PSE PROGRAM EDUCATIONAL OBJECTIVES

Paper Science and Engineering
University of Washington

History and Background of the Undergraduate Paper Science and Engineering (PSE) Program

The Paper Science and Engineering program has a long history of teaching and research activities at the University of Washington that dates back to the 1940's. The current undergraduate program in Paper Science and Engineering was formally established in 1965. Since then, over 450 students have graduated from this four-year program. Of these students, about 400 are now employed in the pulp and paper and allied industries throughout North America and abroad. The program enrollment is about sixty students, selectively recruited from regional high schools and community colleges. Some graduates remain on campus for a fifth year to earn a second BS degree in Chemical Engineering, and others choose to enter graduate school for advanced studies.

At the initiative of pulp and paper industry leaders, the Washington Pulp and Paper Foundation (WPPF) was founded to support the undergraduate program. The five year goals of this foundation are the following: ***1)*** *Assist faculty in developing graduates who are highly attractive to employers.* ***2)*** *Provide a solid financial base to support the Program.* ***3)*** *Evaluate and update the Program to meet future Industry needs.* ***4)*** *Involve alumni and friends in the Foundation and the Program.* ***5)*** *Enroll industry and University leadership in the Program.* Details on the supporting outcomes and strategies to meet these outcomes can be found on the WPPF web page (http://depts.washington.edu/wppf/five-year%20plan.htm).

Since 1965, about 400 University of Washington Paper Science and Engineering students have received scholarships from the Washington Pulp and Paper Foundation.

Mission Statement

The Paper Science and Engineering Undergraduate Program at the University of Washington is dedicated to graduating highly qualified students that can make immediate contributions in their professional careers and have the capabilities to become future leaders in the pulp, paper and allied industries.

Mission Realization

To carry out the mission of the PSE undergraduate program, an excellent instructional program will be maintained to provide the best possible educational experience for students. Students graduating from the PSE program will have the following qualities: 1) They will have strong technical skills that allow them to immediately contribute to their organization and that provides a solid foundation for building technical expertise throughout their careers. 2) They will be outstanding problem solvers, and 3) They will have the intellectual maturity to function well within their organization and for them to contribute to society at-large. To further support the PSE Mission, faculty will maintain solid ties to industrial contacts, as well as to publicly employed professionals associated with the pulp, paper and allied industries to insure program relevance and faculty vitality.

Review of Objectives and Outcomes

To assure that the program mission is being accomplished, a review of program elements will be done on a five-year cycle. The five-year review will include an assessment of program objectives, educational outcomes, and methods to be used to implement and evaluate the outcomes. In addition, the feedback methods used to modify the curriculum to meet the outcomes will be evaluated. Educational objectives and outcomes will be developed and approved by the PSE faculty. They will seek advice and counsel from PSE students, alumni, and members of the Washington Pulp and Paper Foundation curriculum committee. This committee serves as the paper industry representatives for curriculum matters. The PSE curriculum committee will coordinate this review with assistance from the SFR Director.

Program Educational Objectives

Students who graduate from the PSE program will be provided an education that prepares them for effective careers in the paper and allied industries and develops their intellectual and social maturity such that they can contribute to their organization as well as society at-large. The PSE educational program has three broad objectives: 1) Graduates of the PSE program will have strong technical capability. They will have the essential knowledge and basic skills required for technical careers in the Pulp, Paper, and Allied Industries. 2)Graduates of the PSE program will be excellent problem solvers. They will be able to creatively resolve problems and exercise sound professional judgment in open-ended projects such as designing processes or solving product and production problems. 3) Graduates of the PSE program will have the intellectual maturity to be work well within their professional organization and to contribute to society at large.

Under each of these broad objectives are a series of specific outcomes that the program will closely monitor its performance against. The objectives and the supporting outcomes of the PSE program are specified below. Methods to assess the implementation of the objectives and outcomes are also provided. The PSE educational objectives and outcomes have been reviewed and approved by PSE faculty and by the Washington Pulp and Paper Foundation Curriculum Committee.

Curriculum review

A feedback process that uses several evaluation methods is employed to assure that the objectives and outcomes below are being met. The evaluation methods for the program objectives and outcomes are outlined following the presentation of the objectives and outcomes. Following each academic year, the PSE faculty will evaluate results of all the evaluation instruments. Based on this analysis, the committee will present a set of recommendations to assure better achievement of objectives and outcomes and to improve effectiveness of the program. The recommendations will be voted on and those approved will be implemented the following academic year.

Objective #I: Graduates of the PSE program will have strong technical capability. They will have the essential knowledge and basic skills required for technical careers in the Pulp, Paper, and Allied Industries.

Topics in several areas must be mastered by students who intend to establish careers in the paper science and engineering profession. This objective will be accomplished primarily by traditional methods of instruction, i.e. lectures, laboratories and seminars. Faculty will provide students explicit lists of material that must be understood and skills that must be mastered for each class. Appropriate forms of new technology, such as engineering application of web pages and computer models, will be used by the faculty to accomplish this objective.

Outcome #I.1: Students will have the ability to apply knowledge of mathematics, science, and engineering.

Outcome #I.2: Students will have the ability to apply knowledge of fiber and paper physics, chemistry, and chemical engineering as it pertains to the pulp and paper industry.

Outcome #I.3: Students will have the ability to design and conduct experiments, as well as to statistically analyze and interpret data.

Outcome #I.4: Students will have the ability to design a system, component, or process to meet desired needs with realistic constraints.

Outcome #I.5: Students will have the ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Outcome #I.6: Students will have the ability to communicate effectively, both orally and written.

Objective #II: Graduates of the PSE program will be excellent problem solvers. They will be able to creatively resolve problems and exercise sound professional judgment in open-ended projects such as designing processes or solving product and production problems.

An important feature of higher education, one that distinguishes it from the K-12 educational system, is the process by which students acquire the ability to function as independent professionals, secure in their ability to solve problems in complex open-ended scenarios. The ability to cope with various levels of uncertainty and to act in an appropriate professional manner requires a mature and capable mind. While this is a difficult objective to accomplish, students will be given the opportunity to participate in activities where they will be required to define a problem, select and implement a plan of attack, and evaluate their solution to the problem. A wide range of activities will be used to accomplish this objective:

- small, open-ended homework problems
- laboratory experiments
- capstone design course
- required summer employment experiences
- optional intern experiences lasting for 2 quarters or more

Outcome #II.1: Students will be able to pose well-defined, solvable problems from complicated and loosely defined scenarios similar to those found in the pulp and paper industry.

Outcome #II.2: Students will be able to apply scientific and engineering principles in open-ended projects, such as designing processes or solving product and production problems.

Outcome #II.3: Students will be able to generate alternative solutions and designs, and then use sound professional judgment to choose between alternatives in open-ended projects.

Outcome #II.4: Students will be able to evaluate and communicate the results of completed tasks in open-ended projects.

Objective #III: Graduates of the PSE program will have the intellectual maturity to work well within their professional organization and to contribute to society at large.

The Paper Science and Engineering program is but one of many excellent educational programs found at the University of Washington. This diverse collection of programs offers a wide choice of intellectual enrichment possibilities for students enrolled in the PSE program. Yet, as the rate of technical knowledge grows, there is a temptation on the part of faculty to diminish this range of choices in exchange for more technical requirements. The additional requirements are justifiable on the basis of making sure students have a sufficient background to enter the profession at a competent level.

The PSE faculty believe, however, that it is important to maintain a healthy balance between general education and technical requirements. A list of topics, which a PSE graduate must have mastery of, will be maintained by the PSE faculty and will be included in the required courses. The courses will be taught in an efficient manner so as not to consume a large percentage of the total credits, and allow for sufficient elective credits to develop breadth in the students' overall educational program. In addition, advising will be given to students concerning a wide range of elective courses that should help them find a perspective on their future role in society.

Outcome #III.1: Students will be able to contribute to and lead multidisciplinary teams.

Outcome #III.2: Students understand professional and ethical responsibilities.

Outcome #III.3: Students will have the broad education necessary to understand the impact of engineering solutions in a global, economic, and environmental and societal context.

Outcome #III.4: Students will know contemporary issues relevant to the pulp and paper industry.

Outcome #III.5: Students will understand that life-long learning is a necessity for maintenance of professional competency.

IMPLEMENTATION AND ASSESSMENT STRATEGIES for PSE PROGRAM OBJECTIVES AND OUTCOMES

The PSE Program Objectives are the broad qualities we seek in students that graduate from our program. The Program Outcomes, which are student oriented, are designed to support Program Objectives. The Objectives will be achieved by successful implementation of the Outcomes. The PSE program has a multi-faceted program to assess Program Outcomes and these are detailed below. We also do direct assessment of Program Objectives. Objective assessments are done with data from graduates of the program or students nearing graduation. The following are used to provide assessment of achievement of Program Objectives:

- Alumni survey administered every 5 years
- Annual survey of employers of students from the required PSE internship,
- Placement data for our students, which has been tracked by the Washington Pulp and Paper Foundation.

PSE PROGRAM OUTCOMES
IMPLEMENTATION AND ASSESSMENT STRATEGIES

The following matrix describes the implementation strategy to achieve each PSE program outcome. The methods to assess achievement of those outcomes are also presented. For each outcome we have multiple assessment methods – both direct and indirect assessment methods

	Program Outcomes	Implementation Strategy	Assessment Methods
I.1	Students will have the ability to apply knowledge of mathematics, science, and engineering.	Prerequisite courses and PSE courses will instruct students in the knowledge and application of basic math, science, and engineering. Higher level courses will apply and reinforce this knowledge in specific paper science and engineering problems.	▪ Direct assessment PSE 402, 487, 406 ▪ Student survey and Alumni survey ▪ CIDR assessment ▪ Internship ▪ Capstone assessment
I.2	Students will have the ability to apply knowledge of fiber and paper physics, chemistry, and chemical engineering as it pertains to the pulp and paper industry.	PSE courses will instruct students in the knowledge and application of fiber and paper physics, chemistry, and engineering as it applies to paper science and engineering problems. Higher level courses will apply and reinforce this knowledge in more complex and open-ended problems.	▪ Direct assessment PSE 476, 477, 481, 487 ▪ Student survey and Alumni survey ▪ CIDR assessment ▪ Internship ▪ Capstone assessment
I.3	Students will have the ability to design and conduct experiments, as well as to statistically analyze and interpret data.	QSCI 381 Introduction to Statistics required The PSE curriculum has several laboratory course requirements. In these courses, and in prerequisite courses, the design and running of experiments as well as the analysis and interpretation of data is taught.	▪ Direct assessment PSE 478, 479 ▪ Student survey and Alumni survey ▪ CIDR assessment ▪ Internship
I.4	Students will have the ability to design a system, component, or process to meet desired needs with realistic constraints.	Small design projects will be assigned to students in courses that teach basic unit operations in a pulp and paper mill. (e.g. PSE 476 and 477) An in-depth design experience will be the main purpose of the capstone design course, PSE 487.	▪ Direct assessment PSE 479, 487, 476 ▪ Student survey and Alumni survey ▪ CIDR assessment ▪ Internship ▪ Capstone assessment
I.5	Students will have the ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.	Modern analysis techniques and tools (hardware and software) will be used routinely in our laboratory, control, and design courses. The tools and techniques used in these classes will be continuously upgraded. Consultation with industry suppliers will assure that the PSE program uses up-to-date equipment and methods.	▪ Rubric and assignment assessment in PSE 480, 487 ▪ Capstone assessment ▪ Student survey and Alumni survey ▪ CIDR assessment ▪ Internship
I.6	Students will have the ability to effectively communicate, both orally and written.	Required English and Technical Communication course. Instruction in how to write (give) reports appropriate for industry will be provided in PSE courses. Students will receive continuous feedback on their writing and speaking skills throughout the curriculum	▪ Speaking assessment from PSE 478, 479 487, 497. ▪ Writing from junior and senior classes evaluated using rubric at year end. ▪ Student survey and Alumni survey ▪ CIDR assessment ▪ Internship

	Program Outcomes	Implementation Strategy	Evaluation Methods
II.1	Students will be able to pose well-defined, solvable problems from complicated and loosely defined scenarios similar to those found in the pulp and paper industry.	Students will be challenged with open-ended problems that require reducing complicated scenarios to solvable problems throughout their PSE course work. Small projects will be assigned to students in courses that teach basic unit operations in a pulp and paper mill. An in-depth design experience will be the main purpose of the capstone design course PSE 487.	▪ Direct Assessment PSE 479, 487 ▪ Faculty and paper industry professionals will review student design work (PSE 487) and provide feedback on students' ability to reduce open-ended problems. ▪ Student survey and Alumni survey ▪ CIDR assessment ▪ Internship
II.2	Students will be able to apply scientific and engineering principles in open-ended projects, such as designing processes or solving product and production problems.	Students will be challenged with open-ended problems that require application of basic scientific and engineering principles throughout their PSE course work. Courses that specifically address this outcome are the laboratory courses PSE 478, and 479 and the design capstone design course PSE 487.	▪ Direct Assessment PSE 479, 487 ▪ Faculty and paper industry professionals will review student design work (PSE 487) and provide feedback on its quality. ▪ Student survey and Alumni survey ▪ CIDR assessment ▪ Internship
II.3	Students will be able to generate alternative solutions and designs, then use sound professional judgment to choose between alternatives in open-ended projects.	Senior design courses (PSE 487) will lead students through open-ended projects that require higher order problem solving skills. Faculty will act as facilitators through these problems to assist students in gaining these skills. Professional engineers from industry will also provide input to students how to approach and solve such problems. Students will be required to evaluate their own decisions to develop their ability to make sound judgment in deciding between alternatives.	▪ Direct Assessment PSE 479, 487 ▪ Faculty and paper industry professionals will review student design work (PSE 487) and provide feedback on its quality. ▪ Student survey and Alumni survey ▪ CIDR assessment ▪ Internship
II.4	Students will be able to evaluate and communicate the results of completed tasks in open-ended projects.	Guidelines on how to evaluate design (or other project) results will be provided by faculty and industry professionals working on senior capstone projects. Students will be required to evaluate their work and give written and oral reports for their laboratory courses, design courses, and other classes such as the required senior internship and senior research.	▪ Direct Assessment PSE 479, 487 ▪ Faculty and paper industry professionals will review student design work (PSE 487) and provide feedback on its quality. ▪ Student survey and Alumni survey ▪ CIDR assessment ▪ Internship ▪ Direct assessment from reviews of WPPF poster presentations

	Program Outcomes	Implementation Strategy	Evaluation Methods
III.1	Students will be able to contribute to and lead multidisciplinary teams	Students will work in groups in laboratory and design classes. Responsibilities of team members will increase as students' progress. The capstone project in PSE 487 will be a large team project that requires students to delegate tasks, insure accountability, and pull together resources to produce the final design. PSE 478, PSE 479, PSE 487 provide specific leadership and teamwork instruction PSE 450 seminars on leadership	▪ Direct Assessment PSE 478, 479, 487 ▪ Peer evaluation of performance in teams will be made in PSE courses with significant team requirements. ▪ Capstone assessment. ▪ Student survey and Alumni survey ▪ CIDR assessment ▪ Internship ▪ PSE 478 (or PSE 479) for direct assessment metric
III.2	Students will understand professional and ethical responsibilities	Specific ethics topics and assignments given in freshman, sophomore, junior and senior PSE courses. PSE 450 seminars on ethics.	▪ Direct Assessment PSE 202, 248, 478, 487 ▪ Student's assessment of ethical considerations in capstone design project will be evaluated. ▪ Employers and graduates will be surveyed
III.3	Students will have the broad education necessary to understand the impact of engineering solutions in a global and societal context	Outcomes will be met by University VLPA[1] and I&S requirements PSE courses will provide breadth in topics related to the paper industry. Instruction on societal and environmental impact of bioresource process will be provided in PSE 202 and 406. PSE 450 seminars will cover topics that focus on broad global and societal issues.	▪ Direct Assessment PSE 450, 487, 406 ▪ Faculty and industry analysts involved in the capstone course will evaluate student's awareness of the reciprocal impacts of culture and the environment on technology. ▪ Student survey and Alumni survey ▪ CIDR assessment ▪ Internship
III.4	Students will know contemporary issues relevant to the pulp and paper industry	Contemporary issues will be introduced by instructors in all courses as part of maintaining up-to-date and relevant instruction. The PSE 450 course will provide timely seminars on pulp and paper current events. Internships will also provide knowledge of contemporary issues.	▪ Direct Assessment PSE 202, 450 ▪ Faculty and industry analysts involved in the capstone course will evaluate student's awareness of the contemporary issues in the paper and allied industries. ▪ Student survey and Alumni survey ▪ CIDR assessment ▪ Internship
III.5	Students will have the knowledge that life-long learning is a necessity for the maintenance of professional competency	PSE courses will emphasize the need for remaining abreast of new technologies and developments in the pulp and paper industry. In addition, methodologies for obtaining current information will be taught in PSE courses. The PSE 450 seminars will emphasize life long learning. Internships will demonstrate the importance of life long learning.	▪ Direct Assessment PSE 450, 487 ▪ Reports (oral and written) of project results accompanied by an all-inclusive literature review will be primary evaluation tools that demonstrate students have the skills to find needed information. ▪ Student survey and Alumni survey ▪ CIDR assessment ▪ Internship.

[1] VLPA stands for Visual, Literary, and Performing Arts. I&S stands for Individuals and Societies. Courses that are categorized with these designations may be used to satisfy University distribution requirements.