graduates reported that the number one factor impacting their success in the workplace was oral communication. Oral communication was also identified as the number one factor impacting success in the 2005 and 2007 survey of alumni. Table 2.3-2, Alumni Perceptions of Engineering Success Factors, shows the top five topic or skill areas that alumni reported as most important to their success in the workplace. In addition, the table shows how well their RWU education prepared them in each of the success areas. Last, the table reports the gap measure between the two. What is significant about these questions is that compared to the 2007 survey, alumni are reporting much smaller gap areas. In most cases the gaps have been closed by over 50%.

Table 2.3-2. Alumni Perceptions of Engineering Success Factors

Topic and Skill Areas	How important is each of the following topics to your success in the workplace?	How well did your RWU education prepare you for each of the following areas?	Gap Measure
Oral communication	1.36	1.63	0.27
Problem solving skills	1.36	1.54	0.18
Ability to use most current technical tools	1.45	1.72	0.27
Lifelong learning	1.54	1.90	0.36
Ability to apply technical knowledge	1.55	1.81	0.26

Our employer survey conducted with potential employers of our graduates during career fairs and on-campus visits also asked what were the most important factors defining success for engineers in their organizations. Once again, employers continue to stress the importance of communication, problem solving ability and ability to work in a team environment.

- **Objective 2, Lifelong Learning**

Engineering program objective two focuses on the appreciation for lifelong learning. This was another area where engineering alumni perceived a slight gap in their preparation level from an educational perspective. However, this area showed significant improvement from the last alumni survey. This improvement is in part a direct result of the institution of the FE review program and requirement that seniors must take the FE exam. Also, more external professional speakers have been introduced through the senior seminar class. Graduates rated this factor at a mean of 1.54 on a five point scale, (where 5 means not important to success, and 1 means extremely important to success), and rated their preparation at RWU at a 1.90 on a five point scale. This resulted in a gap of .36.

Our alumni survey questioned graduates of our program at the 2, 3 and 4-year time frame. A total of 92% of all of these graduates reported that they had participated in courses, seminars or workshops since graduating from RWU. The mean number of courses, seminars or workshops participated in for this group was approximately 9. Furthermore, 64% of our graduates were currently enrolled in studies for, or had completed an advanced degree at such institutions as: Columbia, New Jersey Institute of Technology, Northeastern University, Norwich University, University of Connecticut, University of New Haven and Worcester Polytechnic Institute.

Again, the increases in percentages of alumni attending graduate school and participating in professional development courses was noteworthy compared to the 2007 survey results that showed only a 42% participation rate.

Some of the names of the courses, workshops and seminars that our graduates had participated in were:

1. Advanced dynamics
2. Finite element analysis
3. Numerical analysis
4. Advanced heat transfer
5. Matrix methods in mechanical engineering
6. Advanced thermofluids
7. Heat and mass transfer in multi-phase systems
8. Applied probability
9. Digital communications
10. Statistical and adaptive signal processing
11. Digital signal processing
12. Project management
13. HVAC workshops
14. Systems integration and test
15. Structural concrete and steel design
16. Water resources for drainage design
17. Soil mechanics for construction specifications
18. Best management practices

It is clear that the concerted emphasis on incorporating more appreciation for lifelong learning into the curriculum and extra-curricular activities has significantly impacted our graduates' behavior. Over the past six years, we have incorporated more emphasis on the concept of lifelong learning into our senior seminar and engineering design courses. This was accomplished by having guest speakers and faculty stress the value of lifelong learning; discuss available options for lifelong learning including certificate programs, advanced degrees and the necessity of maintaining currency in the engineering field. We also are providing more opportunity for our present students to participate in field trips to local engineering companies and for external speakers from NCEES and ASCE to make presentations to our students specifically addressing lifelong learning. Last, we are working with the RWU Career Center to facilitate engineering internships, externships and summer employment for our present students to expose them as soon as possible in their studies to engineering professionals.

- **Objective 3, Actively becoming involved in the profession**

One construct for involvement in the profession is professional licensure or certification. One of our major assessment tools for present students is the Fundamentals of Engineering exam. In our Engineering Program objectives, we expect our graduates to pursue professional licensure either as a Professional Engineer or in some other area related to the graduate's present employment. Overall, 50% of our responding graduates were pursuing some type of engineering related licensure. This is a decrease from 80% from the 2007 survey. Table 2.3-3, Professional Licensure Areas of RWU Engineering Graduates, shows the different areas where our graduates are either studying for, or have achieved licensure or certification.

Table 2.3-3. Professional Licensure Areas of RWU Engineering Graduates

Licensure or Certification Area
Professional Engineer
Engineer in Training
Corrosion Specialist
Pressurized water reactor engineer operating license

Another construct measuring this objective involves the number and types of professional associations to which are our graduates belong. Interestingly, 46% of our graduates were members of one or more professional societies. Table 2.3-4 shows the different professional societies where RWU engineering graduates held membership.

Table 2.3-4. Professional Societies of RWU Engineering Graduates

Professional Societies
American Society of Civil Engineers
American Society of Mechanical Engineers
American Concrete Institute
Society of Women Engineers
National Society of Professional Engineers
ACE Mentor Program

Overall we have begun reviewing whether there is too much overlap between our engineering objective two and three. For example, our students far exceeded our expectations with respect to continuing education and life-long learning, yet this did not translate into professional certification as a P.E. or other. The reality involving the perceived value of a PE outside of Civil Engineering is an area to be further monitored and explored. Our objective 3 is a much more difficult objective for us to impact after requiring all students take the FE exam. So much of the PE licensure process specifically involves factors outside of our control.

- **Encompasses all Objectives, Improving Our Program**

We greatly value the experience and input from our alumni constituency. Therefore, we continually seek opportunities for improving our program. One method of soliciting input for program, facility and resource improvements is by asking our alumni several questions concerning how we can provide a better educational experience for our present graduates that will optimally prepare them for successful engineering careers. We ask our graduates if there were any activities, programs or courses that were not offered when attending RWU that would have better prepared them for the workforce and their career. Alumni feedback from the 2009 survey is presented below.

- Need for code study courses.
- Full course on Matlab.
- More drafting in conjunction with design projects.
- Though I personally like Visual Analysis, no one in the industry is using it. A more appropriate program would be E-tabs or SAP 2000.
- MAPLE in the math classes is useless. MathCAD is amazing and has been valuable tool in career.
- Geometric dimensioning and tolerancing. Etiquette training was very helpful. Most engineers do not pay enough attention to their appearance. Looking professional and being confident are huge plusses that make one person stand out from the rest.

- Traffic engineering.
- Real life design projects.
- Nuclear engineering courses.
- More advanced fluids courses.
- Systems engineering.
- Department of defense acquisitions.
- SolidWorks.
- Digital signal processing with lab.
- A few more practical classes like engineering construction methods, computer courses.
- Require/really push internships, employers like experience more than anything.
- Communication with others who don't speak English as a primary language (communicate with other countries).
- More geometric dimensioning and tolerancing (use it all the time).
- Basic computer programming (use it more than I would have thought-PLC, Visual Basic)
- For students looking into grad school, Matlab and other programming skills are essential.
- MathCad is great tool but students need Matlab as well and also Fluent, C++, etc.
- Having separate steel, concrete and wood classes would allow a greater depth of education. Also there was no focus on knowing codes. Important to be familiar and to be able to navigate the codes. Recommend IBC and ACI.
- Incorporate electric motors into the curriculum. It's too important of a tool to not cover in specifics.
- Make strong contacts w/ engineering firms. Sure career center should but doesn't. Have guest speakers (out of class time). Field trips to job sites- can't engineer unless you know how they build it.
- Make the students work out the arithmetic instead of providing them with simple formulas. I have found that not everything comes from a reference manual.
- More leadership opportunities in class.
- More interpreting data, putting together a project, presenting data, project, what results were found, etc.
- Provide more hands on experience. I work in an operational job. Before, I worked in design engineering. I've learned much more from hands on experience.

There is consensus that the Engineering Program objectives are appropriate as presented with a review of objective three proposed for the upcoming assessment cycle. As indicated in our assessment plan, these objectives are periodically reviewed by our constituent base.

Section 4: Engineering Program Educational Outcome Efficacy Assessment

Engineering program outcomes correspond to the knowledge, skills and behavior that are we expect our engineering graduates to possess at the time of their graduation. These outcomes are established and periodically updated based on constituency input. The outcomes for Engineering Program that we expect our graduates to possess at graduation are:

a. an ability to apply knowledge of mathematics, science, and engineering
b. ability to design and conduct experiments, as well as to analyze and interpret data
c. an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability and sustainability
d. an ability to function on multi-disciplinary teams
e. an ability to identify, formulate and solve engineering problems
f. an understanding of professional and ethical responsibility
g. an ability to communicate effectively
h. the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context

i. a recognition of the need for, and an ability to engage in lifelong learning
j. a knowledge of contemporary issues
k. an ability to use the techniques, skills and modern engineering tools necessary for engineering practice

These program outcomes are related to the Engineering Program educational objectives as presented in Table 2.4-1, Engineering Program Educational Objectives linked to Engineering Program Outcomes.

Table 2.4-1, Program Educational Objectives linked to Engineering Program Outcomes

🔴 = **Weak Relationship** 🔵 = **Moderate Relationship** 🟢 = **Strong Relationship**

A – K Outcomes	Inquisitive mind, excellence in technical skills and knowledge, success, high ethical standards	Lifelong intellectual growth	Advance the engineering profession, service, role model, assist SECCM
a. an ability to apply knowledge of mathematics, science, and engineering	🟢	🔵	🔵
b an ability to design and conduct experiments, as well as to analyze and interpret data	🟢	🔵	🔵
c. an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability and sustainability	🟢	🔵	🔵
d. an ability to function on multi-disciplinary teams	🟢	🟢	🔵
e. an ability to identify, formulate and solve engineering problems	🟢	🟢	🔵
f. an understanding of professional and ethical responsibility	🟢	🟢	🟢
g. an ability to communicate effectively	🟢	🟢	🟢
h. the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context	🟢	🟢	🟢

A – K Outcomes	Inquisitive mind, excellence in technical skills and knowledge, success, high ethical standards	Lifelong intellectual growth	Advance the engineering profession, service, role model, assist SECCM
i. a recognition of the need for, and an ability to engage in lifelong learning	●	●	●
j. a knowledge of contemporary issues	●	●	●
k. an ability to use the techniques, skills and modern engineering tools necessary for engineering practice	●	●	●

All Engineering Program outcomes are operationalized through a process where each faculty member analyzes his or her courses and assigns a measure to the amount of material in the course that corresponds to each outcome. This process is further articulated by having each faculty member review a series of operationalized items associated with each outcome and determining whether certain learning objectives and competencies associated with the specific outcome are covered.

Table 2.4-2 Course Mapping to Expected Engineering Student Outcomes, shows the result of the faculty assessment of exactly how much of the course material supports the achievement of the specific outcome. The input for this table is the respective course outcomes analysis prepared by each faculty member.

Core concentration and core specialization courses outcomes forms are filled out by the Engineering Program Coordinator in collaboration with faculty members teaching these courses based on a review of course material as well as personal interviews.

Table 2.4-2. Course Mapping to Learning Outcomes

Outcome Courses	A: Apply knowledge of math, science and engineering	B: Design and conduct experiments, analyze/ in-terpret data	C: Design system, component or process	D: Function on multi-disciplin-ary teams	E: Identify, formulate and solve engineering problems	F: Under-stand pro-fessional and ethical behavior	G: Commun-icate effectively	H: Broad education to understand impact of engineering	I: Ability to engage in lifelong learning	J: Know-ledge of Contemp-orary issues	K: Modern engineer-ing tools
ENGR 110 Engr. Graphics and Design	10%		50%	50%	50%	10%	50%				50%
ENGR 115 Computer Apps for Engineering	100%	80%			100%		30%				60%
ENGR210 Engr. Mechanics I (Statics)	100%				100%		40%			10%	100%
ENGR 220 Engr. Mechanics II (Dynamics)	100%	10%		70%	100%		10%		10%		100%
ENGR 240 Circuit Theory and Lab	100%	20%	20%	20%	100%	10%	20%				80%
ENGR 260 Engr. Electronics and Lab	100%	20%	20%	20%	100%		30%				80%
ENGR 270 Digital Systems Design and Lab	100%	20%	20%	20%	100%		20%				80%
ENGR 300 Mechanics of Materials & Lab	100%	100%		30%	30%						50%
ENGR 305 Fluid Mechanics and Lab	100%	60%		40%	100%		80%	10%	20%	10%	100%
ENGR 310 Materials Science	100%	10%	10%		80%		20%	10%	20%	10%	90%

Outcome / Courses	A: Apply knowledge of math, science and engineering	B: Design and conduct experiments, analyze/ in-terpret data	C: Design system, component or process	D: Function on multi-disciplin-ary teams	E: Identify, formulate and solve engineering problems	F: Under-stand pro-fessional and ethical behavior	G: Commun-icate effectively	H: Broad education to understand impact of engineering	I: Ability to engage in lifelong learning	J: Know-ledge of Contemp-orary issues	K: Modern engineer-ing tools
ENGR 313 Structural Analysis	80%		10%		80%		10%		10%		80%
ENGR 320 Environmental Engineering	100%	40%	20%		100%	20%	20%	100%	10%	100%	100%
ENGR 330 Thermo-dynamics	100%	10%		10%	80%		30%	20%	10%	30%	70%
ENGR 335 Engr. Economic Analysis	50%	50%			100%	20%	100%			100%	50%
ENGR 401 Engineering Senior Seminar						30%	40%	10%	40%	10%	
ENGR 405 Air Pollution and Control	100%	20%	20%		100%	20%	40%	100%	10%	100%	100%
ENGR 407 Solid and Hazardous Waste Management	100%	10%	40%		100%	20%	40%	100%	10%	100%	100%
ENGR 409 Structural Design I	100%		100%	30%							50%
ENGR 412 Water Resources Engr. and Lab	100%	100%	20%	30%	50%						50%
ENGR 413 Adv. Structural Analysis	100%				50%						50%
ENGR 414 Geotechnical Engr. and Lab	100%	100%	20%	30%	50%						50%

Outcome **Courses**	**A: Apply knowledge of math, science and engineering**	**B: Design and conduct experiments, analyze/ interpret data**	**C: Design system, component or process**	**D: Function on multi-disciplinary teams**	**E: Identify, formulate and solve engineering problems**	**F: Understand professional and ethical behavior**	**G: Communicate effectively**	**H: Broad education to understand impact of engineering**	**I: Ability to engage in lifelong learning**	**J: Knowledge of Contemporary issues**	**K: Modern engineering tools**
ENGR 415 Water and Wastewater Treat and Lab	100%	40%	40%		100%	10%	40%	100%	10%	100%	100%
ENGR 417 Groundwater Hydrology	100%		10%		50%						70%
ENGR 424 Digital Signal Processing	100%		10%		70%						70%
ENGR 430 Transportation Engineering	30%		40%		40%		20%	20%		50%	50%
ENGR 430 Engineering Measurements	50%	90%	30%				70%		20%	20%	20%
ENGR 430 Sustainable Energy Systems	30%		30%		50%						70%
ENGR 431 Mechanical Vibrations	100%	40%	100%	70%	100%		10%		10%		100%
ENGR 433 Heat Transfer	100%	10%	10%	20%	70%	10%	30%	10%	10%	10%	40%
ENGR 445 Dynamic Model and Control	100%	30%	20%		100%		20%				100%
ENGR 450 Mechatronics	10%	40%	50%	80%	50%		10%				50%
ENGR 455 Data Communication						100%				100%	

Outcome / Courses	A: Apply knowledge of math, science and engineering	B: Design and conduct experiments, analyze/ interpret data	C: Design system, component or process	D: Function on multi-disciplinary teams	E: Identify, formulate and solve engineering problems	F: Understand professional and ethical behavior	G: Communicate effectively	H: Broad education to understand impact of engineering	I: Ability to engage in lifelong learning	J: Knowledge of Contemporary issues	K: Modern engineering tools
ENGR 465 Network Analysis and Design						100%	100%			100%	
ENGR 490 Engr. Design I	80%	50%	80%	80%	100%	50%	70%	100%		20%	100%
ENGR 492 Engr. Design II	90%	70%	90%	100%	100%	50%	80%	100%		30%	100%
COMM 210 Intro to Public Speaking		10%		20%	10%	30%	100%	10%			
COMSC 110 Intro. to Comp. Science	40%	10%		20%		10%	20%	10%	10%		20%
COMSC 111 Data Structure and Lab	20%	30%	10%	10%	10%	10%	20%		10%		10%
COMSC 210 Principles of Computer Org. and Lab			20%	10%	20%	10%	10%	10%	30%		10%
COMSC 220 Analysis of Algorithms	40%	50%			30%	30%	10%		20%		
COMSC 230 Principles of Programming Languages		10%	10%		10%		50%	10%	10%		90%
CNST 302 Surveying and Lab	100%	100%	100%	100%	100%	20%	100%	100%	100%		100%

Outcome / Courses	A: Apply knowledge of math, science and engineering	B: Design and conduct experiments, analyze/ in-terpret data	C: Design system, component or process	D: Function on multi-disciplin-ary teams	E: Identify, formulate and solve engineering problems	F: Under-stand pro-fessional and ethical behavior	G: Commun-icate effectively	H: Broad education to understand impact of engineering	I: Ability to engage in lifelong learning	J: Know-ledge of Contemp-orary issues	K: Modern engineer-ing tools
CNST 455 Electrical and Mechanical Design of Bldgs.	90%	40%		20%	90%		50%	40%	50%	20%	50%
CORE 102 History/Modern World				60%		30%	80%		20%	50%	
CORE 103 Human Behavior		20%		10%			50%		10%	20%	
CORE 104 Literature and Philosophy						30%	80%		10%	20%	
CORE 105 Artistic Impulse				100%		20%	80%		60%		
CORE 430 Technology, Self & Society				50%		50%	50%	100%	100%	100%	
MATH 213 Calculus I and Lab	100%										
MATH 214 Calculus II and Lab	100%				100%		100%		100%		
MATH 315 Probability and Statistics	100%	100%			100%		100%		100%		
MATH 317 Diff. Equations	100%										
MATH 330 Engineering Math	100%				100%				100%		
WTNG 102 Expository Writing		10%		20%		10%	100%	10%	20%		

Outcome Courses	A: Apply knowledge of math, science and engineering	B: Design and conduct experiments, analyze/ in-terpret data	C: Design system, component or process	D: Function on multi-disciplin-ary teams	E: Identify, formulate and solve engineering problems	F: Under-stand pro-fessional and ethical behavior	G: Commun-icate effectively	H: Broad education to understand impact of engineering	I: Ability to engage in lifelong learning	J: Know-ledge of Contemp-orary issues	K: Modern engineer-ing tools
WTNG 220 Critical Wtng. for Professions						20%	70%				
CHEM 191 Chemistry I and Lab	100%	100%		10%			50%			10%	
CHEM 192 Chemistry II and Lab	100%	100%		10%			50%			10%	
CHEM 201 Envr Chemistry I	100%	100%		20%			50%			10%	
PHYS 201 Physics I and Lab	100%	30%				10%	20%	10%	10%		
PHYS 202 Physics II and Lab	100%	30%				10%	20%	10%	10%	10%	

After reviewing operationalized outcomes for each a-k item, engineering constituencies review and refine metrics associated with each outcome. The tables in this section show the metrics associated with each outcome and where the metric is measured. Following each table is an assessment of how well our students are meeting the metrics associated with each outcome supported by qualitative and quantitative data gathered on a regular basis. The information following the table is only a sampling of the type of analysis we conduct to identify opportunities for process and program improvement.

Table 2.4-3. Outcome “a” Metrics

Outcome a: an ability to apply knowledge of mathematics, science, and engineering	
Metrics Associated with Outcome a:	**Where Measured**
1. Engineering student pass rate of the FE exam meets or exceeds national average for Masters granting Universities	Fundamentals in Engineering Examination
2. For each required engineering course with a prerequisite in mathematics, science or engineering, at least 75% of the students who have C or better in the prerequisite course pass the course on the first attempt.	Transcript Review
3. All graduating seniors report that they have achieved proficiency in the ability to apply knowledge of mathematics, science and engineering to solve engineering problems. Proficiency is defined of a score of 1 or 2.0 on a 5 point scale.	Course Student Survey Student Exit Survey
4. At least 95% of students are evaluated by sponsors as completely fulfilling the senior design capstone project requirements.	Senior Design Showcase Graduate Employers
5. Faculty report no systemic deficiencies in student learning in basic engineering courses	Engineering Faculty Course Assessment Report
6. At least 85% of all alumni rate their preparation by RWU for the workplace in the ability to apply knowledge of mathematics, science and engineering as good to excellent.	Alumni Survey

2010 - 2011 assessment of outcome a: ability to apply knowledge of mathematics, science, and engineering.

Metrics 2 through 6 were met or exceeded.

Metric number 1. FE exam results. As a result of historical FE pass rates of RWU engineering majors prior to 2005, a major emphasis has been placed on preparing all of our students to take the FE exam and achieve pass rates greater than the national average for our NCEES comparison category. Table 4.11 shows the pass rates for engineering majors for the past 12 years. Of note in this table is the improvement in scores once the FE campaign was initiated. However for the April, 2011 offering of the exam, our students did not perform as well as anticipated.

In the 2011 engineering student exit survey, 100% of all graduating seniors reported that they had sat for the FE exam. Furthermore, one of the highest rated factors in graduating seniors’ assessment of their proficiency levels was in the recognition of the need for life-long learning.

Table 2.4-4. FE Pass Rates for Engineering Majors for the Years 2000 through 2011

Exam Date	Total Examinees	No. Passing	Percent Passing	National Percent Passing	Gap
April 2000	22	10	45.4%	63%	17.6%
April 2001	12	6	50.0%	66%	16.0%
April 2002	17	12	70.6%	81%	10.4%
April 2003	14	6	42.8%	75%	32.2%
April 2004	12	6	50.0%	74%	24%
April 2005	21	17	81.0%	81%	0%
April 2006	18	13	72.0%	73%	1%
April 2007	17	11	65.0%	65%	0%
April 2008	25	16	64.0%	71%	7%
April 2009	30	21	70.0%	76%	6%
April 2010*	25	15	60.0%	63%	3%
April 2011*	32	15	47.8%	70%	23%

* Includes 2 repeat takers.

Table 2.4-5. Outcome "b" Metrics

Outcome b: an ability to design and conduct experiments, as well as to analyze and interpret data	
Metrics Associated with Outcome b:	**Where Measured**
1. At least 95% of all Engineering students demonstrate a proficiency in the design and conducting of experiments as well as in the analysis and interpretation of data. Proficiency is defined as a score of either a 1 or 2 on a 5 point scale.	Engineering Faculty Course Assessment Report Senior Exit Survey
2. At least 20% of all Engineering students will participate in a competition/conference where their ability to design and conduct experiments and analyze and interpret data will be externally judged and assessed.	Student Competitions
3. All graduating seniors report that they have achieved proficiency in the ability to apply knowledge of mathematics, science and engineering to solve engineering problems. Proficiency is defined of at least a score of 1 or 2 on a 5 point scale.	Student Exit Survey
4. At least 85% of all alumni rate their preparation by RWU for the workplace in the ability design and conduct experiments as well as to analyze and interpret data as good to excellent.	Alumni Survey
5. Course binders for the courses reporting a direct contribution to accomplishing Outcome b show examples of experimental design and analysis of designed experiments for each student in the class. An independent evaluator determines that at least 85% of the work is satisfactory.	Course Binders Engineering Faculty Course Assessment Report

2010 - 2011 assessment of outcome b: an ability to design and conduct experiments, as well as to analyze and interpret data

Metrics 3, 4 and 5 were met.

Metric 1: 95% of engineering students will demonstrate a proficiency in the ability to design and conduct experiments as well as to interpret data. Faculty course assessment reports indicated that engineering students require more applied examples and training in design of experiments. Although students were exposed to design of experiments in several engineering classes, as well as the probability and statistics class, the treatment of the topic varied depending on the class. This fact was validated with a review of course binders. When students reached Senior Design class, a foundation in a common DOE terminology and approach was lacking. Faculty assessment of a DOE proficiency level at the beginning of senior year was 70%. At the end of senior year, faculty assessment of proficiency among students had risen to 90%. This was a result of two key factors. The first involved highlighting this point in the faculty semi-annual planning meeting and discussing strategies involving how to address it. The second involved introducing DOE learning modules into Senior Design class to develop a common terminology and engineering approach. Presently, an initiative with the Mathematics Department is under development that will review the Probability and Statistics course offered to Engineers. The discussion will address the philosophy of course delivery and how to incorporate more applied engineering examples into the course.

Interestingly, from the 2011 senior exit survey, students rated their proficiency in the ability to design and conduct experiments at a 1.37 on a five point scale where 1 means proficiency achieved and 5 means proficiency not achieved.

Metric 2: 20% of engineering students will participate in an event or competition requiring the incorporation of DOE methods and applications. We believe that student competitions that stress formal Engineering design and analysis paradigms are an excellent venue for students to apply DOE techniques. Although we met the 20% metric for competition at the senior student level, (in fact for the senior class 100% of all students participated in a conference and/or competition) we missed the target for all other student levels. Some minor success was made in introducing non-senior students to competitions, still a great deal of work has to be done to meet this metric.

A goal for the 2011-2012 academic year will include greater emphasis on involving freshmen, sophomores and juniors in engineering competitions to provide opportunities for more applied experience in the realm of DOE. A new policy will be instituted in the senior design class where each competition team will have at least two undergraduate students as full members of the team. It is expected that these students will also travel to the competition with the senior team.

Table 2.4-6. Outcome “c” Metrics

Outcome c: an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability and sustainability	
Metrics Associated with Outcome c:	**Where Measured**
1. 100% of Engineering students participate in a Senior Multi-Disciplinary Capstone Class that involves a year long design project that demonstrates their ability to **successfully** design a system, component or process to meet client needs within specified constraints.	Engineering Faculty Course Assessment Report Transcript Review
2. 100% of all senior Engineering design groups, not involved in external competitions, participate in the University’s Academic Showcase.	Academic Showcase Competitions/Conferences Graduate Employers
3. All seniors report that they have successfully integrated their engineering and CORE curriculum culminating in the design of their senior capstone project. Success is defined of at least a score of 2.0 on a 5 point scale.	Senior Skills Inventory Course Student Survey Faculty Course Assessment Report
4. At least 50% of upper-division engineering courses and 25% of lower division engineering courses give students the opportunity to design systems, components or processes considering specified constraints.	Course Binders Engineering Faculty Course Assessment Report
5. At least 65% of engineering students will have accepted a job offer or have been accepted to graduate school before the conclusion of Spring semester.	Senior Job Placement Survey
6. 100% of those graduates that were seeking employment will have a job within 6 months of graduation.	Alumni Survey

2010-2011 assessment of outcome c: an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability and sustainability

Metrics 1, 2, 4, 5 and 6 were met.

Metric 3: Seniors once again have reported continued dissatisfaction with the CORE curriculum. In addition, senior exit surveys from the past 8 years have shown a low level of satisfaction among seniors with respect to the external CORE, (general education) courses.

Table 4.14 presents the results from the senior exit survey with respect to senior perceptions of the CORE curriculum.

Table 2.4-7. Senior Perceptions of CORE Curriculum for the Years 2003 through 2011

Exit Survey	Score on a Scale of 1 to 5 where 1 means very satisfied and 5 means very dissatisfied
May 2003	4.0
May 2004	3.5
May 2005	3.3
May 2006	3.2
May 2007	3.0
May 2008	2.5
May 2009	2.9
May 2010	3.2
May 2011	2.8

Since 2005, to further explore student's perceptions of the CORE curriculum, additional questions were included on the exit interview to probe exactly with which courses students were dissatisfied. This further probing indicated that students were most dissatisfied with the four course sequence of CORE 102, 103, 104 and 105. Students do not see the "connection" or relevance between what they are studying in core classes and their engineering education. In addition, the lack of consistency in the CORE classes is another point students mention with respect to quality of the courses.

As a result of these and other factors, a major revision and reconceptualization of the general education component of an engineering student's program is underway. The new plan will be implemented sometime on the 2011-2012 academic year.

Table 2.4-8. Outcome "d" Metrics

Outcome d: an ability to function on multi-disciplinary teams	
Metrics Associated with Outcome d:	**Where Measured**
1. 85% of Engineering students participate in a Senior Multi-Disciplinary Capstone Class that involves a team with members having different engineering disciplinary backgrounds.	Engineering Faculty Course Assessment Report
2. 100% of all Engineering students participate in the university CORE sequence and University Senior Integrative Experience.	Transcripts
3. At least 80% of all graduating seniors will report that their teaming skills have improved from benchmarked data collected at the beginning of their senior year to ending data collected at graduation.	Senior Skills Inventory Course Student Survey Faculty Course Assessment Report
4. At least 25% of upper-division engineering courses and 50% of lower division engineering courses will give students the opportunity to strengthen their skills associated with functioning on multidisciplinary teams.	Course Binders Engineering Faculty Course Assessment Report

2010-2011 assessment of outcome d: an ability to function on multi-disciplinary teams.

All metrics were met.

Table 2.4-9. Outcome "e" Metrics

Outcome e: an ability to identify, formulate and solve engineering problems	
Metrics Associated with Outcome e:	**Where Measured**
1. General engineering student pass rate of the FE exam meets or exceeds national average.	Fundamentals of Engineering Examination
2. At least 70% of all engineering courses will address this outcome.	Course Student Survey Course Binders
3. Senior engineering students report proficiency achieved in their ability to identify, formulate and solve engineering problems. Proficiency defined as all students reporting a 1 or 2 on a five point scale where 1 means proficiency achieved and 5 means proficiency not achieved.	Senior exit survey Course surveys
4. Faculty and professional constituencies report that students have achieved proficiency in their ability to identify, formulate and solve engineering problems by the time of graduation.	Faculty Course Assessment Reports Course Binders Design Showcase

2010-2011 assessment of outcome e: an ability to identify, formulate and solve engineering problems.

Metrics 2, 3, and 4 were met or exceeded.

Metric 1: As a result of historical FE pass rates of RWU engineering majors, a major emphasis was placed on preparing all of our students to take the FE exam and achieve pass rates greater than the national average for engineering students taking the general engineering afternoon exam. Although we failed to reach the national pass rate, (63%) by three percentage points, we have a better understanding of the strengths of our students. In this case, we find that the pass rate for the Civil Engineering afternoon exam is significantly higher than the "other" engineering afternoon exam that approximately 60% of our students take. The pass rate gap between the two has continued to grow over the past four years. We perform a great deal of analysis on the variables impacting pass rates (while controlling for GPA) and find significant correlations between passing the exam and attendance at the review sessions. In addition we find a negative correlation between females and pass rates.

Because we feel strongly that the FE exam is a good assessment tool for engineering majors, we have placed a great deal of emphasis on designing processes and systems that support the accomplishment of this metric. We also feel that a student graduating from our program in engineering possesses a differential advantage over other potential hires in the eyes of employers having passed the FE.

Table 2.4-10. Outcome "f" Metrics

Outcome f: an understanding of professional and ethical responsibility	
Metrics Associated with Outcome f:	**Where Measured**
1. All graduating seniors, (100%) will sit for the FE exam.	Fundamentals in Engineering Examination
2. At least 90% of all graduating seniors will attend the 45 hour FE review course.	Fundamentals in Engineering Examination Review Course
3. All students will be exposed to at least three lectures from external speakers in senior seminar class that focus on professional and ethical responsibility.	Course Student Survey Course Binders
4. At least 50% of all engineering students will be members of at least one of the professional engineering society student chapters.	Faculty Student Sponsorship
5. At least 25% of all engineering classes will address, and students will demonstrate an understanding of professional and ethical responsibility.	Course Binders Course Student Surveys
6. At least 70% of engineering students will have held an engineering related summer position, engineering internship or coop, or engineering work study related position by the time of graduation.	Senior Skills Inventory Exit Survey

2010-2011 assessment of outcome f: an understanding of professional and ethical responsibility

Metrics 1 and 3 through 5 were met or exceeded.

Metric 2: This year, approximately 80% of all seniors attended at least 90% of the review sessions. Student feedback for the lack of full participation involves workload, students feeling that they knew the review topic and therefore didn't need to attend and choice not to attend. This topic will again be a major discussion point at the semi-annual meeting of our faculty. The time and financial commitment to provide the review is significant; we expect the same level of commitment from our students.

Metric 6: One of our metrics measuring an understanding of professional and ethical responsibility on the part of our students is the participation in an engineering work environment. This work experience could be in the form of a co-op, internship, externship or summer employment. By actively collaborating with engineering professionals on a day-to-day basis, we feel our students will be exposed to engineering practices characterized by professional and ethical standards. Of our graduating seniors, 65% had participated in an engineering employment or externship experience over the course of their college careers.

We have addressed this metric in three ways. First, we have instituted a zero credit engineering internship program that will be reported on a student's transcript. This process overcomes a University challenge of having students pay tuition for a class related to an external work experience. Second, we are working with the University Career Center in identifying and formalizing more engineering work opportunities and externships for our students during break months. Last, the Professional Advisory Board is actively involved in identifying and providing work experiences for students.

Table 2.4-11. Outcome "g" Metrics

Outcome g: an ability to communicate effectively	
Metrics Associated with Outcome g:	**Where Measured**
1. At least 85% of all mentors and potential employers agree that graduating seniors possess the ability to communicate effectively.	Senior Design Showcase Professional Advisory Board Meetings Graduate Employers
2. 100% of seniors will have the opportunity in engineering classes to make an oral presentation at least twice a month in their senior year.	Course Binders Faculty Course Assessment Report
3. 100% of all freshmen will have the opportunity in engineering classes to make an oral presentation at least once during the semester.	Course Binders Faculty Course Assessment Report
4. Through the CORE curriculum, all engineering students will pass all writing and communication classes with a grade of "C" or better.	Transcript Review
5. At least 90% of alumni report that their RWU education has prepared them extremely well in communication skills for the workplace. "Extremely well" is defined as a 1 or 2 on a five point scale where 5 means no preparation at all and 1 means the RWU education prepared the graduate extremely well for the workplace.	Alumni Survey
6. Graduating seniors report an increase of at least one half point in their proficiency in communication skills from a pre-test measurement to a post-test measurement, from fall semester senior year to graduation time.	Senior Skills Inventory Senior Exit Survey

2010-2011 assessment of outcome g: an ability to communicate effectively

Metrics1 through 5 were met.

Metric number 6. Graduating senior preparation. The positive change in communication skill preparation from pre-test of seniors at the beginning of senior year to a post-test exit survey equaled .45.

Clearly, proficiency in communication skills remains an area of directed attention by our program. We are addressing this metric in several different ways. At our faculty planning meetings, we continually stress the need to integrate more communication assignments into courses. In determining whether our efforts were successful in enacting the specific changes involved with addressing preparation in communication skills, we found the following. From the 2011 senior exit survey, 65% of graduating students reported that they had achieved proficiency in communicating effectively while 35% rated their proficiency at a 2 on a one to five scale where 1 means proficiency achieved and five means proficiency not achieved. No student rated him or herself at lower than a 2 in communication proficiency.

From peer evaluations of projects, students rated each other equally proficient with no student group receiving a score lower than a 2 on a 1 to 5 scale where 1 means effectively communicated design and 5 means not effectively communicated design.

Interestingly, graduating seniors and alumni were quite consistent with respect to their proficiency in communication preparation. From the 2011 exit survey, the overall average with respect to their ability to communicate effectively was 1.37, while alumni rated the preparation they received from RWU for communicating effectively at 1.63.

Table 2.4-12. Outcome "h" Metrics

Outcome h: the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context	
Metrics Associated with Outcome h:	**Where Measured**
1. 100% of engineering students fulfill the Multidisciplinary Core Education component as well as the Core Concentration component of study to include the Core Senior Seminar.	Transcripts
2. At least 25% of engineering courses address this outcome.	Faculty Course Assessment Report Course Binders
3. At least 90% of all seniors attend at least one external Professional Society meeting.	Faculty Course Assessment

2010-2011 assessment of outcome h: the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context

All metrics were met or exceeded.

Table 2.4-13. Outcome "i" Metrics

Outcome i: a recognition of the need for, and an ability to engage in lifelong learning	
Metrics Associated with Outcome i:	**Where Measured**
1. All graduating seniors, (100%) will sit for the FE exam.	FE Exam Results
2. At least 90% of all graduating seniors will attend the 45 hour FE review course.	FE Review Course
3. All (100%) of seniors will participate in the Senior Design Showcase.	Senior Design Showcase
4. At least 75% of surveyed alumni indicate participation in professional training, professional societies or a graduate school since graduating from RWU.	Alumni Survey
5. At least 70% of our present students indicate that they will attend graduate school in the future.	Senior Skills Inventory

2010-2011 assessment of outcome i a recognition of the need for, and an ability to engage in lifelong learning

Metrics 1, 2 and 4 were met.

Metric 2: As discussed previously, 80% of the 2011 class attended 90% or greater of the review sessions.

Metric 5: 40% of students indicated that they plan to attend graduate school. However in comparing this percentage to the actual percentage of alumni attending graduate school (64%) and/or participating in professional development courses (92%), the number is low. This suggests that as students move into the workforce, companies provide incentives or support graduate study. In addition, alumni report that they attend graduate school to expand or improve their skill set for their jobs.

Table 2.4-14. Outcome "j" Metrics

Outcome j: a knowledge of contemporary issues	
Metrics Associated with Outcome j:	**Where Measured**
1. At least 50% of engineering courses will address this outcome.	Course Binders Faculty Course Assessment Report
2. At least 85% of graduating seniors will rate their proficiency in knowledge of contemporary issues at a score of 1 or 2 on a five point scale where 1 means proficiency developed and 5 means proficiency not developed.	Engineering Student Exit Survey
3. All (100%) of engineering students will be exposed to contemporary issues through the Senior Seminar class.	Course Binders
4. All (100%) of engineering students will participate in the Feinstein Service Learning Requirement of at least 5 hours in the surrounding community.	Transcripts

2010-2011 assessment of outcome j: a knowledge of contemporary issues

All metrics were met or exceeded.

Table 2.4-15. Outcome "k" Metrics

Outcome k: an ability to use the techniques, skills and modern engineering tools necessary for engineering practice	
Metrics Associated with Outcome k:	**Where Measured**
1. All, (100%) of students will successfully demonstrate their ability to use the techniques, skills and modern engineering tools necessary for engineering practice through the year-long senior capstone project.	Faculty Course Assessment Report Course Student Survey Academic Showcase
2. All, (100%) of students participating in the senior design projects will be favorably rated by external mentors and clients.	Academic Showcase Graduate Employers Professional Advisory Board
3. At least 80% of graduating seniors will rate their proficiency in the ability to use modern engineering tools at a score of 1 or 2 on a five point scale where 1 means proficiency developed and 5 means proficiency not developed.	Senior Exit Survey
4. At least 75% of engineering classes address this outcome.	Course Binders Faculty Course Assessment Report

2010-2011 assessment of outcome k: an ability to use the techniques, skills and modern engineering tools necessary for engineering practice

Metrics 1 through 4 were met or exceeded.

Section 5: Assessment of Previously Implemented Program Changes

Changes and refinements as a result of our engineering assessment processes may take several forms. These include:

1. curriculum changes
2. budget requests or modifications
3. space requests or modifications
4. faculty needs
5. program resource needs
6. program modifications.

Proposed and implemented engineering curriculum changes since the last accreditation visit are presented in Table 2.5-1 and Table 2.5-2. For each of these implemented program changes, an assessment of the success of the change, and any issues resulting from the implementation is documented.

Table 2.5-1. Assessment of Proposed and Implemented Engineering Program Curriculum Changes AY 2005-2011

Number	Curriculum Change	When Implemented	Assessment of Success
AY05-06	Create an Engineering core concentration		Proposal sent to committee and tabled.
AY05-06	Create an Engineering minor		Proposal sent to committee and tabled.
AY05-06	Change Course suffices and numbers on ENVR courses to ENGR	2007-2008	No adverse effects.
AY 07-08	Creation of Engineering Specializations and Elimination of Minors	2008-2009	Appears to be creating a differential advantage for students. Continue to study.
AY 07-08	Change name of course and course description from ENGR 415 Wastewater Treatment & Lab to ENGR 415 Water and Wastewater Treatment & Lab	2008-2009	No adverse effects.
AY 07-08	Eliminate ENGR 408 Water Pollution and Treatment & Lab	2008-2009	No adverse effects.
AY 07-08	Change name of course and course description from ENGR 314 Soil Mechanics & Lab to ENGR 414 Geotechnical Engineering & Lab	2008-2009	No adverse effects.
AY 07-08	Change name of course from ENGR 409 Design of Structures to ENGR 409 Structural Design I	2008-2009	No adverse effects.
AY 07-08	Change of course name and course description of ENGR 450 – Robotics to ENGR 450 Mechatronics	2008-2009	No adverse effects.
AY 08-09	Creation of Engineering Specialization in Chemical Engineering		Proposal sent to committee and tabled.
AY 08-09	Change Surveying I to Surveying	2009-2010	No adverse effects.
AY 09-10	Change ENGR490/COMSC490 from three credit to four credit class		Proposal rejected in discussion stages, never sent to committee.
AY 09-10	Change ENGR492/COMSC492 from three credit to four credit class		Proposal rejected in discussion stages, never sent to committee.

Table 2.5-1. SECCM Curriculum Changes AY 2005-2011, continued

Number	Curriculum Change	When Implemented	Assessment of Success
AY 09-10	All students must select a specialization area in Engineering with students not following a traditional path such as mechanical or civil adopting a “custom” specialization.	2010-2011	Monitoring progress
AY 09-10	Replace Business Elective with Free Elective	2010-2011	Monitoring progress
AY09-10	Replace two required courses with Engineering Electives and redefine the Engineering Elective. This change replaces the requirement that all students take both ENGR 313 Structural Analysis and ENGR 260 Engineering Electronics & Lab with the requirement that students take one or the other depending on their specialization	2010-2011	Monitoring progress
AY09-10	Create a “Custom Program” specialization for the engineering major. The “Custom Program” specialization will require both ENGR431 Structural Analysis and ENGR260 Engineering Electronics.	2010-2011	Monitoring progress
AY09-10	Add the requirement for ENGR313 Structural Analysis to the Civil Engineering Specialization and the requirement for ENGR260 Electronics to the M/E/C specializations.	2010-2011	Monitoring progress
AY09-10	ENGR 313 Structural Analysis and ENGR260 Electronics were taken by all students previously and therefore some courses did not explicitly list these as prerequisites. This change adds prerequisites to courses where there was no need to list these before.	2010-2011	Monitoring progress

Table 2.5-1. SECCM Curriculum Changes AY 2005-2011, continued

AY09-10	Implement a series of changes with respect to registrar recording of specializations on transcripts by establishing new specialization designations to include: ENGR.CP.270C.BS- Engineering/Computer Engr. Specialization ENGR.ME.270M.BS- Engineering/Mechanical Engr. Specialization ENGR.CV.270V.BS- Engineering/Civil Engr. Specialization ENGR.EL.270E.BS- Engineering/Electrical Specialization	2010-2011	Under study. Students from the graduating class of 2009 were the first students eligible to switch from a minor classification to a specialization. Several students did just that. Since this was the first class, there were some challenges with the transcript recording and paperwork process. In the end, the problems were addressed and students correctly had the specialization listed on their transcripts.
AY 10-11	Add a laboratory component to the Mechatronics course and change credits from 3 to 4.	2011-2012	Will monitor progress
AY 10-11	Create an Engineering Minor	2011-2012	Proposal discussed and tabled

Table 2.5-2. SECCM Non-Curricular Program-Related Assessment-Driven Actions AY 2005-2011

Category	Action	Date	Reason for Action	Assessment Tools
Faculty & Staff	Hired new CM faculty member, Dr. Gilbert Brunnhoeffer, as Visiting Assistant Professor	Aug 05	Increased enrollment in CM program	Analysis of enrollment data and trends ACCE criteria
	Hired new Engineering faculty member, Dr. Charles Thomas, as Assistant Professor	Aug 05	Replacement for departing faculty member	Analysis of enrollment data and trends ABET criteria
	Converted Dr. Brunnhoeffer to Assistant Professor	Aug 06	Converted as a result of a national search	Analysis of enrollment data and trends ACCE criteria
	Hired new CM faculty member, Mr. Ilyas Bhatti, as Assistant Professor.	Aug 06	Replacement for departing faculty member	Analysis of enrollment data and trends ACCE criteria
	Dr. Riley transitions from Associate dean to faculty status (Professor.) She assumes position as "Engineering Program Coordinator."	Jan 07	Personal preference Increased focus on Engineering program assessment	Analysis of enrollment data and trends SOP (Faculty Contract)
	Hired new CM faculty member, Dr. Lu Na, as Assistant professor.	Aug 07	Increased enrollment in CM program	Analysis of enrollment data and trends ACCE criteria
	Hired new CM faculty member, Mr. Tony Branca, as Visiting Assistant Professor	Aug 08	Replacement for departing faculty member	Analysis of enrollment data and trends ACCE criteria
	Hired new laboratory technician, Mr. Thom Perlmutter	Oct 08	Needed to staff expanded laboratory facilities	Student exit surveys Analysis of enrollment data and trends Course assessment reports SOP (OSHA)

Table 2.5-2. SECCM Non-Curricular Program-Related Assessment-Driven Actions AY 2005-2011, continued

Category	Action	Date	Reason for Action	Assessment Tools
Faculty & Staff	Hired new CM faculty member, Dr. Gokhan Celik, as Assistant Professor	Aug 09	Increased enrollment in CM program	Analysis of enrollment data and trends ACCE criteria
	Hired new CM faculty member, Dr. Michael Emmer, as Assistant Professor	Aug 10	Increased enrollment in SECCM Expansion of program offerings (MSCM)	Analysis of enrollment data and trends ACCE criteria ABET criteria
	Hired new Engineering faculty member, Dr. William Palm, as Assistant Professor	Aug 11	Increased enrollments in Engineering program	Analysis of enrollment data and trends ABET criteria
Facilities and Equipment	Repainting of building interior	Jun 05 - current	Maintenance and appearance	Student exit surveys Course assessment reports
	Installation of wireless hubs in SECCM facility	Aug 05 – Apr 06	Increase student and faculty access to internet and intranet Increase pedagogical flexibility	Student exit surveys Student course surveys Course assessment reports

Table 2.5-2. SECCM Non-Curricular Program-Related Assessment-Driven Actions AY 2005-2011, continued

Category	Action	Date	Reason for Action	Assessment Tools
Facilities and Equipment	Purchased new laboratory equipment to include: Tabletop CNC Mill Stepper (ENGR 450/490/492) Hydraulic bench (ENGR 305) Bernoulli's Theorem kit IENGR 305) Orifice and Free Jet kit (ENGR 305) Series/parallel pumps (ENGR 305) Shear testing machine (ENGR 414) Leica Deluxe Total Station (CNST 302)	Jul – Aug 05	Provide enhanced laboratory experience Expand laboratory scope Replace outdated/used equipment	Student exit surveys Student course surveys Course assessment reports CMPAB input EPAB input ABET criteria ACCE Criteria Analysis of enrollment data and trends
	Installed computer projectors and associated equipment in SE 125 and SE 200	Jul – Aug 05	Enhance IT capability	Student exit surveys Student course surveys Course assessment reports
	Remodeled SECCM lobby creating student lounge/study area	Aug 06	Need for additional space for students to gather and work on projects, homework, etc.	Student exit surveys Student course surveys Course assessment reports ABET criteria ACCE criteria Analysis of enrollment data and trends

Table 2.5-2. SECCM Non-Curricular Program-Related Assessment-Driven Actions AY 2005-2011, continued

Category	Action	Date	Reason for Action	Assessment Tools
Facilities and Equipment	Installed computer projector and associated equipment in SE 124	Jul – Aug 06	Enhance IT capability	Student exit surveys Student course surveys Course assessment reports
	Purchased new laboratory equipment to include: Heat Exchanger bench (ENGR 433) Extensometer (ENGR 300) Hand operated pump (ENGR 300)	Jul – Aug 06	Provide enhanced laboratory experience Expand laboratory scope Replace outdated/used equipment	Student exit surveys Student course surveys Course assessment reports EPAB input ABET criteria Analysis of enrollment data and trends
	Expanded Student Project room (SE 205) floor space by 50% and computer facilities by 80%.	Jun- Aug 07	Provide additional space for students to gather and work Provide additional computing resources.	Student exit surveys Student course surveys Course assessment reports CMPAB input EPAB input ABET criteria ACCE criteria Analysis of enrollment data and trends Graduate employer input

Table 2.5-2. SECCM Non-Curricular Program-Related Assessment-Driven Actions AY 2005-2011, continued

Category	Action	Date	Reason for Action	Assessment Tools
Facilities and Equipment	Purchased new laboratory equipment to include: Admet Universal Testing machine (ENGR 300, CNST 201, CNST 304) ELE International Direct Shear machine (ENGR 414) Armfield Rainfall Hydrograph (ENGR 412, ENGR 417	Aug 07	Provide enhanced laboratory experience Expand laboratory scope Replace outdated/used equipment	Student exit surveys Student course surveys Course assessment reports CMPAB input EPAB input ABET criteria ACCE Criteria Analysis of enrollment data and trends
	Installed computer projector and associated equipment in SE 126	Aug 07	Enhance IT capability	Student exit surveys Student course surveys Course assessment reports
	Installed computer projector and associated equipment in SE 132	Aug 08	Enhance IT capability	Student exit surveys Student course surveys Course assessment reports
	Purchased new laboratory equipment to include: Hampton Lift and Drag Force unit (ENGR 305) Koala Robot II (ENGR 450) Syil America Milling machine (ENGR 490/492)	Aug 08	Provide enhanced laboratory experience Expand laboratory scope Replace outdated/used equipment	Student exit surveys Student course surveys Course assessment reports EPAB input ABET criteria ACCE Criteria Analysis of enrollment data and trends

Table 2.5-2. SECCM Non-Curricular Program-Related Assessment-Driven Actions AY 2005-2011, continued

Category	Action	Date	Reason for Action	Assessment Tools
Facilities and Equipment	Remote 2000 square foot facility (named "Hawkworks") rented and equipped for student project fabrication and laboratories	Oct – Dec 08	Increase senior engineering design team fabrication capacity Provide students with a dedicated facility Provide CM method and material courses a place for laboratory fabrication	Student exit surveys Student course surveys Course assessment reports SOP (OSHA) CMPAB input EPAB input ABET criteria ACCE criteria Analysis of enrollment data and trends Graduate employer input
	Reconfigured laboratory space utilization in SECCM facility	Oct – Dec 08	Provide enhanced laboratory experience Expand laboratory scope	Student exit surveys Student course surveys Course assessment reports SOP (OSHA) CMPAB input EPAB input ABET criteria ACCE criteria Analysis of enrollment data and trends Graduate employer input

Table 2.5-2. SECCM Non-Curricular Program-Related Assessment-Driven Actions AY 2005-2011, continued

Category	Action	Date	Reason for Action	Assessment Tools
Facilities and Equipment	Purchased new laboratory equipment to include: Promark RTK System and Base Unit Rover (CNST 302) Ease of Learning CNC machine (4 ea) (ENGR 110, ENGR 115 Portable flow meter with wading rod cable (ENGR 412, ENGR 417)	Aug 09	Provide enhanced laboratory experience Expand laboratory scope Replace outdated/used equipment	Student exit surveys Student course surveys Course assessment reports CMPAB input EPAB input ABET criteria ACCE Criteria Analysis of enrollment data and trends
	Computer monitors replaced in SE 200, SE 204, SE 205, and SE 206	Aug 09	Upgrade equipment Provide more desk space for students to work	Student exit surveys Student course surveys Course assessment reports
	Computer chairs replaced in SE 204	Aug 09	Chairs worn	Student exit surveys Course assessment reports
	Renovate SE 125 creating CM Student Project Center. Renovation included extensive construction as well as new AV and IT resources and furnishings	Jan – Jul 10	Provide CM students a dedicated space for instruction and project activities Relieve congestion in SE 205	Student exit surveys Student course surveys Course assessment reports CMPAB input Analysis of enrollment data and trends ACCE criteria Graduate employer input

Table 2.5-2. SECCM Non-Curricular Program-Related Assessment-Driven Actions AY 2005-2011, continued

Category	Action	Date	Reason for Action	Assessment Tools
Facilities and Equipment	Computers replaced in SE 200, SE 204, SE 205, and SE 206	Aug 10	Upgrade equipment Provide more computing capacity for students	Student exit surveys Student course surveys Course assessment reports
	Purchased new laboratory equipment to include: Mixed Signal Oscillocope (ENGR 240, ENGR 260, ENGR 270) Complete GPS Base and Rover unit (CNST 302)	Aug 10	Provide enhanced laboratory experience Expand laboratory scope Replace outdated/used equipment	Student exit surveys Student course surveys Course assessment reports CMPAB input EPAB input ABET criteria ACCE Criteria Analysis of enrollment data and trends
	Relocated “Hawkworks” to larger remote 4000 square foot facility doubling the space for students to work	Oct – Dec 10	Increase senior design fabrication capacity Provide students with a dedicated facility Provide CM method and material courses a place for laboratory fabrication	Student exit surveys Student course surveys Course assessment reports SOP (OSHA) CMPAB input EPAB input ABET criteria ACCE criteria Analysis of enrollment data and trends Graduate employer input

Table 2.5-2. SECCM Non-Curricular Program-Related Assessment-Driven Actions AY 2005-2011, continued

Category	Action	Date	Reason for Action	Assessment Tools
Facilities and Equipment	Remodel SECCM lobby to include replacing entry door and furniture	Jun-Aug 11	Needed repair to exterior door and improved access Upgrade used furniture	Student exit surveys SOP (OSHA)
Professional Enhancement and Outreach	A senior design team competed in the WERC International Environmental Engineering competition (held at New Mexico State University) for the first time	Apr 06	External client-based design experience Evaluate RWU performance against other institutions	Student exit surveys Course assessment reports EPAB input ABET criteria
	A senior design team competed in the ASCE Student Seismic Design competition (held in New Orleans) for the first time	Mar 08	External client-based design experience Evaluate RWU performance against other institutions	Student exit surveys Course assessment reports EPAB input ABET criteria
	A senior design team competed in the ASME Human Powered Vehicle competition (held at the University of Wisconsin, Madison) for the first time	Apr 08	External client-based design experience Evaluate RWU performance against other institutions	Student exit surveys Course assessment reports EPAB input ABET criteria
	Two senior design teams competed in the ASEE Zone 1 Student poster competition (held at the USMA, West Point, NY) for the first time; one team captured the first-place award	Apr 08	External client-based design experience Evaluate RWU performance against other institutions	Student exit surveys Course assessment reports EPAB input ABET criteria

Table 2.5-2. SECCM Non-Curricular Program-Related Assessment-Driven Actions AY 2005-2011, continued

Category	Action	Date	Reason for Action	Assessment Tools
Professional Enhancement and Outreach	A senior design team competed in the Federal Aviation Administration (FAA) Design competition (held in Oshkosh, WI) for the first time; the team captured the first place award in the Operations and Maintenance category	Apr 10	External client-based design experience Evaluate RWU performance against other institutions	Student exit surveys Course assessment reports EPAB input ABET criteria
Policies, Processes and Procedures	Published formalized SECCM Assessment Plan requiring written annual school and program assessments	Oct 06	Need to formalize continuous improvement process	Course assessment reports CMPAB input EPAB input ABET criteria ACCE criteria Graduate employer input
	Major effort to transform CM and Engineering PABs into self-governing organizations	2006 – 2011	Improve operation and contributions of PABs Encourage greater independence	CMPAB input EPAB input ABET criteria ACCE criteria Graduate employer input

Section 6: Discussion of Recommended Engineering Program Changes

As a result of the engineering assessment process, the evaluation and consideration of several Engineering Program changes are suggested for the upcoming academic year. Some of these focus areas are repeated from previous years. These suggestions are presented below and then discussed.

1. Need for a review of software used and taught in engineering classes especially discipline specific software

Once again, as documented in the senior exit survey and alumni survey especially, students repeatedly recognized the absence of software that they had used in internships, the workplace and required for senior design competitions. This year there was less focus on specific software programs and more emphasis on including “programming” in the curriculum and receiving better training for the software that was already available to the students.

Recommendation: Undertake a review of all of the engineering lab software, correlate this software with engineering course offerings and identify gaps. Discuss available software in the labs and determine where students are learning how to use specific programs.

2. Lack of elective courses and variety of instructors in the civil and mechanical engineering specialization areas

In the past as with this year’s assessment, students, alumni and employers have pointed to gaps in our curriculum with respect to courses that form the basis of a civil and mechanical specialization. Over the past few years, additional courses have been added, however this year’s concern is with having the availability of more electives for the specialization areas. Students also specifically mention having the same instructor for a number of courses which they felt was not an optimal situation.

Recommendation: Continue to review and study of the engineering curriculum with respect to the program of study and how well it fits the needs of our students, alumni, industry and graduate programs. If agreed upon and justified, introduce additional electives into the civil and mechanical specializations. Furthermore, propose additional faculty lines in engineering as a result of increased enrollment.

3. Review the adequacy of engineering lab equipment and computer lab areas

As documented again in the senior exit survey, students repeatedly noted outdated equipment in some engineering labs that would at times be broken. In addition, this year students also cited the engineering computer lab areas as crowded and not presenting an optimal work environment.

Recommendation: Further study benchmark engineering programs and state-of-the art practices and procurements with respect to engineering lab equipment. Initiate a study of the computer lab areas to determine usage and adequacy.

4. Continue to implement strategies that improve oral and written communication skills among engineering students

This finding has been a common finding for the past five years. Although engineering seniors and graduates rate their oral and written communications skills as high, students still recognize the need for self-improvement in this area. This year however, employers and the Professional Advisory Board specifically have mentioned the superior communication skills of our graduates.

Recommendation: Continue to explore ways in which writing and communication might be better integrated into engineering courses that traditionally do not include these requirement while recognizing the differential advantage this skillset provides to our graduates.

5. Increase FE pass rate

Passing the FE exam has historically provided a differential advantage for our students in their job search as well as advancement opportunities once employed. In addition it is used as an assessment tool for our engineering program. Therefore, continued attention must be directed to explore new strategies for improving the FE pass rate especially in light of this year's decline in the pass rate.

Recommendation: Investigate best practices of other institutions for FE pass strategies. Benchmark our practices against these institutions. Discuss with faculty the most appropriate way to deliver the review course for students. Determine through faculty discussions whether the use of the FE exam remains a good assessment tool with respect to our program.