PAPER ENGINEERING

SELF-STUDY QUESTIONNAIRE

State University of New York College of Environmental Science and Forestry

15 June 2006
Revision 3.0

Engineering Accreditation Commission

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E3 8/7/02

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A. Background Information

1. Degree Titles

The Faculty of Paper Science and Engineering offers the Bachelor of Science in Paper Engineering and Paper Science effective with the 2004-05 academic year. Prior to this time, the Faculty offered a single program in Paper Science and Engineering with two options: Engineering option and Science option. The Engineering option was accredited by EAC/ABET. With the curriculum remaining the same, the options were elevated to programs to provide greater clarity with respect to the accreditation of the engineering program.

The Faculty of Paper Science and Engineering is responsible for the design and implementation of the Paper Engineering and Paper Science programs (See Table 1). The Paper Engineering program is the only one that is seeking reaccredidation through ABET. With either program, it is possible to take one of several college-wide minors that are offered at ESF (See Table 2). Typically, students taking a minor with the Paper Engineering program require an additional semester of study.

Table 1. Undergraduate degrees offered by the Faculty of Paper Science and Engineering.

Program	Degree
Paper Engineering* (formerly Paper Science and Engineering: Engineering option)	Bachelor of Science
Paper Science (formerly Paper Science and Engineering: Science option)	Bachelor of Science
*Program for which accreditation is sought.	

Table 2. Minors offered at SUNY-ESF that are open to Paper Engineering and Paper Science students.

Entrepreneurship Minor
Management Studies Minor
Marketing Minor
Construction Management
Computer and Information Technology Minor
Urban Environmental Science Minor

The Paper Science program consists mainly of chemistry and chemical engineering courses with specialized courses relating to the manufacture and use of pulp and paper products. The technical elective concentration allows the student to select a subject area of interest in which to specialize. This program prepares the student for careers in the engineering, management, or technical representative areas with opportunities to extend interests in other directions.

The Paper Engineering program has been designed to provide greater depth in chemical engineering education for the student preparing for an engineering career in the pulp and paper industry. The courses are designed to present the principles of engineering with the disciplines and examples selected especially for the pulp and paper industry. Courses have been added in the areas of basic principles in electricity, statics and dynamics, and mechanics, as well as thermodynamics and design. The graduate is prepared to move into assignments in the engineering field and advance quickly to positions of responsibility in the analysis and design of processes and equipment.

It is important to point out that, although we are seeking reaccreditation through ABET of the Paper Engineering and not the Paper Science program, the processes of continuous improvement and outcomes-based assessment described in this document apply to all programs. The two programs have a nearly common first two years; students are able to switch seamlessly between the two programs. For this reason, some of the data presented in this self-study represent the entire Paper Science and Paper Engineering programs. Historically, 39% of our students graduated from the Paper Engineering program (formerly the engineering option). Of our current students, 67% are in the Paper Engineering Program.

2. Program Modes

The Faculty of Paper Science and Engineering operates in a traditional, day mode of instruction. While some courses are offered in the afternoon and evening, the great majority of our undergraduate instruction occurs during the day. Every student, however, is required to take a 12-week summer mill experience (PSE 304) at a pulp, paper, or allied manufacturing site. In addition, longer co-op work experiences during the semester (PSE 305) are also offered to students.

3. Actions to Correct Previous Shortcomings

The undergraduate Engineering Option in Paper Science and Engineering (now Paper Engineering) was evaluated by ABET in 2002. The previous accreditation team in 2002 identified the following issues (Final Statement, 2002 visit). Since the last visit, a number of actions have been taken to address these issues as summarized below.

<u>Program Concerns:</u>

1. <u>Criterion 3. Program Outcomes and Assessment.</u> The criteria and metrics to assess student abilities, particularly technical skills, are not fully developed. Improved assessment processes are needed to provide quantitative evaluation of outcomes. Students' abilities to apply modern computing software and techniques are weak. Modern computing procedures, software, and their utilization need to be integrated into coursework throughout the curriculum and into appropriate design and analysis courses.

   <u>Due Process Response</u>: Improvements in the area of computer software and techniques were described. It was stated that the PSE curriculum is in transition to incorporate the

Matlab software package throughout the curriculum. A dual loop method is described to assist the instructor in course assessment and longer timescale assessment is described to improve instructional effectiveness. Improvement plans for the outcomes assessment process to be implemented over the next two years were described.

Final Resolution*:* This weakness is resolved but remains as a concern pending further implementation of the changes described in the due process response.

- The assessment of the program outcomes was systematized and improved as described under Criterion 3 later in this self-study. In the improvement of the outcomes assessment, specific courses were targeted with respect to each of the outcomes for detailed assessment of that outcome to determine the satisfaction of that outcome.
- Each course, that is part of the program, has been categorized as to its impact on each of the outcomes in terms of its level of involvement with that outcome. Each outcome for each course is categorized as giving students exposure to the outcome ("X"), familiarity with the outcome ("F"), or in depth coverage of the outcome ("D"). It is expected that the category for each course would increase as the class level of the course increases.
- The faculty has implemented a more focused Faculty Course Assessment Report (FCAR) that will be completed at the end of each semester. In this report, the instructor of the course will detail how the course has touched on the various program outcomes, discuss the changes made in the course content and delivery, and reflect on changes that may need to be made in the subsequent offering of the course.

2. Criterion 1. Students: Advising of students by faculty members and help provided to students by faculty members outside of class appear to not always be adequate. Some faculty members could not answer basic questions concerning the curriculum. Not all students could easily obtain the help they needed to plan their programs, and this planning is complicated by the low enrollment in classes, causing some courses to be cancelled. The catalog makes it difficult for students to plan their programs. Curriculum related statements in the catalog are confusing.

Due Process Response: Statements were provided indicating that this shortcoming has been addressed by (1) improving faculty knowledge of the curricular and advising issues of concern to students and involving the associate chair in the process, (2) classes that were cancelled due to low enrollment were stated to not affect the schedule of any students, and (3) catalog descriptions are evolving to better describe the curriculum and courses as the program evolves from primarily upper level to one in which many students begin on campus as freshmen. Statements to be included in the catalog for the 2003-4 academic year address the latter issue.

Final Resolution: This concern is resolved.

- The catalog description has evolved to clarify the requirements of the program. Additional supplemental material is provided in the Student Handbook to detail the typical course sequence (semester-by-semester course layout), the program outcomes and objectives, the ethical responsibilities of an engineer, and information about engineering licensure.

3. Criterion 2. Program Educational Objectives. The evaluation metrics used to determine achievement of all objectives are insufficient. It is recognized that progress has been made in evaluation processes and in the development of more adequate metrics.

   Due Process Response: Statements were provided indicating the evaluation metrics have been revised. Statements were provided indicating an improvement to the metrics in four areas to be implemented over the next two to four years. The surveys are to be modified to more directly relate to program objectives.

   Final Resolution: This concern is resolved.

   1. The system of Program Educational Objectives has been systematized to a greater degree with the various surveys revised to be more directly related to the Objectives. The metrics have been more specifically determined and the instruments used revised.

Program Observations

1. Most faculty members in paper science and engineering are not licensed professional engineers.
   - The recent advertisement for a position specifically mentioned the desirability of holding a professional license. Dr. Shijie Liu, who was hired in August 2005, is a registered engineer in Canada and is seeking reciprocal registration in New York.
2. The number of students in the engineering option, i.e., twelve, is low relative to the department's capacity. The department is encouraged to implement a strong "recruiting" program to address this issue.
   - Over the past several years, a strong recruiting program in the high schools and community college has resulted in an increase in the number of students entering the program. In addition, the proportion of students selecting the Paper Engineering program has increased significantly.
3. Students do not appear to be aware of EAC requirements. The student professional organization appears amenable to making the information generally available to the students.
   - Greater information about the EAC requirements has been placed in the student handbook and the importance of engineering licensure is discussed at least twice in PSE 132 (PSE Orientation).

4. Contact Information

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B. Accreditation Summary

1. Students

Describe how students are evaluated, advised, and monitored in a manner consistent with program objectives, as required by Criterion 1. Address each item individually.

Describe the processes and procedures used to enforce policies for the acceptance of transfer students and provide evidence that the processes and procedures are working.

Describe the procedures used to validate credit for courses taken elsewhere and provide evidence that the procedures are working.

The Faculty[*] of Paper Science and Engineering provides the pulp, paper, and allied industries with entry-level engineers trained in the technology and science of the pulp and paper industry as well as the traditional engineering topics. The program also prepares students for graduate study in a wide-range of engineering fields. The program tends to be very demanding as are most engineering programs. Guidance and advising of students is a high priority for this department. In many cases, students are counseled even before they have entered the application process and are admitted to the College. This serves the students by providing them with an understanding of the curriculum and ensuring that their preparation is optimized. Undergraduate recruitment focuses on those students who are strong in both mathematics and chemistry. Since the PSE program recruits and admits both freshman and transfer students, these groups are described separately in the sections that follow. Once students are enrolled, frequent communication is maintained by faculty advisors to ensure that the students progress toward the program outcomes. This also enables students to tailor their elective course selection to focus on personal strengths and preferences within the paper engineering discipline.

Undergraduate Recruitment

The Faculty of Paper Science and Engineering generally draws its admissions from two distinct populations: freshmen entering as recent high school graduates; and students who transfer into the program, usually at the junior level, from community and junior colleges. Table 3 provides the distribution of the admissions from these two groups for the past six years. Once students are admitted to the program, the two groups are not distinguished with respect to advising and students are guided according to their individual needs. The recruitment of new students is a collaborative effort between this Faculty and the Office of Undergraduate Admissions.

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[*] The State University of New York, College of Environmental Science and Forestry (SUNY-ESF) does not have academic departments. Therefore, Faculty refers to an individual academic unit, while faculty refers to the body of academic employees. In the context of this report, Faculty will refer to the Faculty of Paper Science and Engineering (PSE).

Table 3. Freshman and Transfer Admissions to PSE for the past eleven years.

Year	Freshman Admissions		Transfer Admissions		Total
	Paper Engineering	Paper Science	Paper Engineering	Paper Science	
2006-07**	11 (+9***)	2	0 (+1)	1	14 (+10)
2005-06	9	5	2	1	17
2004-05	11	1	2	1	15
2003-04	4		7		11
2002-03	4		5		9
2001-02	9		7		16
2000-01	9		8		17
1999-00	5		11		16
1998-99	13		8		21
1997-98	4		22		26
1996-97	11		17		28

*Prior to the 2004-5 academic year, students were not required to immediately select an option upon admission. With the 2004-05 year, students must select a program immediately, but can easily change it during the first two years of study.

**Information available as of 15 May 2006. Data includes only Fall 2006 admissions. Other years include both Fall and Spring admissions of that academic year.

***Accepted students, but have not made a decision.

Recruitment of students at the freshmen level is typical for a college campus of the size of SUNY-ESF. The Undergraduate Admissions Office has typically taken the lead for recruiting at this level through solicitation at college fairs, and direct contact of high school career councilors. PSE faculty members have taken a more active role in recruiting at this level over the past several years. The Faculty has initiated direct contact with students from regional high schools that excel in mathematics and science. Faculty members have also made direct contact with instructors of mathematics and science in local schools to increase the awareness of potential opportunities in this engineering field. The faculty also hosts small groups from regional high schools that visit the department to tour the engineering laboratories and learn about the program. In addition, the faculty has hosted a number of open house events to introduce students to the programs and opportunities in the industry.

The responsibility for recruitment from junior or community colleges is shared by the Faculty and the Undergraduate Admissions Office. The latter usually recruits at college transfer fairs or through the transfer office at each college. The Faculty actively recruits at key feeder colleges through contacts in the Engineering Sciences, Chemistry, and Physics departments within those schools. Many of the feeder colleges are visited annually by faculty members. During such visits, lectures about the PSE program and the opportunities in the field of paper science and engineering are given to Engineering Orientation, Chemistry, Mathematics classes, or Engineering clubs. Following the lectures, the faculty member usually meets with prospective students to discuss their situation in greater detail. At times this involves planning course selection to facilitate transfer into the program.

Students who are interested in applying to the program often visit the campus during scheduled Open House sessions or Accepted student receptions. The faculty members receive the students in groups to discuss the Faculty and the program. It is also common for prospective students and their parents to visit the department to discuss the curriculum and the opportunities for graduates from this program. In such cases, they are received by a faculty member and one or more current students for pre-admission counseling.

Table 4. Summary of major recruiting activities for academic years 2005-06.

Date	Activity	Target Audience	Partic-ipants
2005-07-28	DEC Camp	High School	50
2005-10-22	Fall Open House (ESF)	High School	35
2005-11-03	Manlius Pebble Hill High School	High School	3
2005-11-04	Bloomsberg School Career Fair	High School	15
2005-11-07	Franklin/Unadilla High School	High School	20
2005-11-11	Engineering Open House (ESF)	High School	30
2005-12-07	Broome Community College	Administrators	16
2005-12-20	Ilion Central Schools	High School	100
2006-02-15	Emma Willard High School	High School	100
2006-03-09	Canastota High School	High School	25
2006-03-17	Manlius Pebble High	5th Grade	40
2006-04-12	Tomkins Community College	Transfer	40
2006-04-21	Adirondack Community College	Transfer	40
2006-04-22	Spring Open House (ESF)	High School	12
2006-05-03	Jamesville-Dewitt High School	High School	35
2006-05-31	Manlius Pebble High	6th Grade	12

Undergraduate Admissions

SUNY-ESF accepts students from both high school and as transfer students from other institutions of higher education. SUNY-ESF operated on an upper division, transfer mode during the late 1980's, reverting to a freshman admission mode in 1990. Thus, the college is becoming both a four-year school and a transfer school with increasingly higher proportions of students entering as freshman (See Table 3). The fact that students enroll at different entry points within the four years means that consideration must be given to curriculum design and the issues of advanced placement and transfer credits.

The Faculty of PSE works closely with the Office of Undergraduate Admissions to evaluate the transcripts of students entering as freshman and or transferring in as upper classmen. The Office of Undergraduate Admissions implements admissions criteria developed in cooperation with each Faculty. College admission standards and data are summarized in Volume II of this report.

Students seeking admission to the PSE program must file their application under one of the processes as detailed in the College Catalog. The descriptions of the college application processes are detailed on the college website at www.esf.edu/admissions/undergrad/freshman. Briefly, the application methods are:

> Early Decision Freshman Admission. Applicants for freshman admission who are certain that ESF is their first choice may apply under the early decision option. Early decision candidates must have a completed application on file by November 15. This must include the SUNY Application (which should be received at the SUNY Application Processing Center by November 1), official high school transcripts, official results of either the SAT I or ACT, the ESF Supplemental Application with essay question response and the Early Decision Applicant Agreement.
>
> Regular Freshman Admission. Students who choose to attend ESF following high school graduation apply for admission to the college under regular freshman admission. This freshman enrollment option is available for students who meet the admissions standards for all baccalaureate programs and for a limited number of students for the A.A.S. in Forest Technology. Most applicants to the A.A.S. program in Forest Technology will apply under the Guaranteed Transfer Admission process. Please refer to the next section, which explains this process.
>
> Successful freshman applicants should present strong academic credentials from high school. A minimum of three units each of college preparatory mathematics and science are required for most majors. An official high school transcript must be submitted as part of the student's application credentials. Applicants are required to forward the official results of either the SAT I or ACT examination. SAT II tests are not required, but in some cases they may highlight the special talents of an applicant. Freshman applicants are also required to write an essay. The essay question is contained on the ESF Supplemental Application, sent to each applicant or available on the ESF Web site, which must accompany the essay response.
>
> Guaranteed Transfer Admission**.** The college recognizes that some students have made arrangements to spend some portion of their first two years of college at other institutions, and will transfer to ESF in either their sophomore or junior year. To facilitate this process and reduce difficulties associated with transferring, ESF has established a Guaranteed Transfer Admission (GTA) option.
>
> Under this option, admitted students are guaranteed admission to ESF for either their sophomore or junior year. These students benefit from long-term academic advising to ensure they meet all academic requirements for transferring to the college. Guaranteed Transfer applicants must submit the same credentials as outlined under "Regular Freshman Admission." Successful applicants for this

option must present a strong academic background including at least three years each of college preparatory mathematics and science. To satisfy the guarantee of admission, students must satisfactorily complete, with a minimum cumulative grade point average of 2.000 (A = 4.000), any of the lower division requirements, which are part of their program of study. Only course work with grades of “C” or higher will transfer to meet ESF degree requirements.

Transfer Admission. Approximately half of the students who enroll at the college each year transfer to ESF after completing at least one semester at another college following high school graduation. ESF recognizes the unique interests and needs of transfer students.

Transfer students' admissibility is based primarily on the quality and distribution of previous college-level course work. Consideration involves how much of their previous course work applies to the requirements of their intended program of study at ESF, overall academic performance at their previous colleges, and specific interest in ESF programs. For most programs, a significant emphasis is placed on students' backgrounds in mathematics and science. Students who have completed less than 30 semester hours at their previous college may be required to submit copies of their high school transcript and SAT I or ACT test scores.

Acceptance of Transfer Students

Up until the early 1990’s, SUNY-ESF was strictly an upper division college, only accepting students after they had completed two years at a community college or other university. Thus, the Paper Science and Engineering programs, as well as all program on campus, were designed as two-year, upper-division programs. As SUNY-ESF returned to a four-year college starting in the early 1990’s, the curriculum was adjusted to accommodate those students who would spend four years in the program, while still serving transfer students. Currently, transfer students are still a significant portion of the incoming students and standard processes are in place to incorporate them into the curriculum at the appropriate level.

Significant changes have taken place in the transfer student cohort at ESF since 1992 as the College transitioned back from a two-year college to a four-year college. Historically, many academic programs had specific admission restrictions for transfer students based on the student’s total number of advanced standing credits or their successful completion of core lower division course requirements. In many cases, students did not historically enroll until they were in full junior status.

Due to changes in admissions and academic policies in recent years, the number of students transferring with a class standing of less than junior has increased significantly. Such students frequently enter lacking core lower division requirements. This change of accepting transfer students with anywhere from 30 to more than 70 transfer credits means that students will be entered with a greater variety of background. For example, some students may come in well prepared in math and physics but may be lacking in chemistry. Other students may have other deficiencies. Thus, the first semester on campus for a transfer student is often the most difficult to schedule. Advisors who are most familiar with the curriculum typically schedule and advise the students for their first semester.

The process for accepting transfer students is well established at ESF and detailed in the college catalog. We base the acceptance of a transfer student on their post-secondary transcripts, the SUNY application, and the SUNY-ESF supplemental application. Transfer admission is based on a review of the student's performance in all previous post-secondary work and the compatibility of the course work with the requirements of their intended program of study at ESF. The overall performance criteria are classified as selective, with emphasis on areas most important to the foundation needed for their program of study. For Paper Science and Engineering, Table 5 indicates what transfer students (assuming that the student is prepared to enter the junior year) should have. Students who come in with less than the courses listed in Table 5 will be appropriately placed. It is to the student's advantage to adhere as closely as possible to the suggested schedule in the college catalog. In this way, students that transfer as sophomores will be able to start into the program with little difficulty.

Transfer students, who potentially may only be spending two years at SUNY-ESF, need to adjust quickly to the academic life in the Paper Science and Engineering program. This is especially true with respect to job interviews for the summer work experience for which interviewing begins in mid-October. This requires that most transfer students assemble a resume within the first six weeks of class. To help with this transition to the college in general and to the Paper Science and Engineering Program in particular, all transfer students are required to take PSE 132, the PSE student orientation. Freshmen are also required to take PSE 132.

Table 5. Expected courses for transfer students into Paper Science and Engineering.

First Year Courses		**Second Year Courses**	
General chemistry (with lab)	8 credits	Engineering physics (with lab)	8 credits
Calculus I & II	8 credits	Calculus III	4 credits
English with a focus on writing	3 credits	Differential equations	3 credits
Economics	3 credits	Organic chemistry (with laboratory)	8 credits
Computer programming	3 credits	Quantitative analysis	3 credits
Engineering graphics	1 credit	Literature with a focus on writing	3 credits
General education	6 credits	General education	6 credits

Students who apply as transfers to ESF are expected to have successfully completed some portion of the established required sequence of courses appropriate to their intended major at the college. Students attending one of our Pre-ESF Cooperative Transfer Colleges (see below) will find information on course equivalencies for all of our programs of study on our Web page. To be considered for admission to ESF, a transfer student must have a minimum cumulative grade point average of 2.000 (A = 4.000) at the last institution where the student was enrolled full time. Only course work with grades of "C" or higher will transfer to meet ESF degree requirements.

The college has developed transfer articulation agreements with other colleges both in (Table 6) and out of New York State (Table 7). These programs offer students a wide selection of colleges from which they can obtain the necessary courses, and appropriate advice on how to prepare for transfer to ESF. Information on ESF Cooperative Transfer Colleges may be found on our web page.

These institutions represent a broad spectrum of higher education, including private, public, two- and four-year colleges. Students who attend these colleges and follow the academic program prescribed by ESF will share a common academic background with other students who transfer to the college.

Table 6. New York State cooperative transfer colleges for which the college has articulation agreements.

Adirondack Community College
Broome Community College
Cayuga County Community College
Columbia-Greene Community College
Corning Community College
Dutchess County Community College
Erie Community College (City Campus)
Erie Community College (North Campus)
Erie Community College (South Campus)
Finger Lakes Community Colllege
Fulton-Montgomery Community College
Genesee Community College
Herkimer County Community College
Hudson Valley Community College
Jamestown Community College
Jefferson County Community College
Kingsborough Community College
Mohawk Valley Community College
Monroe County Community College
Morrisville State College
Nassau County Community College
Niagara County Community College
North Country Community College
Onondaga County Community College
Orange County Community College
Rockland County Community College
Schenectady Community College
Suffolk County Community College
Sullivan County Community College
SUNY College of Technology at Alfred
SUNY College of Technology at Canton
SUNY College of Agriculture and Technology at Cobleskill
SUNY College of Technology at Delhi
Syracuse University

Tompkins-Cortland Community College Ulster County Community College Westchester County Community College

Table 7. Out-of-state cooperative transfer colleges for which the college has articulation agreements.

Berkshire Community College Bucks County Community College, Newtown, PA Holyoke Community College Housatonic Community College Northampton Community College

Validation of Transfer Credit

Credit hours appropriate to the Paper Science and Paper Engineering programs can be transferred to the college, but grades and grade points cannot be transferred. Courses to be transferred to meet graduation requirements must be acceptable in content, and credit is awarded only for those completed with a grade of “C” or higher (a “C-“ is not acceptable). All transfer credit will remain tentative until official final transcripts are received and reviewed by the Office of Undergraduate Admissions staff. It is the student’s responsibility to ensure that official and final transcripts are sent to and received by the college.

Only course work completed at institutions that are fully accredited by one of six regional accrediting agencies will be considered for possible transfer credit toward ESF degree requirements. These agencies are the Middle States Association of Colleges and Schools, New England Association of Schools and Colleges, North Central Association of Colleges and Schools, Northwest Association of Schools and Colleges, Southern Association of Colleges and Schools, and Western Association of Schools and Colleges.

The College will consider for advanced standing credit the results of examinations from standardized testing agencies such as the College Entrance Examination Board's Advanced Placement Program (AP) or the College Level Examination Programs (CLEP). The following guidelines are intended to assist students and advisers.

- Scores of 3, 4, or 5 on AP exams may be accepted for credit for all exams except those defined below as the fundamentals of math and science.
- Scores of 4 or 5 on AP exams are needed for credit in areas defined as the fundamentals of math and science. The AP exams indicative of knowledge areas in fundamentals of math and science are given in Table 8.
- Scores of 3 or higher on the LanCom (credit awarded for CLL 190) and LitCom (credit awarded for CLL 290) AP exams are acceptable for writing course credit.

Table 8. Credit given for Advanced Placement (AP) scores in the area of math and science.

AP Examination	Credits	Courses
Biology	8	EFB 226/ EFB 285

Chemistry	8	FCH150/151/152/153
Calculus AB	4	APM 105 or MAT 295
Calculus BC	8	APM 105/106 or MAT 295/296
Physics B	8	PHY 101/102
Physics C: Mechanics	4	PHY 211/221
Physics C: Electricity and Magnetism	4	PHY 212/222

There are two distinct processes by which a transfer credit is accepted by SUNY-ESF: upon admission and after admission. Upon admission, the initial acceptance of transfer credit is determined the Office of Undergraduate Admissions. The process used is determined by the transferring college. The college has developed articulation agreements with other colleges both in and out of New York ("Cooperative Transfer Colleges"). These colleges offer high school students a wide variety of programs from which they can obtain the necessary lower-division courses, and appropriate advice on how to prepare for ESF. Detailed information on the specific guidelines used for specific college. An example of the guidelines used for a transfer college for Paper Engineering is given in Table 9. Similar information is available for approximately 60 colleges and universities. These agreements are reviewed periodically in consultation with the Faculty of Paper Science and Engineering.

Transfers from other colleges are handled on an individual basis. In these cases, course equivalences are based on a comparison of the catalog descriptions and course syllabi of the transferring college and the corresponding course at SUNY-ESF (or SU). Again, the Office of Undergraduate Admissions makes the initial decisions of acceptance. However, in the case of questions, that office will consult with the Chair or Curriculum Coordinator of Paper Science and Engineering. In the case of doubt of the appropriateness of a transfer, the transfer is **not** made and it is up to the student to petition acceptance of the course through the Faculty of Paper Science and Engineering. In this way, Faculty control is maintained over the transfer from other colleges.

Table 9. Example of Transfer/Articulation Guidelines for Broome Community College.

Paper Engineering Requirement	Credits	Transfer College Courses
Calculus I, II, & III	12 credits	MAT181 & MAT182/172 & MAT281
Chemistry I & II w/ Lab	8 credits	CHM145+CHM145L & CHM146+CHM146L
Computer Programming	3 credits	CST113 or CST117 or CST120 or CST124 or CST127 or CST128 or CST133 or CST138 or CST150
Differential Equations	3 credits	MAT282
Economics	3 credits	ECO110 or ECO111
Engineering Graphics	1 credit	EGR150 or MET113
Engineering Physics I & II w/Lab	8 credits	PHY181+PHY181L & PHY182+PHY182L
English w/ Focus on Writing	3 credits	ENG110 or ENG111
Literature w/ Focus on Writing	3 credits	ENG220 or Any course with LIT prefix

Organic Chemistry I & II w/ Lab	8 credits	CHM245+CHM245L & CHM246+CHM246L
Quantative Analysis	3 credits	Not offered
*General Education requirement - American History	3 credits	
*General Education requirement - The Arts	3 credits	
*General Education requirement - Other World Civilizations	3 credits	
*General Education requirement - Western Civilization	3 credits	

A student may also transfer credit through the use of a "Petition to the Faculty," which is a multipurpose form used to handle many student actions with respect to their coursework. For courses that did not transfer when a student entered a PSE program, the student must complete the petition form and supply the documentation necessary (e.g., a syllabus for the course taken and/or a catalog description) that substantiates the claim that the course satisfies a program requirement. A transcript that shows that the student received at least a grade of "C" is also required. The petition must be approved with a signature of the student's advisor and Associate Chair. The petition is then sent to the office of the Dean of Instruction and Graduate Studies for final approval. While the ESF Faculty Committee on Instruction has final authority on all petitions, the authority to approve most petitions has been vested with the Dean. Once approved, the petition is forwarded to the Registrar's office for final approval. Petitions regarding the satisfaction of General Education requirements are adjudicated by the General Education subcommittee.

The same process is used to transfer credit for courses taken at other institutions once the student has started at SUNY-ESF. For example, a student may take an elective or mathematics course over the summer at a community college in order to satisfy a program requirement. It is very important in this case that the petition be approved **before** taking the class to guarantee that the course will transfer as expected. As for all petitions, it must be approved by the advisor and the Associate Chair prior to being forwarded to the Dean's office.

PETITION TO THE FACULTY

SUNY - ESF
JAN 16 2004
OFFICE OF INSTRUCTION AND

SUNY COLLEGE OF ENVIRONMENTAL SCIENCE AND FORESTRY

Undergraduate Student
Degree Program Paper Science
Class Level Senior

Name (Print) [redacted]
Local Address [redacted]
Email Address [redacted]

Graduate Student
Degree Program
Degree Sought

Signature [redacted]
Social Security # [redacted]
ID # [redacted]
Date [redacted]

Request:

Transfer economic class credit from MCC (Monroe Community College) to count for FOR207 requirement.
ECO101

Justification for Request:

Instructor's signature required for late drops/adds and extension of incompletes.

Signature Date

RECOMMENDATIONS

Advisor/~~Major Professor~~
Signature P.N. Ramarao
Date 1/13/04
Approved ✓
Disapproved
Comments MCC Transcript is available on-line for ECO-101.

Faculty Committee/Coordinator
Signature
Date
Approved
Disapproved
Comments

Faculty Chairman
Signature [signature]
Date 13 Jan 2003
Approved ✓
Disapproved
Comments

FINAL ACTION

Committee on Instruction/Dean, Instruction and Graduate Studies
Signature D. Raynal
Date 1/20/04
Approved ✓
Disapproved
Comments If grade appropriate

Figure 1. Example of a petition to transfer credit from another institution to ESF.

Undergraduate Advising

While informal guidance of prospective students may begin even before they are accepted into the program, all enrolled students are offered formal advising from the spring preceding enrollment through the completion of their studies within our Faculty. Communication with our students and advising is considered of paramount importance for the PSE program at SUNY-ESF. This ensures that our students maintain optimal progress toward personal goals and completion of the degree. Advising of PSE students takes on several facets: academic, professional, and personal. These three categories, however, are not independent and cannot be discussed separately. Professional and career goals will impact the academic advice that a student receives. In addition, personal concerns can affect the academic performance and needs of a student. Thus, while we discuss these three aspects separately, we continually consider the interactions between them. It is a goal of the PSE Faculty that all PSE students progress through the academic program in its intended sequence while meeting all prerequisites. This ensures that our students benefit most from their education and are able to successfully pursue their careers in engineering.

A Summer Orientation Program is offered to all accepted students. This program consists of a four-day retreat that takes place in late Spring before their first enrollment in the Fall semester. The objective of the program is to provide the students with an overview of the curriculum and the basic concepts of the field of paper science and engineering. Students meet as a group with faculty and staff members who lead various sessions and field trips. Students interact as a team in work and social settings. Initially, one to two faculty members advise incoming students during the session, when their Fall schedule is prepared. Students who are unable to attend the Orientation Program during their first year are required to do so the following year.

Once students are enrolled, a permanent advisor is assigned. This advisor will typically guide the student for his/her entire tenure at ESF. While the assigned advisor is the key contact for the student, advising can take many forms and can come from many different offices at SUNY-ESF. From an academic standpoint, the advisor's role is to help the student plan course schedules on a semester-by-semester basis. All students are required to meet with their advisor at least once per semester for this purpose. Students are not allowed to register for classes without a signature from the advisor approving the next semester's course work. This system should prevent students from taking courses without the prerequisites or without the proper authorization. Throughout the college, this academic advising takes on a whole range of effectiveness from the advisor "rubber stamping" what the student has chosen for courses to serious discussions of the most appropriate course for the particular student's goals. Of course, the necessity of this type of advising varies considerably across the different faculties at ESF. Several programs have rigid requirements with few choices. There is little for the advisor to do academically except to say "take these classes." In more flexible programs, academic advising takes on a much more critical role.

Professional advising involves discussing with the student the career and the continued education opportunities that are available. For PSE, this level of advising includes advice on the opportunities for summer and other employment. For example, advisors in Paper Science and Engineering often consult with students on the different jobs that are available for summer and co-op positions. In addition, advisers may review resumes and provide training for interviews.

Personal advising requires the highest level of trust between the advisor and the advisee. In most cases, the student must be the initiator of these advising sessions; very rarely can the advisor proactively advise students on personal matters. Students must feel comfortable enough with advisors to see them as trusted mentors in whom they can confide. Personal advising can involve a wide range of topics and concerns including home situations, conflicts with instructors, financial difficulties, learning disabilities, drug and alcohol abuse, and so on.

It is important that each professional acting as an advisor to students be knowledgeable of the options and choices that students need to make with regards to coursework. Within each Faculty at ESF is a Curriculum Coordinator, who is responsible for curricular issues as they arise and for helping the advisors within the Faculty. The Curriculum Coordinator generally acts as a second-level advisor and helps resolve issues that cannot be resolved between the student and the advisor. The Curriculum Coordinator also keeps the advisors in the Faculty up-to-date with the changing curriculum.

Beyond academic advising, there are resources available at ESF to help with the other advising concerns. The mission statement of the Division of Student Affairs and Educational Services includes several student support services:

- Assistance with daily student life and transitions as they affect the learning process, e.g. orientation, financial aid, counseling, career services, alumni services.
- Assistance with students' individual educational progress, e.g. recruiting and retaining students, recording progress to degrees, tutoring, internships.
- Helping students meet institutional requirements and expectations, e.g., credit transfer, registration, judicial affairs.

The college is responsible for providing quality advising that is both inviting and realistic. There is always room for improvement in the advising process. To achieve this, advisor training was suggested, with this training encompassing both curriculum and people skills. Advisors need to be involved, interested, and available for student advising. Students seem to be asking for detailed information regarding internships and job orientation. Career services needs to be more visible.

Undergraduate Monitoring

Once admitted, the Office of Undergraduate Admissions cooperates with the Registrar's Office to produce a SUNY-ESF Curriculum Plan Sheet. The Plan Sheet includes the 8 semesters of coursework (for freshman) and generic lower division requirements and four semesters of coursework (for transfer students). Transfer credits granted at the time of admissions or by petition after admission are indicated on the transfer student version of the Plan Sheet.

The Registrar's Office continually updates the Plan Sheets by indicating courses completed (with grades) and courses in progress (indicated as IP). Each student can get a current copy of the updated Plan sheet at any time using the Registrar's web-based system. With the Plan Sheet, the advisor has a clear picture as to how the student is progressing towards completion of the degree requirements. In addition, the academic advisor can review the details of a student's admissions portfolio by accessing an electronic folder via the same web site. The portfolio is passwordprotected and can only be accessed by the faculty advisor, the Curriculum Coordinator, and the Faculty Chair.

Copies of the Curriculum Plan Sheet for Paper Science and Paper Engineering are included in Appendix B. For each program, there is a freshman form and a transfer student form. In addition, the Plan Sheets are updated every time the program is modified; the forms shown attached are valid for the 2001-02 to 2004-05 academic years. As described in Criterion 4, the program is undergoing changes that will become effective in the 2006-07 academic year. These plan sheets representing the new program are also given in the appendix. Plan Sheets for previous academic years reflect the curriculum in force at that time. Note that students must fulfill the requirements listed in the catalog when they first enter ESF, so at any particular time, a number of different plan sheets may actively be in use. At any point, however, they may choose to follow the most recent catalog.

The Plan Sheet provides a semester-by-semester check against which students can gauge their progress towards the Bachelor of Science degree. The student and advisor can identify and rectify any issues related to progress towards the degree. In addition to the advisor checking the Plan Sheet, a number of additional procedures are used to validate the students' progress through the programs:

1. During the advising period for the subsequent semester, students meet with their advisors to determine their course schedule for the following semester. At this time, the advisor verifies that the student has (or will have) the proper prerequisites for which they are registering.
2. At the beginning of each semester, advisors verify (by checking the plan sheet online) that the students are properly registered for the oncoming semester. Any corrections needed are made during the add/drop period, which runs the first two weeks of classes.
3. The Associate Chair reviews the transcripts of all Paper Engineering and Paper Science students at the beginning of each semester. The objective of this audit is to determine those students who have failed courses that are prerequisites for other courses or registered for courses for which they do not have the prerequisites. Students register for the following semester's classes at about the 12th week of classes. Thus, in most cases, they do not yet know if they will pass the courses that may be prerequisites for other courses. A review of the transcripts of students that have failed reveals the need to adjust the students' class schedule for the new semester, which can easily be done during the first week of classes.
4. At the beginning of each semester, instructors check to see that all students have passed the necessary prerequisites to take that course. This is accomplished by the students self-reporting their preparation for the course.
5. Finally, the Registrar reviews all senior students in anticipation of their graduation, and alerts the Faculty Chair and Curriculum Coordinator of any potential discrepancies. The advisor and/or student are consulted to understand and work towards resolving the issue.

The above processes assure that students progress through the academic program in the prescribed manner. Exceptions can be granted with proper justification. To be granted an exception, a Petition Form must be filled out and approved prior to registering for the class. The instructor, the advisor, and the Associate Chair must approve the petition form. It is the student's responsibility to discuss their preparation for the course with the instructor.

After Fall or Spring Commencement, the Associate Chair (designated by the Faculty Chair) and Registrar review the academic records of all potential graduates. A Diploma is generated if and only if both the Associate Chair (as designated by the Faculty Chair) and Registrar agree that all published degree requirements have been met. Both must certify the completion of all degree requirements by their signatures.

Current Students

There are currently a total of 36 students enrolled in either the Paper Science or Paper Engineering programs (Table 10). As the table shows, there are a number of small classes working their way through the curriculum (e.g., Juniors). This is representative of the low recruiting numbers for a number of years as shown in the previous discussion on recruiting. A slightly higher level of attrition was also seen with this class. With the entering freshman class this year, we are also seeing an improvement in the quality of the students that are entering the programs as shown by the improvement of the average GPA back to the level expected in our program. The average GPA of graduates in the program over the past five academic years is 3.06.

Table 10. Current student matrix as of 26 April 2006.

Class	Paper Engineering	Paper Science	Total	Average GPA
Freshman	8	6	14	2.9
Sophomore	7	1	8	2.2
Junior	3	2	5	3.0
Senior	6	3	9	3.2
Total	**24**	**12**	**36**	**2.8**

Table 11. Average GPA of graduates.

Academic Year	Average GPA
2000-01	3.13
2001-02	3.23
2002-03	3.03
2003-04	2.87
2004-05	3.01
2005-06	3.63
Overall Average	**3.10**

Recent Improvements

The Faculty has made several improvements since the last review that impact this Criterion.

1. PSE Student Handbook. The PSE Faculty has published a PSE Student Handbook as a supplement to the general College-wide student handbook. The purpose of this handbook is to answer frequently asked questions as well as giving specific information regarding the PSE program. The handbook is updated annually as curriculum and policy changes are made. Incoming students receive the handbook at the PSE orientation in September during the PSE Orientation Class. Recent updates to the handbook include the following changes:
    a. FE Exam information added.
    b. Ethics information added
    c. Descriptions of the new curricula added for 2006-7.
2. PSE Advisor Handbook. The relationship between the advisor and the student is a very important one. The advisor is the first person that the student usually approaches when there is a concern. In 2001, an Advisor Handbook for Paper Science and Engineering was produced which answers many of the questions that advisors have with regards to the curriculum and college procedures. The handbook is updated biannually as new information is added.
3. Registrar's Website. The registrar's website is continually improving to aid the students in their understanding of the program.
4. PSE 132 Discussion. An expanded discussion of the programs and minors was included in the PSE Orientation class to make the students aware of the options and choices that are available for their education.

Summary

The process of accepting students into the program is well established and systematic. The synergy between the Office of Undergraduate Admissions and the Faculty allow the acceptance of students to proceed rapidly and with minimum problems. The system of regular review of the major transfer colleges by the Office of Undergraduate Admissions allows students at these colleges know precisely what will transfer. The petition process for the transfer of other courses allows the proper consideration and documentation of all articulations for transfer students. Recruitment is a cooperative effort between the Faculty and Admissions.

2. Program Educational Objectives

Discuss in detail the educational objectives, the process by which these objectives are determined and evaluated, how the program ensures these objectives are achieved, and the system of ongoing evaluation that leads to continuous improvement of the program, as required by Criterion 2.

As a minimum:

List the Program Educational Objectives and show how they are consistent with the mission of the institution and the accreditation criteria.

Identify the significant constituencies of the program.

Describe the processes used to establish and review the Program Educational Objectives and the extent to which the program's various constituencies are involved in these processes. Provide documentation that demonstrates that the processes are working.

Describe how the program curriculum and your processes ensure achievement of the Program Educational Objectives.

Provide documentation that describes the ongoing evaluation of the level of achievement of these objectives, the results obtained by this periodic evaluation and evidence that the results are being used to improve the effectiveness of the program.

In this section, we present the mission of the State University of New York, the mission of our college as a part of SUNY, the mission of our faculty and the program educational objectives for the Paper Engineering program, in sequence. We will emphasize how each of these missions is integrated upwards and finally how the program educational objectives fulfill the mission of the faculty and through it the college and thus, the State University of New York.

The latter part of this section is focused on the process by which these program educational objectives are developed, implemented and the resulting activities are monitored. As an integral part of this process, we identify the constituencies and existing communication channels and vehicles with them. Demonstrations of how interactions with our constituencies result in modifications, extensions and enrichments to our program educational objectives are provided.

The program educational objectives are a set of goals, which are a significant part of a hierarchy of charters and missions that lead upwards to the entire State University of New York system. At each level, the mission must support the mission, goals, and objectives of the level immediately above it. In the following sections, we work our way down from the Charter of the College according to the New York State Education Law and eventually to the Program Outcomes, which are discussed under Criterion 3.

Charter and Mission Statement of the College

The Charter presents the foundation on which the College's mission is constructed. The Charter was enacted into law by the New York Legislature, as required by Article 121 of the New York

State Education Law. Article 121 prescribes the College shall direct its efforts towards the following:

- Teaching in the science and practice of environmental science and forestry in its several branches, including landscape architecture; environmental design; environmental and resource engineering; environmental and resource management; wildlife studies; biology, chemistry, ecology; the manufacture and marketing of forest products; and the technologies appropriate to these branches of environmental science and forestry.
- The conduct of research, investigation, and experimentation relating to such studies whenever appropriate, including suburban or urban areas, and in commercial or industrial facilities.
- The conduct of experiments in forest and related development and management for public, commercial, recreational and aesthetic purposes and generally the giving of popular instruction and information concerning the elements of environmental science and forestry.
- The operation of demonstration and public service programs with a view to acquiring, transmitting and applying knowledge concerning the scientific management and use of forest and related natural resources for human benefit.

The mission of the State University of New York, College of Environmental Science and Forestry, which is based on this Charter, is to be a world leader in instruction, research, and public service related to:

- Understanding the structure and function of the world's ecosystems;
- Developing, managing, and use of renewable natural resources;
- Improving outdoor environments ranging from wilderness to managed forests to urban landscapes; and
- Maintaining and enhancing biological diversity, environmental quality, and resource options.

Mission Statement of Paper Science and Engineering

The mission of the Faculty of Paper Science and Engineering is:

- To develop well-educated and skilled engineers for technical and leadership careers in the pulp, paper, and allied industries;
- To foster the creation of new fundamental knowledge and technology relating to the science and engineering of pulp, paper, and associated products;
- To serve as a resource for societal interaction on the broad environmental resource and conservation topics related to the pulp, paper, and allied industries.

The mission of Paper Science and Engineering follows the traditional academic mission of "teaching, research, and public service." Being a Faculty that deals primarily with the use of natural resources, we directly support mainly the second mission of the university: "Developing, managing, and use of renewable natural resources." Fostering new knowledge and new technology for the pulp and paper industry also helps to maintain and enhance the resources options that are available to the industry. Indirectly, through prudent utilization of the natural resources, the Faculty also supports the other two statements in the College's mission statement.

Likewise the mission statement of the Faculty is in agreement and supports the charter of the College as given above. Again, the mission of the Faculty deals mainly with the efficient and environmentally-conscious utilization of the natural resources for pulp and paper production. In the first statement of the charter, the Faculty of Paper Science and Engineering falls under "environmental and resource engineering" which is the umbrella division for the three engineering Faculties at SUNY-ESF. In addition, the Faculty of Paper Science and Engineering has a very strong and long-standing research program within the Empire State Paper Research Institute (ESPRI), which is co-housed with PSE in Walters Hall. Further research outside of ESPRI is funded through competitive grants and by individual sponsor companies.

Program Educational Objectives (Paper Engineering Program)

Program educational objectives are defined as "what a student is expected (or is able to) accomplish **after** graduation from the Paper Science and Engineering Program." The educational objectives of the Faculty are to produce graduates who, during their first few years after graduation:

1. Have a sound background in fundamental science and engineering principles as applied to paper science and engineering;
2. Understand related societal issues such as environmental protection, occupational health and safety, resource management, and appropriate business skills;
3. Are well-rounded professionals in terms of teamwork, communication, and problem solving;
4. Are well-prepared for engineering practice in paper science and engineering;
5. Have developed life-long learning skills and abilities.

The program educational objectives were developed by the faculty with input from the constituent groups throughout the history of the PSE Faculty. Over these years, the program objectives have demonstrably evolved to fulfill the missions of the faculty and college. These program educational objectives codify the philosophy of education that has been part of the PSE curriculum for many years. They serve to fulfill the mission of the faculty and the college,

- By engaging in the education and training of professional engineers to serve the pulp, paper and allied industries in New York, the United States and globally,
- By being a leader in producing graduates employed by the pulp, paper and allied industries, some of whom who have since gone on to serve as senior industry executives, recognized educators and academic professionals, and renowned advocates of environmental issues.

The objectives are thus consistent with and support part I of the mission statement of the Faculty of Paper Science and Engineering. In addition, activities supporting parts II and III of the mission statement also indirectly support part I by improving faculty expertise in their area of instruction.

The curriculum of the engineering ~~option~~ program is designed to develop engineering professionals to work in pulp and paper mills. Anecdotally, employers have told us that our graduates tend to be 6 to 12 months ahead of graduates of standard chemical engineering programs due to training that is specific to the pulp and paper industry. Students receive instruction in the basic sciences and mathematics, unit operations and chemical engineering, and specialized training in the chemistry and technology specific to the paper industry. While aspects of design are incorporated throughout the curriculum, specific design experiences are typically geared to the paper industry and are often conducted at a nearby recycled paper mill.

Significant Constituencies

The PSE Faculty interacts with many diverse groups of people and organizations. Each of these groups has needs and concerns with respect to the PSE programs. In interacting with these groups, both formal and informal methods of ascertaining their needs are used. Table 12 summarizes these constituencies and how they interact with the PSE programs through the evaluation, assessment, and feedback instruments.

Of course there can be significant overlap amongst these constituent groups: A single person can be part of different constituent groups at different times or even at the same time. The various constituencies provide feedback in various degrees and of various types both collectively as a group and individually. For example, current students often provide informal, anecdotal feedback to Faculty members regarding the program and its component courses. In addition, graduating students provide feedback though the use of an exit survey and exit interview conducted by the chair. While these tend to be qualitative, they are important to focus and identify those areas that need improvement. It must be remembered that this represents a large number of constituents. To keep the assessment and evaluation workload reasonable, equal input is not solicited from all the listed constituents.

The following list gives a brief description of each of these constituencies.

1. Current undergraduate students: This group consists of the current student body in residence in the PSE program at SUNY. Information is generally sought from the current undergraduate students at the course level and at the outcome level.
2. Graduating Students. This group consists of those students expecting to graduate at the end of the current semester. These students can provide good immediate feedback regarding the meeting of their needs and can give an immediate perspective of the program with respect to their expectations and future employment requirements.
3. Syracuse Pulp and Paper Foundation. The Syracuse Pulp and Paper Foundation (SPPF) has both companies and individuals as members. Company representatives and individuals can serve on the Board of Directors and also participate in the various committees. Many of these member companies are also the employers of the graduates of the program. The Curriculum Committee deals directly with the educational issues of the PSE program. Employers in the pulp and paper industry are the primary “consumers” of our graduates, thus their concerns and comments are very important. The members of the committee are keenly aware of the changes that are occurring within the pulp and paper industry. With the input from the committee, the PSE Faculty can make adjustments to best serve the needs of the industry.

4. Alumni. Being the oldest pulp and paper program in the United States, the program has a large alumni base from which to get information. These alumni fulfill roles in the industry from entry-level engineers to Vice-Presidents, Presidents, CEO's, Engineering Directors, and Department Chairs. Alumni of the faculty and program have an opportunity to interact directly with the Faculty Chair or individual faculty members. More significantly, alumni constitute the members of the education, program, equipment, research and other committees of the Syracuse Pulp and Paper Foundation and also the Empire State Paper Research Associates.

5. PSE Faculty. The members of the PSE Faculty are the key constituent in evaluating the feedback received from other constituents, proposing improvements in the curriculum, outcomes, and objectives, and implementing these changes. All changes in the curriculum are initiated by Faculty action. In addition, the faculty continually interact with all of the other constituents, allowing the opportunities for the informal feedback into the process. Faculty members who are not members of the relevant committees have an opportunity to provide direct input during the faculty meetings when activities of the ABET are discussed.

6. Summer employers. All students in the program are required to work at least one summer in the pulp, paper, or allied industry. The summer employers can give us valuable feedback on how the students are doing up to that point and what needs to be improved. Students usually obtain summer and co-op positions through on-campus interviews.

7. Permanent employers. The PSE Faculty in conjunction with SPPF has an active recruiting program for permanent positions for our graduates. Each year, 10-30 recruiters come to campus to interview students who are graduating in the next year. Many of our students will have accepted positions by the time they graduate. The permanent employers see our students as "finished products," so their needs must be satisfied.

8. Empire State Paper Research Associates. ESPRI (Empire State Paper Research Institute) is a key player in fulfilling the second statement of the PSE Faculty's mission statement relating to research. The Empire State Paper Research Associates (ESPRA), an organization of over 10 pulp, paper, and related companies, supports ESPRI. Faculty and staff attached to the Empire State Paper Research Institute are directly involved in the academic program. ESPRI research staff assists students in laboratories and other instructional settings (such as paper machine runs). The representatives from the member companies of ESPRA meet twice a year to discuss the research program and evaluate the progress on the sponsored projects. The research effort and the contact with companies allow the faculty to stay current with the evolving technology and needs of the industry.

9. ESF Faculty. PSE is one of eight academic Faculties at SUNY-ESF. Opportunities for the college faculty (ESF) as a whole exist in collaborative teaching and research activities. PSE students take several classes in other faculties at ESF, especially chemistry and several engineering courses. All syllabus, course, and program changes are broadcast to the entire college faculty via the web to provide an opportunity for comment. The changes are reviewed and put to vote by the Committee on Instruction at the college-wide faculty meeting held every month.

10. ESF Administration. PSE is part of the overall administrative structure of the college, with the chair reporting to the provost of the college. The faculty meets annually with the provost, president, and other administrative personnel to review the program. In addition, additional ad hoc meetings with campus administration occur throughout the year.

11. Instructors. Course instructors are directly responsible for delivery of course materials consistent with the course outcomes and program outcomes. As detailed in Table 12, instructors perform a number of assessment activities integrated into the class activities.

The Faculty interacts with a number of other constituencies on a more ad hoc basis. Interactions with these constituents often give more anecdotal information and suggestions for improvement of the programs and processes.

1. Pulp and Paper Education and Research Alliance. The Pulp and Paper Education and Research Alliance (PPERA) is an alliance of universities with programs which are individually distinctive but which are similar in being committed to the advancement of the North American pulp, paper and allied industries. Each of the PPERA university partners has various supportive relationships with industry and government designed to strengthen the contributions of higher education to the pulp, paper and allied industries. In recognition of these strategic partnerships, the university programs comprising PPERA will work together to develop synergistic programs in education, research, and service, which are mutually beneficial and collectively leverage contributions to the pulp, paper and allied industries. Appendix H summarizes the role of PPERA in guiding the interactions between the various pulp and paper schools.

2. Prospective high school students. The faculty and staff work closely with Admissions to identify and contact prospective high school students. These are the students that would enter ESF into the freshman residency program.

3. Parents of prospective high school students. When students visit or contact the Faculty, sometimes it is the parents that are the primary contact with us. The parents communicate the perceived needs of the student.

4. Prospective transfer students. The faculty and staff also work with Admissions to identify and contact prospective transfer students. These students have usually already attended at least one year of college and would enter the program as either sophomores or juniors. This group is actively recruited at a number of community colleges in New York State (See Chapter 1).

5. Primary and middle school students. The faculty and staff often give tours and demonstrations to primary and middle school students to introduce them to paper engineering as well as engineering in general.

6. Public at large. The faculty and staff also interact with the public at large. This often takes the form of responding to inquiries regarding various aspects of the paper industry.

The primary feedback mechanism from these three constituency groups is informal discussion. One-on-one and group meetings with the prospective students and their parents give excellent feedback on the effectiveness of our recruiting program and the perceived benefits of the PSE program. It is important that we communicate the objectives of the PSE program so that the prospective students can determine if this program meets their individual goals.

Table 12. Constituencies involved with the Paper Engineering program and their involvement with evaluation and assessment instruments and feedback instruments.

Constituency	Evaluation and Assessment Instruments	Feedback Instruments
Undergraduate students	End of course survey	Mid-course survey End of course survey Informal feedback Student discussion group
Graduating students	Graduate survey	Graduate survey
Syracuse Pulp and Paper Foundation	Placement analysis SPPF committees	SPPF committees
Alumni	Alumni survey	Alumni survey Informal feedback
PSE Faculty		Faculty meetings Faculty retreat
ESF Faculty	GenEd assessment Writing assessment	
ESF Administration		Annual Faculty review
Summer employers	Internship survey	Recruiter feedback Internship survey
Permanent employers	Employment analysis	Recruiter feedback
Empire State Paper Research Associates		Informal feedback
Instructors	Student work Prerequisite Exams Course assessment report	Course assessment report
Others		Informal feedback

Table 13. Instruments used in the evaluation and assessment processes cross-referenced with the scope of the methods.

SCOPE	Course Outcomes	Program Outcomes	Program Objectives
Within Course	-Student work -End of course survey	-Student work	
Within ESF	-Prerequisite exam	-Prerequisite exam -General education assessment -Writing program assessment	-General education assessment -Writing program assessment -Graduate survey
Outside of ESF		-Summer internship survey -FE exam -Placement analysis	-Summer internship survey -FE and PE exam -Alumni survey -Employment analysis -SPPF committees

Table 14. Instruments used for feedback for course and process improvement.

SCOPE	Course Outcomes	Program Outcomes	Program Objectives
Within Course	-Mid-course survey -End of course survey -Informal student feedback	-End of course survey	
Within ESF	-Graduate survey -Informal student feedback -Student discussion group	-Annual faculty review -Faculty retreat -Informal student feedback	-Annual faculty review -Faculty retreat -Graduate survey
Outside of ESF		-SPPF committees -Alumni survey -Recruiter feedback -Summer internship survey	-SPPF committees -ESPRA discussion -Recruiter feedback -Summer internship survey -PPERA

Establishment and Review of Objectives

Program educational objectives are determined and evaluated periodically by a process coordinated by the Associate Chair. Modifications to the program objectives and programs are proposed by any of the constituent groups during their numerous interactions with the faculty. The standing committee within the faculty on undergraduate programs meets and discusses the proposals. The proposals are put forward to the Faculty of Paper Science and Engineering at a faculty meeting where they are then ratified. The program modifications are then sent to the college-wide Committee on Instruction for further canvassing within the entire college faculty for comment. Furthermore, reports of the accreditation process are furnished and discussed at the Syracuse Pulp and Paper Foundation at their annual meeting. The faculty developed the program educational objectives by engaging in review and evaluation of alumni surveys, employer surveys, student exit interviews, input from the Syracuse Pulp and Paper Foundation, and input from the Empire State Paper Research Associates.

Our process of continuous improvement is based on the two-loop model of ABET (See Figure 2). In this model, there is an "inner loop" of setting and determining the Program Outcomes and designing a curriculum to achieve these outcomes. As these outcomes are assessed, modifications can be made to the outcomes and the curriculum to achieve the desired goals. In the "outer loop," these Program Educational Objectives are evaluated to determine if the program is achieving its goals. This outer loop receives a great deal of its evaluative information from the constituency groups discussed above. In general, the outer loop works at a slower time scale than the inner loop.

In the Paper Science and Paper Engineering programs, we have a number of loops that provide feedback at many different time scales ranging from almost immediate to cycles of five years and longer. We feel that it is very important that the feedback loops be as short as possible. For this reason, feedback often goes back directly to the agent that can effect the change, especially for feedback for courses. More global feedback goes through the Faculty process for more major changes.

The continuous improvement process shorter cycle loop uses data from course surveys, exit interviews, informal student feedback, performance in sequential courses, and performance in laboratory and paper machine problem solving exercises to evaluate mastery of material. The continuous improvement process longer cycle loop uses feedback from the Syracuse Pulp and Paper Foundation, Alumni, and employers to make strategic changes in the program objectives and learning outcomes intended as well as changes in course content and the curriculum to best fit student needs in their careers in the paper and allied industries. The SPPF has a standing curriculum committee that meets twice each year to recommend changes and review Faculty suggested changes.

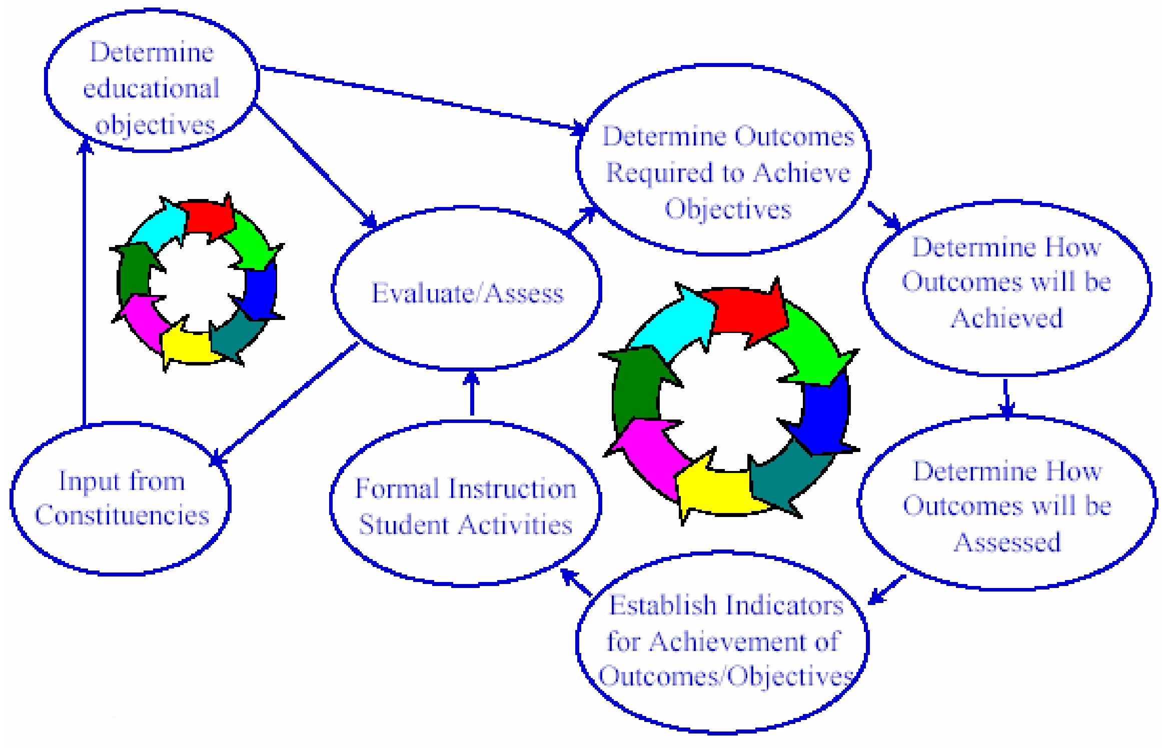

Figure 2. ABET two-loop process of continuous improvement.

The process of evaluation of the program objectives is continuous although the cycle may take 4 to 6 years to complete. The steps in the process can be described as:

1. Establish needs of constituencies
2. Update program objectives
3. Update program outcomes
4. Update course outcomes and curriculum
5. Evaluate program objectives and repeat

Figure 3 summarizes the processes for evaluation, assessment and continuous process improvement in the Faculty of Paper Science and Engineering. As the figure shows, there is assessment and evaluation ongoing on many time scales. The left part of the diagram corresponds to the "outer" loop of the ABET two-loop process in which information from our constituents is used to evaluate and improve the Program Objectives. Within this broad loop are a number of loops that operate at several time scales. The loops at the right depict the assessment processes that are involved in the improvement of the Program Outcomes and the courses themselves. Again, the assessment processes run at several different time scales, although the time scales of these processes tend to be shorter than those of the evaluation processes. The diagram also shows the relationships between the Program Outcomes, Program Objectives, the ABET "a-k" Outcomes, and the Courses.

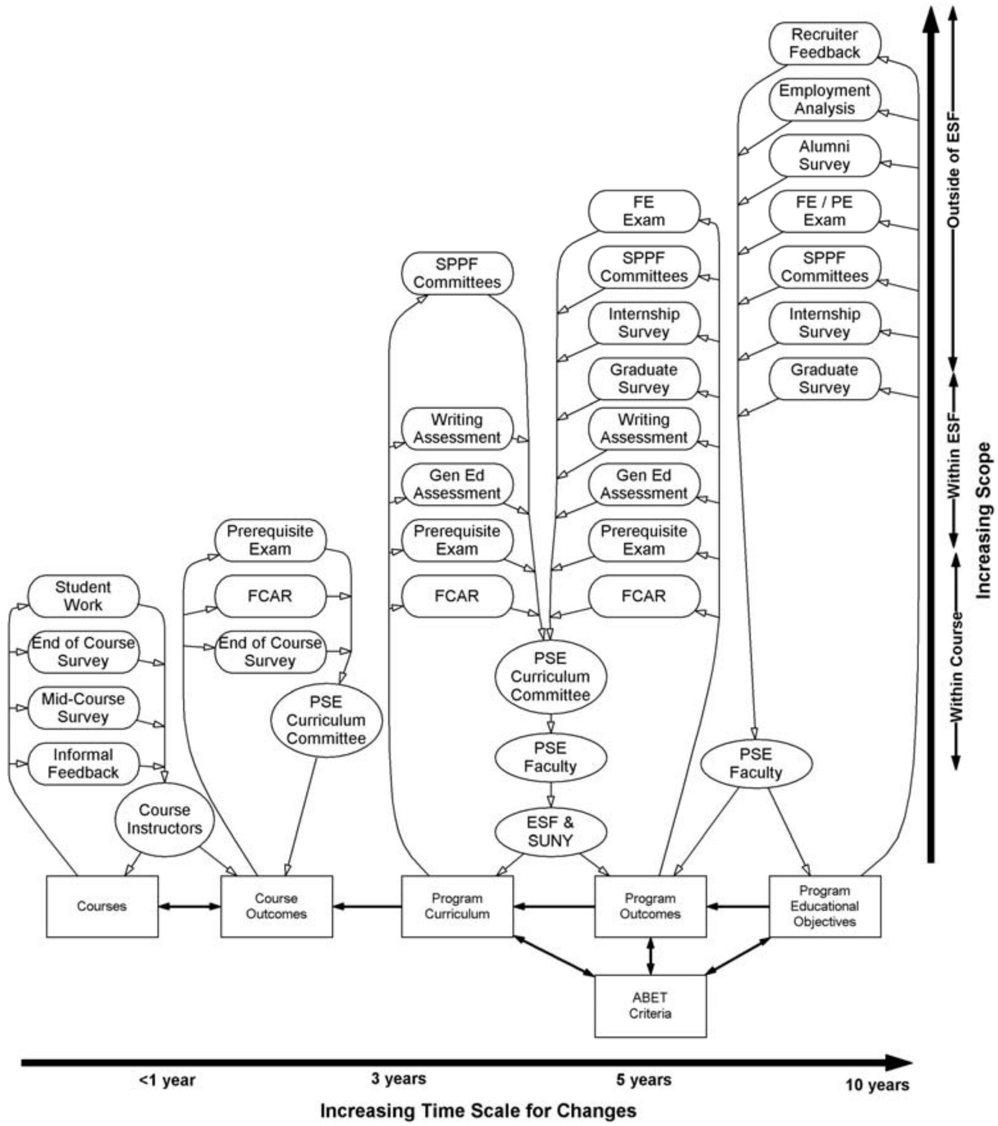

Figure 3. Diagram of assessment and evaluation processes in the Faculty of Paper Science and Engineering.

Establish Needs of Constituencies

The needs of our outside constituents may not necessarily be in agreement. It is the responsibility of the PSE Faculty to consider their specific needs and establish the composite needs of the program. It is important to remember that the success of the program is dependent on the placement of our students after graduation and the ability to attract high-quality students into the program. Feedback from these constituents is very important to achieving the success of the program.

Monthly Faculty meetings are used to discuss administrative and programmatic issues. ABET issues have been discussed throughout the past few years. In addition, Faculty retreats held periodically have been used as a forum to discuss accreditation-related issues. The program objectives have been continuously defined and refined as a result of all these interactions.

Update Program Objectives

The program objectives were developed and selected by the ABET committee and presented to the Faculty for approval and/or modifications. The current objectives were approved in 2000. A review of the objectives over the 2004-05 academic year required no changes to the objectives. However, objectives were established for the Paper Science program to clarify the differences and similarities between the two.

Update Program Outcomes

The program outcomes were also discussed and set by the ABET committee within the Faculty. The ABET committee developed and discussed the current outcomes over several meetings in 2000. The outcomes were evaluated to meet the constituent needs as well as satisfy the ABET "a-k" requirements. Further details on the Program Outcomes are presented in Criterion 3. The tables in Criterion 3 indicate the relationship between the Outcomes and the Objectives. As with the program objectives, program outcomes were established for the Paper Science program to illustrate the relationship between the two.

Update Course Objectives

The objectives of the individual courses are periodically reviewed and updated as is deemed necessary by the course instructor and the Curriculum Committee within PSE. In addition, the Curriculum Committee has recently undertaken the task of regularly reviewing the objectives of each of the courses within the faculty in order to improve the articulation between courses. In this effort, each course will be reviewed periodically (on approximately a three-year cycle) and the course description updated as necessary. To assure that prerequisite courses meet the needs of subsequent courses, this effort is being undertaken in reverse order of the students taking the courses. That is, the senior level courses will be reviewed first.

Recent Developments in Paper Science and Engineering

A number of recent developments in the Faculty of Paper Science and Engineering should be noted as they impact the Paper Engineering program and its relation to other programs offered by the faculty.

- Formerly, the PSE Faculty offered a single program (Paper Science and Engineering) with two options (Engineering Option and Science Option). Only the Engineering Option was accredited by EAC/ABET. Since the last accreditation visit, the two options have been elevated to programs (Paper Engineering and Paper Science). This was done in order to clarify the fact that only the Paper Engineering program is EAC/ABET accredited.
- With the 2005-6 academic year, the curricula for both the Paper Engineering and Paper Science program have changed. The goals of these changes were to more clearly differentiate between the two programs, with the Paper Science program having a lesser

emphasis on engineering and a greater focus on science. In addition, the Paper Science program has been changed to allow the student to chose an area of focus such as business management, chemistry, biology, information technology, construction management, or others. The impetus of these changes were to be able to attract a wider range of students into the programs as well as be able to allow students to have a concentration in business management within the context of the paper industry. This change was primarily at the request of the Syracuse Pulp and Paper Foundation. The specific changes to the Paper Engineering program are discussed in detail in the Professional Component section (Criterion 4).

- Beginning in the 2006-7 academic year, the PSE Faculty will be offering a new program in Bioprocess Engineering (BPE). This program prepares students for careers as engineers in positions that would have typically been filled with chemical engineers with additional biological training. The BPE programs seek to train engineers in chemical process engineering coupled with coursework in microbiology, biochemistry and bioprocess engineering. The curriculum draws bioprocess engineering examples from the development of products and energy from sustainable sources and from the biopharmaceutical industry. The program builds on the long-standing success of the current Paper Engineering program.

  Students in the program receive a broad base of study in the fundamentals of engineering focused on the chemical and biological processing of raw materials from sustainable sources. Emphasis in this program focuses on using renewable biomass re-sources to replace petroleum in energy and industrial product applications. Examples include the production of ethanol, acetic acid, polymers, and other chemicals that have traditionally been produced from fossil fuels such as oil, coal, and natural gas.

  Student in the program gain valuable experience through a capstone-design experience in which they work on significant problems in the design and implementation of new biotechnologies. In addition, a summer internship is required of all students in which they gain valuable skills and experience the areas of technical knowledge and professional development. Both of these experiences serve to integrate the knowledge gained in their coursework with real-world work experiences commonly seen in their first positions after graduation.

- The curriculum consists of a number of categories of courses. The general education component, broadens the students' perspectives on global and societal issues, an important component of any education. Students also take a number of courses in math and the basic sciences — chemistry, physics, and biology — to provide the background for the engineering courses that prepare students for engineering practice. The engineering courses cover a variety of topics that are traditional for a chemical engineering program, supplemented with courses specific to Bioprocess Engineering.

A comparison of the three curricula is given in Table 15.

Table 15. Comparison of programs offered in PSE for the 2006-07 academic year.

Course Title	Course Number	Credits	Paper Engineering	Paper Science	Bioprocess Engineering
Math and Computer Science					
Computing Methods	APM 153	3	X	X	X
Probability and Statistics for Engineers	APM 395	3	X		X
Differential Equations	APM 485	3	X		X
Calculus I	MAT 295	4	X	X	X
Calculus II	MAT 296	4	X	X	X
Calculus III	MAT 397	4	X		X
Basic Sciences					
Botany	EFB 226	4			X
Zoology	EFB 285	4			X
General Chemistry I	FCH 150/151	4	X	X	X
General Chemistry II	FCH 152/153	4	X	X	X
Organic Chemistry I	FCH 221/222	4	X	X	X
Organic Chemistry II	FCH 223/224	4	X	X	X
Physical Chemistry I	FCH 360	3	X	X	
Physical Chemistry II	FCH 361	3	se	X	
Analytical Chemistry I	FCH 380	3	X	X	
General Physics I	PHY 211/221	4	X	X	X
General Physics II	**PHY 212**/222	4	X	X	
General Education					
Writing and the Environment	CLL 190	3	X	X	X
Writing, Humanities and the Environment	CLL 290	3	X	X	X
Introduction to Economics	FOR 207	3	X	X	X
General Education: American History		3	X	X	X
General Education: Western Civilization		3	X	X	X
General Education: Other World Civ.		3	X	X	X
General Education: The Arts		3	X	X	X
Professional Education					
Writing for Science Professionals	CLL 405	2	X	X	X
Information Literacy	ESF 200	1	X	X	X
Structure and Properties of Wood	WPE 386	2	X	X	
Fiber Identification Laboratory	**WPE 3**90	1	X	X	
Engineering Courses					
Transport Phenomena	BPE 335	3	X	ee	X
Transport Phenomena Laboratory	BPE 336	1			X
Bioprocess Kinetics and Systems Engineering	BPE 421	3			X
Bioprocess and Systems Laboratory	BPE 440	3			X
Bioprocess Engineering Design	BPE 481	3			X
Electrical Engineering Fundamentals I	ELE 231	3	ee		
Statics and Dynamics	ERE 223	4	ee		X
Engineering Graphics	ERE 225	1	X	X	
Mechanics Of Materials	ERE 362	3	ee		

Water Pollution Engineering	ERE 440	3	X	ee	
Air Pollution Engineering	ERE 441	3	ee	ee	
Engineering Thermodynamics	PSE 361	3	X	ee	X
Principles of Mass and Energy Balances	PSE 370	3	X	X	X
Fluid Mechanics	PSE 371	3	X	ee	X
Pulp and Paper Unit Operations	PSE 436	3	X	ee	
Process Control	PSE 477	3	ee	ee	
Engineering Design Economics	PSE 480	3	X	ee	X
Engineering Design	**PS**E 481	3	X	ee	
Science Courses					
BPE Orientation Seminar	BPE 132	1			X
Summer Internship in Bioprocess Engineering	BPE 304	2			X
Colloid Interface Science of Bioprocess Engineering	BPE 310	3			X
Bioseparations	BPE 320	3			X
PSE Orientation Seminar	PSE 132	1	X	X	
Intro to Papermaking	PSE 300	3	X	X	
Pulp and Paper Laboratory Skills	PSE 302	1	X	X	
Summer Mill Experience	PSE 304	2	X	X	
Pulping and Bleaching Processes	PSE 350	3	X	X	
Pulping and Bleaching Laboratory	PSE 351	2	X	X	
Paper Properties	PSE 465	4	X	X	
Paper Coating and Converting	PSE 466	3	se	X	
Papermaking Wet End Chemistry	PSE 467	3	se	X	
Papermaking Processes	PSE 468	3	X	X	
Electives					
Biology Electives					3-6
Chemistry Electives					3
Environmental Engineering Electives					3
Engineering Electives			12	12	3-6
Science Electives			6		
Technical Electives (Minor)				14-**18**	
Free Electives				**3-6**	**3**
Total Credit Hours			140	132	132

X = required course   se = science elective   ee = engineering elective

Evaluation of Program Objectives

The following pages describe the specific evaluation methods that are used in our continuous improvement process. Each description contains a summary table together with a narrative of the process. Further details of each method, together with the collected information, will be available during the site visit in the form of notebooks for each method.

It must be remembered that not all the evaluation methods are equally weighted. For example, the more anecdotal methods (e.g., Informal Student Feedback) are more useful in identifying issues that will need further investigation and discussion. On the other hand, feedback from the Alumni Survey (Table 16), passing rate on the Fundamentals of Engineering (FE) exam (Table

17), End-of-Course survey by juniors and seniors (Table 18), job title and responsibility of recent graduates (Table 19), salary increases of alumni graduating during 1999-2003 (Table 19), job function of alumni by decade (Table 20), starting salary of alumni graduating from 2000 to the present (Table 21), and permanent job placement for 2005 and 2006 (Table 22) are more comprehensive and indicative of the program performance.

Objective Evaluation Tables

Table 16. Alumni Survey.

Instrument:	**Alumni Survey**
Objectives Evaluated:	1, 2, 3, 4, 5
Constituents:	Alumni
Frequency:	Every 5 years
Timescale:	5-10 years
Responsibility:	Faculty
Coordinator:	Dr. Raymond Francis

Program Objective (PEN)	**Specific Assessment Metric**	**Expectations**
	Responses and Action	
	Specific Questions relating to Objective A: I have a sound background in fundamental science as applied to Paper Science and Engineering	It is expected that more than 90% of our graduates would respond with: "AGREE" or "STRONGLY AGREE" that they have "Sound Knowledge".

The results of the latest Alumni Survey are reported here for students who graduated between 2000 and 2004. There were 14 respondents out of 53 total graduates. In many cases the survey was mailed to the address of the graduate's parents and we are only confident that approximately 30 of the graduates actually received the survey. The College tries to keep in contact with all alumni but their database shows 58 graduates and have no contact information for 24 of them. The College database appears to contain some students who obtained Graduate degrees in that time period and miss-assigned a few alumni to the wrong Faculty. A 2005 graduate completed the survey online and his/her responses are included in some cases. This survey has been modified from the previous Alumni Survey shown in the Self-Study. This modified survey has five specific questions relating to Objectives and eight specific questions relating to Outcomes, a series of 17 “General Questions”, which elicit more detailed career data from the respondents, and a set of three “Open-Answer Questions”, which the respondent can answer with an essay format. This revised Alumni Survey also asks the pertinent questions regarding the ESF program of study, job position and work history, salary history, and professional licensure (FE and PE Exam) activity. In addition to response to this survey by mail, response was made available on the ESF website.

Specifically, for these Objectives, the following responses were available: “Strongly Agree”, “Agree”, “Neutral”, “Disagree”, and “Strongly Disagree”.

For Objective A, the responses were as follows: 60% - Strongly Agree and 40% - Agree. Thus, 100% of the respondents feel that they have sound knowledge.

General Questions were also asked: The average amongst the 15 respondents was 4.4/5 to the question “”My background in science and engineering was sufficient for me to do my job”.

The average amongst the 11 respondents was 4.5/5 to the question “In my current or past position, I have designed and/or implemented a product, trial, or process that was successful”. Four respondents were not included because they were either a student, did not work as an engineer or in production, or did not report their salaries.

The average amongst the 15 respondents was 4.3/5 to the question “The PSE program at SUNY-ESF gave me training comparable to a traditional science or engineering program”.

The expectation was that the average would be at least 4/5 for all three questions.

Discussion

The high rate of recent graduates for which we have no contact info was a bit of a surprise. This did not show up when we conducted the Alumni survey for ABET accreditation in 2000. In that case we used data from 1990-1999 and had 62 respondents. The percentage with no contact info was only 24% (41/170). Apparently, there is a college-wide trend that within the first 3-5 years after graduation the students are very busy with their professional and personal lives and do not have time to be active alumni. The percent with no contact information (2000-2004 graduation) in the present survey was 45% (24/53) while the data for 1990-1999 graduates (updated since the last Self-study) is 22% (37/172). The data for another Faculty at the College was analyzed. Their percentage of no contact information was 62% (38/61) for 2000-2005 graduates and 30% (27/90) for 1990 to 1999 graduates.

We will modify our exit survey and interviews to seek Company addresses, personal e-mail addresses and cell phone numbers of our departing students.

<table>
<tr><td rowspan="2">B</td><td>Specific Question relating to Objective B: I understand related societal issues such as environmental protection, occupational health and safety, resource management and appropriate business skills.</td><td>It is expected that graduates will respond essentially in the positive, i.e. approximately 75% agree or strongly agree with the statement. One’s commitment to these issues is sometimes difficult to gauge especially for young professionals.</td></tr>
<tr><td colspan="2">The responses to Question 2 yielded the following: 40% - Strongly Agree; 47% - Agree. The difference, 13%, was made up of one Neutral and one Disagree. Thus, the percentage of the respondents who Agree or Strongly Agree is 87%.

The average amongst 11 respondents was 3.5/5 to the general question “My job function involves environmental concerns faced by my company”. Four respondents were not included because they were either a student, did not work as an engineer or in production, or did not report their salaries. The expectation was that the average would be 3/5 because many of our graduates start out as process or production engineers and would not have much responsibility for environmental issues.

The average amongst 11 respondents was 3.1/5 to the general question “My job function involves societal concerns faced by the company”. The expectation was an average of 2.5/5 because societal concerns faced by a company are normally handled by senior management.

The average amongst 11 respondents was 3.5/5 to the general question “My job function is primarily managerial in nature”. An average of 3/5 was expected because of the limited real world experience of the respondents.</td></tr>
<tr><td rowspan="2">C</td><td>Specific Question relating to Objective C: I am a well-rounded professional in terms of teamwork, communication, and problem solving.</td><td>It is expected that more than 80% of graduates will respond with Agree or Strongly Agree.</td></tr>
<tr><td colspan="2">The responses to Question 3 were as follows: 53% - Strongly Agree; 47% - Agree. Thus, 100% of respondents feel that they are well-rounded professionals.

The average amongst 11 respondents was 4.3/5 to the general question “I regularly write reports regarding the projects involved in my job”. An average of 4/5 was expected.

The average amongst 11 respondents was 4.1/5 to the general question “I regularly give presentations or oral reports regarding the projects involved in my job”. An average of 3.5/5 was expected.</td></tr>
<tr><td>D</td><td>Specific Question relating to Objective D: I am well prepared for practice in Paper Science and Engineering.</td><td>It is expected that more than 80% of graduates will respond with Agree or Strongly Agree.</td></tr>
</table>

	The responses to Question 4 were as follows: 60% - Strongly Agree and 33%- Agree. Thus, 93% of the respondents feel that they are well prepared for engineering work in Paper Science and Engineering. In addition, three out of the thirteen respondents took the FE Exam (the 2 graduate students were excluded). All of the three students that took the exam passed it. This result also supports the attainment of Objective D. The average amongst 11 respondents was 4.6/5 to the general question "I understand the ethical responsibility of an engineer or scientist with respect to the goals of my company". An average of 4/5 was expected. The average amongst the 11 respondents was 4.5/5 to the question "In my current or past position, I have designed and/or implemented a product, trial, or process that was successful". An average of 4/5 was expected.	
E	Specific Question relating to Objective E: I have developed life-long learning skills or abilities.	It is expected that more than 80% of the graduates will respond with Agree or Strongly Agree.
	The responses to Question 5 were as follows: 60% - Strongly Agree; 40% Agree. Thus, 100% of respondents feel that they have developed life-long learning skills and abilities. The lowest score given by a respondent was 4/5 to general question "My education gave me sufficient background to continue learning through on the job training, self-study, or additional education". We expected an average of 4.5/5 for this question and the actual value was 4.6/5.	

Table 17. Fundamentals of Engineering (FE) Exam.

Instrument:	FE Exam
Objectives Evaluated:	A, B, (D, E)
Constituents:	NCEES
Frequency:	Once per year
Timescale:	One to three years
Responsibility:	Associate Chair
Coordinator:	Dr. Gary M. Scott

Program Objective (PEN)	Specific Assessment Metric	Expectations
	Responses and Action	
A, B	The Fundamentals of Engineering (FE) Exam administered by the National Council of Examiners for Engineering and Surveying (NCEES). While the overall exam is pass/fail, we receive a breakdown of average percent correct by topic category of question. We note that since this is a recently accredited program, the data available is very sparse and has not probably reached a significant level. However, we do present the data as an indication of its use in the future as more data become available.	We have an expectation that all of our students will be well-prepared educationally and pass the exam. In addition, we expect that the average percent correct of our students will be at least the national average for those designating their field as chemical engineering: Objective A: Chemistry, Mathematics, Thermodynamics Objective B: Ethics

	FE Exam Scores	
D, E	The Professional Engineering (PE) exam is taken by practicing engineers several years after graduation. The successful passing of this exam demonstrates competence in engineering practice as well as continued learning skills. Since this is a newly accredited program, we expect to have data regarding the pass rate of our students beginning in 2007, which will be the first year that students are eligible to take the exam.	The metrics for the use of the PE exam will need to be determined. However, we will expect a significant portion of our students to pass this exam.

FE Exam Scores

			Average Percent Correct			
Year	**Examinees**	**Passing**	**Ethics**	**Chem-istry**	**Mathe-matics**	**Thermo-dynamics**
Benchmark		all	61%	79%	69%	59%
2003	1	1				
2004	1	1				
2005	4	4	65%	**75%**	**68%**	**48%**

The table above shows that our students are successful in passing the FE exam. However, the data must be used with caution because of the small number of students that have taken the exam so far. With the data that we have, we show that our students do above average on the ethics-related questions (Objective B), and are approaching the benchmark on topics related to fundamental knowledge (Objective A).

	PE Exam Scores (proposed)

Year	Examinees	Passing
Benchmark		
2007		
2008		
2009		
2010		

Table 18. End-of-Course Survey.

Instrument:	End-of-Course Survey
Objectives Evaluated:	A
Constituents:	Students
Frequency:	Once per semester
Timescale:	One year
Responsibility:	Instructors
Coordinator:	Dr. Raymond Francis

Program Objective (PEN)	Specific Assessment Metric	Expectations
	Responses and Action	
A	Here we examine years 2003-2005 and we report on the Generic Division courses (Junior/Senior years) Questions 1-5 on the survey relate directly to the delivering of information in the courses.	We expect information to be delivered effectively in PSE courses. Therefore, we expect the average overall courses to be 4.0 or greater on a 5.0 scale for these five semesters. No course should be lower than 3.5.

	The average of questions 1-5 of the End-of-Course Survey for all upper-division courses for the past 5 semesters was 4.38. The average of these questions for the previous 4 semesters was 4.20. Thus, we see a positive improvement in this response to this metric. Spring 2003 courses had an average of 4.52 with one course below 4.0. Fall 2003 courses had an average of 4.31. Two courses were below 4.0 with one course slightly below 3.50. Spring 2004 courses had on average 4.09 with 2 courses below 4.0 and one of these courses slightly below 3.50. Fall 2004 courses had an average of 4.39 with 2 courses slightly below 4.0. The Fall 2005 courses had an average of 4.61, with no courses below 4.0. The courses that were below 4.0 over the past 5 semesters are mainly all different courses, some of which were low enrollment where data can be shifted quite easily. In general, the average of courses has improved over the past 5 semesters.

Table 19. Advancement of Recent Graduates.

Instrument:	**Advancement of Recent Graduates**
Objectives Evaluated:	C,E
Constituents:	Alumni
Frequency:	Every 5 years
Timescale:	5-10 years
Responsibility:	Faculty
Coordinator:	Dr. Raymond Francis

Program Objective (PEN)	**Specific Assessment Metric**	**Expectations**
	Responses and Action	
C	Comments made by some of our Alumni in the most recent Alumni survey point to significant growth in professionalism and leadership	We have an expectation that within the first six years after graduation 50% of our graduates would be assigned leadership roles or demonstrate evidence of exemplary performance.

<table>
<tr><td></td><td colspan="2">The following comments or titles were taken from the 16 Alumni surveys received. A maximum of one comment or title was taken from an individual survey.

1) Quality Coordinator
2) Responsible for optimizing day to day runnability and quality of 3,300 feet/min coated freesheet paper machine
3) Sent for 2 weeks of training on the Six Sigma Process
4) Responsible for two machines and crews (a 2004 graduate)
5) Co-author of a patent
6) Assistant Superintendent
7) Applications Consultant
8) Advanced Manufacturing Engineer and MBA Degree
9) Environmental Department Manager
10) Supervisor for an entire kraft recovery system

The above data indicate professional growth in our recent graduates that will lead to a high percentage (30-40) of middle and upper management positions ~10 years after graduation.</td></tr>
<tr><td>E</td><td>The Alumni Survey was analyzed for salary increases of students who graduated between 2000-2003. It is projected that increase in salary and job responsibility is an indication of advancement in maturity and life-long learning skills.</td><td>We expect at least 50% of our 1999-2003 graduates to have a rate of salary increase equal or higher than the rate of inflation. The 50% rate is lower than our normal expectation and this is due to the challenging economic times being faced by the U.S. pulp and paper industry (explained below)</td></tr>
</table>

Eleven of the 15 respondents graduated between 2000 and 2003. Two of them have been graduate students since graduation; one did not report his/her salary history and another never obtained employment as an engineer. The data for the remaining 9 are given below.

Year of Graduation	Starting Salary	Present Salary
2000	$50,000	$57,000
2000	$44,000	$65,000
2001	$55,000	$75,000
2002	$45,000	$42,000*
2003	$38,000	$45,000
2003	$52,000	$62,000
2003	$52,000	$66,000

*Operates a consultancy. Most consultants tend to minimize their income by having higher operating costs.

From the above data, 5 of 7 definitely have had salary increases equal or higher than the rate of inflation. This is quite impressive considering that between 2000 and 2004 the U.S. pulp and paper industry was probably in the midst of its most significant downsizing in history.

The increasing consumption of paper products is attracting more foreign competition and unfortunately paper prices are falling even as demand increases. Most of the new production is from southern hemisphere countries with lower cost for wages and environmental compliance and more importantly, weather conditions well-suited for clonal propagation of eucalyptus hybrids. They have a huge advantage in eucalyptus fibers that are inexpensive and have excellent papermaking properties.

The salary of one of the 2004 graduates has already increased from $55,000 to $62,000.

Table 20. Job Functions of Alumni.

Instrument:	**Job Functions**
Objectives Evaluated:	C,E
Constituents:	Alumni
Frequency:	Once every 5 years
Timescale:	Five to ten years
Responsibility:	SPPF Admin. Manager
Coordinator:	Ms. Linda Fagan (SPPF)

Program Objective (PEN)	**Specific Assessment Metric**	**Expectations**
	Responses and Action	
C, E	Advancement to middle and upper management positions is being projected as an indicator of 1) our graduates developing into well-rounded professionals and leaders and 2) acquiring life-long learning skills.	We expect at least 40% of our graduates to hold middle and upper management positions 15-25 years after graduation.

Job Function	2000-present	1990-99	1980-89	1970-79	1960-69	1950-59	1940-49	1930-39	1920-29
Number in Survey	58	172	253	182	137	149	81	26	1
Upper Management[1]	0.00%	5.23%	11.46%	13.19%	23.36%	11.41%	9.88%	3.85%	0.00%
Middle Management[2]	10.34%	32.56%	35.57%	31.87%	16.79%	12.08%	4.94%	0.00%	0.00%
Process/ Product Engineer	17.24%	19.19%	10.28%	7.69%	3.65%	1.34%	3.70%	0.00%	0.00%
Technical Sales/ Service	10.34%	9.30%	5.14%	6.59%	0.73%	0.67%	2.47%	0.00%	0.00%
Chemist/ Specialist/Scientist	13.79%	2.91%	4.35%	6.59%	2.19%	1.34%	0.00%	3.85%	0.00%
Faculty	0.00%	0.58%	1.19%	0.00%	3.65%	0.67%	0.00%	0.00%	0.00%
Consultant	0.00%	0.00%	0.00%	0.55%	2.92%	2.68%	2.47%	0.00%	0.00%
Grad Student	5.17%	8.72%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Other	1.72%	0.00%	12.65%	12.64%	10.95%	6.04%	3.70%	11.54%	0.00%
Retired	0.00%	0.00%	0.00%	1.10%	14.60%	43.62%	53.09%	50.00%	100.00%
No Information	41.38%	21.51%	19.37%	19.78%	21.17%	20.13%	19.75%	30.77%	0.00%

[1]*Upper Management* includes titles such as President, Vice President, General Manager, Director, Mill Manager, etc.

[2]*Middle Management* includes titles such as Manager, Supervisor, Superintendent, Coordinator, Leader, etc.

The results show that 37% of our graduates achieve middle and upper management positions within 15 years of graduation (1990-2005). The number increases to 47% within 25 years of graduation (1980-2005). These data appear to prove that our graduates leave with a solid foundation for long-term growth.

Table 21. Starting Salary of Alumni.

Instrument:	Starting Salary
Objectives Evaluated:	D
Constituents:	Alumni/recent Graduates
Frequency:	Once per year
Timescale:	One to five years
Responsibility:	SPPF Admin. Manager
Coordinator:	Ms. Linda Fagan (SPPF)

Program Objective (PEN)	Specific Assessment Metric	Expectations
	Responses and Action	
D	A high starting salary is projected as an indicator that a graduate from our program is well-prepared for engineering practice.	We expect our graduates to obtain starting salaries typical of those obtained by chemical engineers

The Alumni Survey was analyzed for starting salary of students who graduated between 2000 and 2004. Fourteen of the 15 respondents graduated in that time period. Two of them have been graduate students since obtaining their Bachelors degree; one did not report his/her salary history and another never obtained employment as an engineer. The data for the remaining 10 are given below.

Year of Graduation	Starting Salary
2000	$50,000
2000	$44,000
2001	$55,000
2002	$45,000
2003	$38,000
2003	$52,000
2003	$52,000
2004	$48,000
2004	$50,000
2004	$55,000

The average starting salary for the 10 respondents above was $48,900. This was lower than normal due to the difficult economic circumstances faced by the U.S. pulp and paper industry.

The increasing consumption of paper products is attracting more foreign competition and unfortunately paper prices are falling even as demand increases. Most of the new production is from southern hemisphere countries with lower cost for wages and environmental compliance and more importantly, weather conditions well-suited for clonal propagation of eucalyptus hybrids. They have a huge advantage in eucalyptus fibers that are inexpensive and have excellent papermaking properties.

The U.S. industry is rebounding and the average starting salary for the 14 total graduates in 2005 and 2006 (Permanent Job Placements Metric) is self-reported to be ~$55,000

Table 22. Permanent Job Placements.

Instrument:	Permanent Job Placements
Objectives Evaluated:	D
Constituents:	Recent Graduates
Frequency:	Once per year
Timescale:	One to two years
Responsibility:	SPPF Admin. Manager
Coordinator:	Ms. Linda Fagan (SPPF)

Program Objective (PEN)	Specific Assessment Metric	Expectations
	Responses and Action	
D	A permanent job in an engineering related capacity is projected as an indicator of a graduate that is well-prepared for engineering practice.	We expect 90% of our students to obtain permanent, engineering related jobs by the time of graduation.

Nine students graduated from the Paper Science and Engineering Program in 2004/05.

Robert	Culican	Hercules	Philadelphia, PA
Zachary	Ehlers	Clariant	Charleston. NC
Scott	Freyburger	Solvay Paperboard (temp)	Syracuse, NY
William	Garrisi	Newark Pacific Paperboard Corp.	Los Angeles, CA
Michael	Graff	KX Industries	Orange, CT
Larissa	Perlmutter	KX Industries	Orange, CT
Jessica	Smith	Solvay Paperboard	Syracuse, NY
Christopher	Staley	Lydall, Inc.	Green Island, NY
Jeff	Tyler	KX Industries	Orange, CT

Permanent employment placement for 2005-06 Graduates

Christopher	Gassner	Lockheed Martin	Owego, NY
James	Gleason*	Cytec	Anaheim, CA
Jessica	Herrington	P&G	Mehoopany, PA
Erik	Olsen	Hercules	Solvay, NY
Michael	Sanger	Marcal Paper Mills	Elmwood Park, NJ

* Accepted a permanent position in the paper industry bypassing his senior year in our program

All graduates from the last 2 years obtained engineering related positions with a wide range of companies in six different States. This is clearly an indication that they are well prepared for engineering practice

Closing Remarks

The evaluation metrics (Tables 17-23) demonstrate that the present objectives are being met.

As discussed previously, our process of continuous improvement is based on the two-loop model of ABET (See Figure 2). The inner-loop process of semester by semester changes appears to be working effectively and does not appear to be dictating any major changes to our Program Objectives at the present time. Steps will be taken to obtain contact information and maintain contact with more of our recent graduates as discussed in Table 16. Apparently, there is a college-wide trend that within the first 3-5 years after graduation the students are very busy with their professional and personal lives and do not have time to be active alumni. The percent of alumni for whom we have no contact info (2000-2004 graduation) was 45% (24/53) in the present survey while the data for 1990-1999 graduates (updated since the last Self-study) is 22% (37/172). The data for another faculty at the College was analyzed. Their percentage of no contact info was 62% (38/61) for 2000-2005 graduates and 30% (27/90) for 1990 to 1999 graduates.

Brief evaluations of the five Objectives are presented below.

Objective A; have a sound background in fundamental science and engineering principles as applied to paper science and engineering.

All the indications point to our students graduating with a sound background in the fundamentals. One hundred percent of the respondents in our 2006 Alumni survey agreed or strongly agreed that they graduated with a sound knowledge of the fundamentals (Table 16). All six of our graduates who have taken the FE exam have passed it and our average scores for 2005 graduates were close to all of the benchmarks (Table 17). All of our graduates from 2005 and 2006 obtained engineering related jobs at a starting salary of ~$55,000/annum (Table 21).

Objective B; understand related societal issues such as environmental protection, occupational health and safety, resource management, and appropriate business skills.

Eighty-seven percent of the respondent agreed or strongly agreed with the Objective statement (Table 16).

The average was 3.5/5 in response to the general question. “My job function involves environmental concerns faced by my company”. The expectation was that the average would be 3/5 because many of our graduates start out as process or production engineers and would not have much responsibility for environmental issues.

The average was 3.1/5 to the general question “My job function involves societal concerns faced by the company”. The expectation was an average of 2.5/5 because societal concerns faced by a company are normally handled by senior management.

The average was 3.5/5 to the general question “My job function is primarily managerial in nature”. An average of 3/5 was expected because of the limited real world experience of the respondents.

Objective C; are well-rounded professionals in terms of teamwork, communication, and problem solving.

One hundred percent of the respondents agreed or strongly agreed to the Objective statement. Job titles and responsibilities documented in the survey and described in Table 19 were quite impressive.

The average was 4.3/5 to the general question “I regularly write reports regarding the projects involved in my job”. An average of 4/5 was expected.

The average was 4.1/5 to the general question “I regularly give presentations or oral reports regarding the projects involved in my job”. An average of 3.5/5 was expected.

Objective D; are well-prepared for engineering practice in paper science and engineering.

Eighty-eight percent of the respondents agreed or strongly agreed with the Objective statement. The passing rate of alumni who have taken the FE exam is 100% and their average scores in the four categories (ethics, chemistry, mathematics, thermodynamics) were all close to the benchmarks (Table 17). All of our graduates for the past two years, 2005 and 2006, obtained engineering related jobs (Table 22) and their average salary was ~$55,000/annum (Table 21).

In the alumni survey, the average was 4.5/5 to the general question “In my current or past position, I have designed and/or implemented a product, trial, or process that was successful”. An average of 4/5 was expected.

Objective E; have developed life-long learning skills and abilities.

One hundred percent of the respondents agreed or strongly agreed to the Objective statement.

The alumni survey was analyzed for salary increases of students who graduated between 2000-2003. It is projected that increase in salary and job responsibility is an indication of advancement in maturity and life-long learning skills. (Table 19). Most of our recent graduates are getting raises at a rate higher than the inflation rate

The job functions of our alumni were analyzed by decades starting in 1920 (Table 20). The results show that 37% of our graduates achieve middle and upper management positions within 15 years of graduation (1990-2005). The number increases to 47% within 25 years of graduation (1980-2005). These data appear to prove that our graduates leave with a solid foundation for long-term learning and growth.

3. Program Outcomes and Assessment

Describe the assessment process, documented assessment results, evidence that results are applied to further development and improvement, and a demonstration of the achievement of each program outcome important to the mission of the institution and the objectives of the program, as required by Criterion 3.

As a minimum:

List the Program Outcomes that have been established based on the Program Educational Objectives and describe how these Program Outcomes relate to the Program Educational Objectives.

Describe how the Program Outcomes chosen by the program encompass and relate to the outcome requirements of Criterion 3.

Describe the processes used to produce and assess each of the program outcomes.

Provide metric goals for each outcome that illustrate the level of quality of outcomes achievement felt necessary to produce graduates that will ultimately achieve the Educational Objectives following their graduation

Provide qualitative and quantitative data gathered on a regular basis that are used to assess the quality of achievement of the outcomes and our analysis of those assessment results.

Describe the process by which the assessment results are applied to further develop and improve the program.

Document changes that have been implemented to further develop and improve the program. Provide qualitative and quantitative data used to support these changes.

Describe the materials, including student work and other tangible materials, that will be available for review during the visit to demonstrate achievement of the Program Outcomes and Assessment. The programs are encouraged to organize these materials on the basis of outcomes, rather than on a course-by-course basis.

As described in the previous section, the Faculty developed a Mission Statement and Learning Objectives that are consistent with the Charter and Mission of the College as a whole. These Learning Objectives, together with the Program Outcomes given in this section, were developed over the course of several years by the ABET Committee within the Faculty and accepted by the entire Faculty. In this section, the Paper Science and Engineering program outcomes are described in comparison to the appropriate ABET criteria and then our program objectives.

The quality of instruction is a high priority, and that is discussed next. The curriculum has courses and academic experiences of a diverse nature, encompassing direct lecture courses such as coating and converting as well as courses including laboratory and computer exercises such as process control, heat transfer, fluid mechanics and water pollution. A significant portion of the curriculum is devoted to teaching the manufacturing operations of pulp and paper and the properties of the final end product. This portion has significant laboratory and pilot plant experiences integral to the courses. Design as a philosophy as well as a critical skill is imparted throughout the curriculum, culminating in the capstone design courses. The curriculum is thus structured to achieve the program objectives in a targeted fashion with components addressing each objective as well as in an integral manner where the objective is met by the appropriate academic experience across broad sections of the curriculum.

Statement of Program Outcomes

Program outcomes are defined as "what a student should have demonstrated by the time the student graduates from the program." The educational objectives of the Faculty are to produce graduates who have:

1. a sound knowledge of science and engineering as applied to paper science and engineering (sound knowledge);
2. the ability to conceptualize problems in terms of unifying principles, design and conduct experiments, and analyze and interpret data (conceptualize);
3. the ability to solve a real engineering problem in a team environment using appropriate design techniques (team problem solving);
4. an ability to engage in life-long learning (life-long learning);
5. well-developed written and oral communication skills (communication);
6. the ability to work in an industrial position within the pulp, paper, or allied industries (industrial experience);
7. understand the professional and ethical responsibility of an engineer (ethics);
8. a knowledge of the broad, contemporary issues facing the engineer in global and societal contexts (contemporary issues).

Relationship of Program Outcomes to EC2000 Criterion 3

The Program Outcomes listed above are in agreement with the Engineering Criteria 2000: Criterion 3. The Program Outcomes listed in EC2000 states (the "a-k" statements):

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 engineering solutions in a global, economic, environmental, and societal context
i. a recognition of the need for, and an ability to engage in life-long learning
j. a knowledge of contemporary issues
k. an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Table 23~~Table 23~~ summarizes the mapping of the PSE program outcomes to the EC2000 Criterion 3 outcomes. As can be seen, many of our outcomes coincide with multiple EC2000 outcomes. In this way, by satisfying the PSE Program Outcomes, the EC2000 Outcomes can be likewise satisfied.

Table 23. Mapping of PSE program outcomes to EC2000 Criterion 3.

PSE Program Outcomes	Engineering Criterion 2000: Criterion 3										
	a	b	c	d	e	f	g	h	i	j	k
1. Sound background	X	X			X			X			
2. Conceptualize	X	X	X		X						X
3. Team problem solving	X	X	X	X			X				X
4. Life-long learning						X			X	X	
5. Communication							X				
6. Industrial experience	X	X		X	X	X	X	X	X		X
7. Ethics			X			X					
8. Contemporary Issues								X		X	

As with the Program Objectives that need to support the Faculty Mission Statement, the Program Outcomes also need to support the Program Objectives. To demonstrate this support, Table 24~~Table 24~~ maps the Program Objectives given in the previous section to the Program Outcomes. Again, there is a greater than one-to-one correspondence between the two concepts. That is, some Program Outcomes support more than one Program Objective. As can be seen, each Program Objective is supported by at least one Program Outcome. Thus, assessment of the Program Outcomes allows us, Table 24~~Table 24~~, to determine if we are achieving our objectives in addition to the Evaluation Methods described in Criterion 2.

Table 24. Mapping of PSE program outcomes to program objectives.

Program Objectives \ Program Outcomes	1. Sound knowledge	2. Conceptualize	3. Team problem solving	4. Life-long learning;	5. Communication skills;	6. Industrial experience	7. Ethics	8. Contemporary issues
1. Have a sound background in fundamental science and engineering principles as applied to paper science and engineering	X	X	X	X				
2. Understand related societal issues such as environmental protection, occupational health and safety, resource management, and appropriate business skills.						X	X	X
3. Are well-rounded professionals in terms of teamwork, communication, and problem solving.		X	X		X	X		
4. Are well-prepared for engineering practice in paper science and engineering.	X	X	X		X	X	X	X
5. Have developed life-long learning skills.	X			X				

Development and Ongoing Improvement of Program Outcomes

The program outcomes were initially developed through an extended discussion and revision within the PSE faculty, based on input from the various constituent groups discussed in Criterion 2. The key constituents in this respect are the Syracuse Pulp and Paper Foundation (SPPF), recruiters for both internships and permanent jobs, and the faculty members themselves. In developing the outcomes, the Faculty used the strategy of developing program specific outcomes that encompass the requirements of the ABET 'a-k' requirements. The relationship between the program-specific outcomes and 'a-k' are detailed in Table 23~~Table 23~~ as discussed previously. Hence, by the assessment of our program-specific outcomes, we are able to demonstrate compliance with ABET 'a-k'.

We continually discuss the appropriateness of the outcomes with several of our constituent groups, especially the Curriculum Committee of SPPF. The Faculty meets with this committee twice per year, at the semi-annual meetings of the Foundation held in Syracuse New York. Up until now, the discussions have not led to a need for change of the Program Outcomes. However, the discussions and meetings have led to some significant changes in the curricula in order to meet the outcomes. Between the most recent meeting (March 2006) and the upcoming fall meeting (October 2006), we are undergoing a detailed and systematic review of both the

Program Objectives and Program Outcomes in conjunction with SPPF and the recruiters coming to interview in the Fall 2006. This will be the first major review of both the Program Objectives and Program Outcomes since the last development and revision in 2001. We feel that a time scale of approximately five years is appropriate for changes at this level.

Assessment Processes to Ensure Outcomes are Achieved

In general, the Program Outcomes are achieved through activities in courses in the curriculum. While it is not expected that every course will address every Program Outcome, we do expect that every Outcome is addressed in at least one course in the curriculum and that each course address at least one program outcome. On the most basic level, a student who achieves a passing grade in a course could be assumed to have achieved the course objectives and thus achieved the Program Outcomes associated with that course. Table 25~~Table 25~~ shows the mapping of courses to the Program Outcomes. The specific activities in the course that demonstrate the achievement of the Program Outcomes are discussed further in Criterion 4.

As detailed in the figures in Criterion 2, a number of methods are used to determine if the students have fulfilled the outcomes, and are thus eligible for graduation. On the most basic level (i.e., has the student passed every class required of the curriculum), the College has a number of tools to assess the achievement of Program Outcomes with respect to the curriculum. These include the curriculum itself, the Curriculum Plan Sheet, and Degree Certification.

Curriculum. The curriculum itself provides the opportunity for the students to achieve the Program Outcomes and thus the Program Objectives. Students must maintain a minimum grade point average of 2.000 and achieve a passing grade in all of the degree requirements in order for a degree to be granted. The broad undergraduate engineering curriculum gives students exposure to a wide range of topics, from math and science to the general education requirements including humanities and social sciences, as well as including engineering and design. The field of Paper Science and Engineering touches a broad range of fields from chemistry (in pulping), fluid mechanics (in paper making), separations (in recycling), physics (in paper testing and design) and engineering design (in plant and process optimization). One strength of the Faculty as a whole is the diverse backgrounds that each member brings to the curriculum with each teaching within the areas of their expertise. With this expertise, the curriculum provides excellent opportunities for students to achieve the program outcomes. Table 25~~Table 25~~ relates the curriculum to the program outcomes.

Curriculum plan sheet. The curriculum plan sheet provides a printed outline of each student's undergraduate curriculum. It includes information regarding the required Paper Science and Engineering undergraduate curriculum, including course names, numbers, and credits. It also contains a listing of all courses the student has taken to fulfill the curriculum requirements including the course number, credits, time taken, and final grade. Transfer credits are identified as well as summaries of lower division credit hours required and taken. Further discussion and examples of curriculum plan sheets can be found in the discussion of Criterion 1. The curriculum plan sheet provides an excellent tool to identify courses in which the student is deficient.

Degree certification. Degree certification provides a final process to certify that all degree requirements have been fulfilled. This process is discussed under Criterion 1.

Table 25. Mapping of courses to program outcomes. The courses are listed in the general order that they are taken by the students. The letters indicate the level of exposure (X = exposure, F = familiarity, D = depth coverage, A = key assessment point). The key assessment points in the curriculum are highlighted in yellow.

		Program Outcome							
Yr	Course	#1	#2	#3	#4	#5	#6	#7	#8
1	APM 153	D	F	_	_	X	_	X	X
1	CLL 190	_	F	F	X	DA	_	X	_
1	FCH 150	F	_	_	_	_	_	_	_
1	FCH 151	F	F	_	_	_	_	_	_
1	FCH 152	F	_	_	_	_	_	_	_
1	FCH 153	F	F	_	_	_	_	_	_
1	FOR 207	_	_	_	_	_	_	X	X
1	MAT 295	F	_	_	_	_	_	_	_
1	MAT 296	F	_	_	_	_	_	_	_
1	PHY 211	F	_	_	_	_	_	_	_
1	PHY 221	F	F	_	_	_	_	_	_
1	PSE 132	X	_	_	X	X	X	FA	X
2	APM 485	D	D	_	F	_	_	_	F
2	CLL 290	_	F	F	_	D	_	X	_
2	ERE 225	X	_	_	_	F	_	_	_
2	FCH 221	F	_	_	_	_	_	_	_
2	FCH 222	F	F	_	_	_	_	_	_
2	FCH 223	F	_	_	_	_	_	_	_
2	FCH 224	F	F	_	_	_	_	_	_
2	MAT 397	F	_	_	_	_	_	_	_
2	PHY 212	F	_	_	_	_	_	_	_
2	PHY 222	F	F	_	_	_	_	_	_
2	PSE 300	F	_	_	_	_	X	_	X
2	PSE 302	X	F	F	_	X	F	_	_
2	PSE 304	_	X	X	XA	F	DA	DA	DA
2	PSE 305	_	X	X	X	F	DA	DA	DA
2	PSE 370	FA	X	F	_	X	_	_	_
3	CLL 405	_	F	F	_	D	_	X	_
3	ESF 200	_	_	_	F	F	_	_	_
3	FCH 360	X	X	_	_	X	_	_	X
3	FCH 361	X	X	_	_	X	_	_	X

3	FCH 380	F	F	X	X	_	_	_	_
3	PSE 350	D	X	_	_	X	_	_	X
3	PSE 351	D	D	D	_	F	_	_	_
3	PSE 361	D	D	_	F	_	_	_	_
3	PSE 371	D	D	F	_	F	_	F	X
3	PSE 372	D	F	X	_	X	X	_	_
3	PSE 480	F	F	_	_	F	_	X	X
3	WPE 386	X	X	_	_	_	_	_	_
3	WPE 390	X	X	_	_	_	_	_	_
4	APM 395	X	F	_	_	_	_	_	_
4	ELE 231	F	X	_	_	_	_	_	_
4	ELE 394	F	X	X	_	_	_	_	_
4	ERE 223	F	F	_	_	_	_	_	_
4	ERE 362	F	F	_	_	_	_	_	_
4	ERE 440	X	F	X	X	F	_	X	X
4	PSE 465	D	F	F	_	F	F	X	_
4	PSE 466	D	_	_	_	_	F	_	_
4	PSE 467	D	D	_	_	F	_	F	X
4	PSE 468	DA	DA	DA	DA	DA	F	F	_
4	PSE 473	D	F	_	_	_	_	_	_
4	PSE 477	D	D	_	F	_	_	_	_
4	PSE 481	F	DA	DA	F	DA	DA	X	_

At the next level, we have assessment ongoing in specific courses. At the conclusion of each semester, each instructor completes a Faculty Course Assessment Report (FCAR) for their specific course. In this report, the Faculty details the assessment of the program with respect to both the Program Outcomes and the specific Course Objectives. Information from this report is used to determine improvements in the course itself as well as its integration into the curriculum.

Finally, the Faculty has a system of assessment that is essentially external to the courses. While this assessment system often is incorporated into courses, we consider it external based on the fact that the assessors do not only include the instructors of the particular courses. These tools include course evaluations, feedback from students and alumni, prerequisite exams, and several others. Like the evaluation methods for the Program Objectives, these different processes necessarily operate on different time scales, with some being relatively quick feedback. On the other end of the scale is the feedback regarding the basic mission of the Faculty of Paper Science and Engineering or even the charter of the College itself, which would be on the time scale of several years or even decades.

Program Outcome Assessment Methods, Metrics, and Data

Eight instruments have been selected to assess the program outcomes with corresponding courses highlighted in Table 25~~Table 25~~. Table 26~~Table 26~~ shows a summary of the instruments and corresponding outcomes assessed.

Table 26. Instruments selected for the assessment of program outcomes and their parameters.

Instrument:	PSE 132	Industrial Experience	Prerequisite Exams	PSE 468			PSE 481	Alumni Survey
	Orientation	PSE 305 Co-op and PSE 304 Summer Internship Survey	PSE 370 PSE 468	Seminar	Report	Student Cross Evaluations	Engineering Design	
Outcomes Assessed	7	4,6,7,8	1	1, 2, 3, 4, 5	4, 5	1, 2, 3, 4, 5, 6, 7, 8	2, 3, 5, 6	3,4,6,8
Assessment datasheet	Table 27 ~~Table 27~~	Table 28	Table 29	Table 30	Table 31	Table 34	Table 35	Table 41
Constituents	PSE Faculty and Staff	Employers	Course Instructor	PSE Faculty and Staff		PSE Students	PSE Faculty and Staff	Alumni
Frequency	Once per year	Once per semester / once per summer	Once per year in each class	Once per year	Once per year	Once per year	Once per year	Every 5 years
Timescale	One to two years	One to three years	One year	One to two years	One to two years	One year	One to three years	5-10 years
Responsibility	PSE 132 Instructor	Co-op / summer coordinator	PSE 370, 468 course instructors	PSE 468 Instructor	PSE 468 Instructor	PSE 468 instructor	PSE 481 Instructors	Faculty
Coordinator	Dr. G. M. Scott	Dr. S. Keller	Dr. G. M. Scott	Dr. G. M. Scott	Dr. G. M. Scott	Dr. G. M. Scott	Dr. S. G. Chatterjee	Dr. R.C. Francis

Table 27. Instrument 1: PSE 132 Orientation Seminars.

Program	**Specific Assessment Metric**	**Expectations**

Outcome (PEN-ABET)	Responses and Action	
7 – c, f	Students in PSE 132 (PSE Orientation) watched the ethics training video, “Incident at Morales.” After an in-class discussion, the students wrote a response paper to the video, where they discussed the ethical implications of the decisions that were made by the primary character in the video.	The response papers were evaluated by the instructor as either meeting or not meeting the criteria of understanding the ethical responsibilities of the engineer in the video. We expected that at least 90% of the students, as demonstrated by their written response, would meet this criteria.
	In 2005, 100% of the students (of 16 students) demonstrated a sufficient understanding of the ethical responsibilities of an engineer through a study and thoughtful review of the training video. The activity in the PSE 132 class represents an evolution of the ethical training of our students. This training activity was first developed by Dr. William Tully and implemented on a trial basis in an experimental course on Management and Professional Skills. The ethics module was then implemented in this class on a trial basis with success. It appears that students became aware of the ethical decisions that they may need to make during their career. In the future, this module will be part of the preparation for PSE 304 (Mill Experience). The ethical training will prepare students for their work experience during the summer and will be expected to incorporate a discussion of ethics as it relates to their summer positions in their reports that are due upon return from their internships.	

In PSE 304 (Mill Experience) and PSE 305 (Co-op Experience) students work for at least 12 weeks as interns in industrial positions. Upon completion of this work experience, the student's immediate supervisor submits a written performance evaluation that addresses various aspects of the student's technical preparation and professional work habits. The *Employer Evaluation Form* (EEF) provides an independent assessment metric for several Program Outcomes.

Table 28. Instrument 2: PSE 304 Mill Experience and PSE 305 Co-op Experience.

<table>
<tr><th rowspan="2">Program Outcome
(PEN-ABET)</th><th>Specific Assessment Metric</th><th>Expectations</th></tr>
<tr><th colspan="2">Responses and Action</th></tr>
<tr><td>4 – f, i, j</td><td>The specific questions on the EEF that targeted this outcome were addressed under the Professional Work Habits section:
1. Ability to learn: five ranks based on perceived rate of learning new material
2. Attitude – Application to work: five ranks from disinterested to enthusiastic
3. A third question asked, “Did the student's performance improve during the course of the internship?” More detail was requested for an affirmative answer.</td><td>1. We expect students to have an average rank of 4.00 on the 5.00 ranking for each of the two questions on the Professional Work Habits section.
2. We expect that 90% of the students will be observed to improve during their industry work experience.</td></tr>
</table>

PSE 304/305 Internship Survey: Outcome #4: Life-Long Learning

Year	2000	2001	2002	2003	2004	2005	2006
Students	15	26	12	16	6	4	3
Professional Work Habits:							
Attitude	3.80	4.00	4.18	4.44	4.17	4.00	*
Ability to Learn	4.27	4.46	4.67	4.69	4.83	5.00	*
Performance improvement	57%	25%	25%	100%	100%	100%	*

Outcome #4 – Life-long Learning was assessed using the attitude and learning potential of students in the industrial work environment. Two questions on the EEF survey measured student performance by external review. For the past six years, students met the expectations that project the ability to continue life-long learning. Further, in the most recent years, students were observed to improve performance over the course of their internship. This is a clear indication of continued growth and learning outside of the academic environment. Our metric indicates that we are continuing to meet our targets for Outcome #4.

6 – a, b, d, e, f, g, h, i, k	The ability to work in an industrial position is assessed by the student's performance during the internship experience. This is assessed by specific questions on the EEF: 1. "Did you find the students academic preparation adequate for your needs?" 2. In the Professional Work Habits section, all questions pertain to the student's ability to work and function well in an industrial position. Five ranks from poor to exceptional are used to assess various critical aspects of work habits. 3. "In which areas would you like to see more proficiency?" includes technical skills, teamwork skills, basic knowledge, communication and safety. These are all essential elements of a successful industrial work experience. 4. The students overall performance was assessed at eleven levels from unsatisfactory to outstanding.	1. We expect that 90% of the students will be academically prepared for their internship. 2. We expect students to have an average rank of 4.00 on the 5.00 ranking for the questions in the Professional Work Habits section. 3. We expect that students will have no more skill areas that require additional proficiency 4. We expect the average overall performance of students to rate at least 8.00 on a 11.00 point scale.

<table>
<tr>
<td></td>
<td colspan="2">PSE 304/305 Internship Survey: Outcome #6: Ability to work in an Industrial Position

Clearly, the internship experience focuses on providing our student with an immersive exposure to working in an industrial experience. Survey responses by internship supervisors assess our students’ ability to adapt to the industrial work environment and meet Outcome #6. The survey results indicate the following:

1. Students are well prepared, academically for the experience, as perceived by their engineering supervisor.
2. Students exceed expectations in all of the critical outcomes essential to performance in an industrial engineering position, with the exception of “Judgment”
3. The overall performance of our students continues to exceed expectations and is rated highly by engineering supervisors in sponsoring companies.

Improvement in “judgment” will be addressed as described in the following section. Improvement in “attitude” may be achieved by attentive coaching of students before they begin their internship experience. Both aspects will be the focus of pre-internship meetings. Our metric indicates that we are continuing to meet our targets for Outcome #6.</td>
</tr>
<tr>
<td>7 – c, f</td>
<td>The students understanding of professional and ethical responsibility is assessed by the supervisor using the EEF in questions:

1. “In which areas would you like to see more proficiency?” Safety
2. In the Professional Work Habits section:
• Judgment: five ranks from consistently poor judgment to exceptionally mature.
• Dependability: five ranks from unreliable to completely dependable.
• Attendance: regular or not.
• Punctuality: regular or not.</td>
<td>1. We expect that 90% of students will need no additional proficiency in Safety.
2. We expect students to have an average rank of 4.00 on the 5.00 ranking for the Judgment and Dependability questions in the Professional Work Habits section.
3. We expect that 90% of students will show regular punctuality and attendance.</td>
</tr>
</table>

PSE 304/305 Internship Survey: Outcome #7: Professional and Ethical Responsibility

Year	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
Students	15	26	12	16	6	4	3
Increase in **Safety** proficiency needed	0	0	8%	19%	0	0	*
Professional Work Habits:							
Judgment	3.67	3.85	3.75	3.94	4.33	3.50	*
Dependability	4.00	4.27	4.50	4.75	5.00	4.75	*
Attendance	4.71	5.00	5.00	5.00	5.00	5.00	*
Punctuality	4.47	5.00	5.00	5.00	5.00	5.00	*

The student performance in the industrial internship is an excellent test of knowledge of ethical and professional responsibility. The supervisors work in close contact with students in an environment that requires adaptation to engineering professionalism required for a manufacturing facility. Supervisors have rated our students well for their dependability, attendance and punctuality as indicated by scores that well exceed expectations. Professional judgment clearly indicates room for improvement as it only approaches the expectation in most years. This may vary depending on the mean class ranking of the cohort being surveyed (average age and maturity). Professional judgment can improve over the course of a single internship, and certainly develops as students repeat the internship experience. Performance of this will be addressed in pre-internship meetings where discussion of ethics and professional judgment will be increased. Our metric indicates that we are continuing to meet most targets for Outcome #7. Attention will be given to improving our students awareness of professional judgment.

8 – a, h, j	A knowledge of contemporary issues Academic preparation adequate? 1. "Did you find the students academic preparation adequate for your needs?" 2. Additional comments are solicited relative to the student's academic preparedness include Broad societal issues (big Picture?)	1. We expect that 90% of the students will be academically prepared for their internship

PSE 304/305 Internship Survey: Outcome #8: Knowledge of contemporary issues, global context.

Year	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
Students	15	26	12	16	6	4	3
Academic Preparedness	87%	88%	100%	100%	100%	100%	*
Professional Work Habits:							
Relations with others	3.80	4.24	4.25	4.31	4.33	4.25	*
Attitude	3.80	4.00	4.18	4.44	4.17	4.00	*
Judgment	3.67	3.85	3.75	3.94	4.33	3.50	*
Dependability	4.00	4.27	4.50	4.75	5.00	4.75	*
Ability to Learn	4.27	4.46	4.67	4.69	4.83	5.00	*
Quality of work	4.00	4.23	4.25	4.56	4.67	4.75	*
Attendance	4.71	5.00	5.00	5.00	5.00	5.00	*
Punctuality	4.47	5.00	5.00	5.00	5.00	5.00	*
Overall Performance	7.53	7.96	8.58	8.88	8.83	8.20	*

The “academic preparedness” of the students met the expectations in the most recent years that this survey was administered. This suggests that the students possessed sufficient knowledge of contemporary societal and global issues in the opinion of engineering professionals who are keenly aware of the importance of this outcome.

To further support this view, a question on the survey directly addressed the performance of students with regard to “Broad societal issues regarding the paper industry (“big picture”)”. Comments were not provided for all students. In those cases where answers were provided, comments reflected, “good” or “very good” or “still learning, progressing well”. In general, it is felt that this outcome is directly linked to Outcome #4 – Life-long Learning, especially the need to adapt to changes in broad societal issues. Our metric indicates that we are continuing to meet our targets for Outcome #8.

Table 29. Instrument 3: Pre-requisite Exams.

<table>
<tr><th rowspan="2">Program Outcome
(PEN-ABET)</th><th>Specific Assessment Metric</th><th>Expectations</th></tr>
<tr><th colspan="2">Responses and Action</th></tr>
<tr><td rowspan="2">1 – a, b, e, h</td><td>An exam given in PSE 370 (Mass and energy balances) that covers general chemistry, physics, and calculus.</td><td>We expect that 80% of the students will score 75% or above on the exam. We expect all students to score 60% or above.</td></tr>
<tr><td colspan="2">PSE 370 Prerequisite Exam: Chemistry, Physics, Calculus

<table>
<tr><th>Year</th><th>Students</th><th>Average Score</th><th>Above 75%</th><th>Above 60%</th></tr>
<tr><td>Benchmark</td><td></td><td></td><td>80%</td><td>100%</td></tr>
<tr><td>2001</td><td>10</td><td>78%</td><td>75%</td><td>100%</td></tr>
<tr><td>2002</td><td>16</td><td>80%</td><td>75%</td><td>94%</td></tr>
<tr><td>2003</td><td>6</td><td>82%</td><td>83%</td><td>100%</td></tr>
<tr><td>2004</td><td>6</td><td>82%</td><td>83%</td><td>83%</td></tr>
<tr><td>2005</td><td>10</td><td>78%</td><td>90%</td><td>100%</td></tr>
</table>

The prerequisite exam in PSE 370 serves multiple purposes. First of all, it identifies to students those areas in which a review of basic material may be needed. It also serves to inform students more strongly of the expectations of knowledge going into the class.

In general, students over the past three years have been well prepared for PSE 370, which represents the first engineering course taken by most of the students. Over this time frame, only one student fell below the 60% level on the exam (score of 55). This student went on to pass the course with a grade of a “B”. No systematic weaknesses were found amongst all students, indicating that the Chemistry, Physics, and Calculus courses are appropriately preparing students for their engineering classes. Any systematic weaknesses would be communicated to the instructors of these courses, although this has not been necessary.</td></tr>
<tr><td>1 – a, b, e, h</td><td>An exam given in PSE 468 (Papermaking processes) that covers engineering calculations and basic paper properties).</td><td>We expect that 80% of the students will score 75% or above on the exam. We expect all students to score 60% or above.</td></tr>
</table>

PSE 468 Prerequisite Exam: Engineering Calculations, Paper Properties

Year	Students	Average Score	Above 75%	Above 60%
Benchmark			80%	100%
2002	9	100%	100%	100%
2003	8	87%	88%	100%
2004	13	87%	92%	100%
2005				
2006	16	87%	81%	100%

*Course not offered due to low enrollment. Students that would have taken the course in 2006 took it in 2005.

Table 30. Instrument 4: PSE 468 Papermaking Processes Seminar.

Program Outcome (PEN-ABET)	**Specific Assessment Metric**	**Expectations**
	Responses and Action	
1 – a, b, e, h	Performance on seminar at conclusion of paper machine runs. In PSE 468, the students give seminars and field questions regarding their plan, performance, and results of the product design experience. Each team has approximately 30 minutes for a presentation and 60 minutes for questions and discussion. A panel of faculty and staff, including the course instructor and the TA, independently rate the students' abilities to analyze and present data from the paper machine runs. Beginning in 2004, the ratings were specifically broken out with respect to the PSE Program Outcomes.	We expect the average grade to be a B- on Run A and a B on the Run B. We expect 80% of the students to achieve a grade of C or better on Run A and 90% of the students to achieve a grade of C or better on Run B.

PSE 468 Seminar Assessment: Outcome #1: Sound Knowledge

		Average Grade		Above "C"	
Year	**Students**	**Run A**	**Run B**	**Run A**	**Run B**
Benchmark		B- (2.70)	B (3.00)	80%	90%
2002	9	B	B+	89%	100%
2003	8	B+ (3.46)	A- (3.71)	100%	**87%**
2004	12	A- (3.68)	B+ (3.43)	100%	100%
2004 (Outcome 1)	12	B (3.02)	B+ (3.33)	100%	92%
2005 (Outcome 1)					

Students receive feedback on data interpretation, analysis, and presentation from all attending. Each faculty and staff member brings their expertise to bear in the discussion. The students are then able to incorporate the discussion into their final report. In general, an improvement is seen by the same students from Run A to Run B. As can be seen from the above data, all students except one in 2003 met the expectations of receiving above a grade of "C" on the presentations. In 2004, the panel of faculty and staff assessing the student were specifically asked to rate the students' knowledge in relation to the first Program Outcome. For this year, both the composite and specific data are given.

2 – a, b, c, e, k	A panel of faculty and staff rate the students' abilities to conceptualize problems. Students are expected during the seminars and discussion to relate what they are discussing back to the fundamental principles of science and engineering that they have learned in this and previous courses. In the course of the seminar, they must defend their decisions in how they produced the grade of paper and the process by which they did it. As in the previous outcome, separate assessments were made beginning in the 2004 year; previous years represent composite data.	We expect the average grade to be a B- on Run A and a B on the Run B. We expect 80% of the students to achieve a grade of C or better on Run A and 90% of the students to achieve a grade of C or better on Run B.

	PSE 468 Seminar Assessment: Outcome #2: Problem Conceptualization					
			Average Grade		**Above "C"**	
	Year	**Students**	**Run A**	**Run B**	**Run A**	**Run B**
	Benchmark		B- (2.70)	B (3.00)	80%	90%
	2002	9	B	B+	89%	100%
	2003	8	B+ (3.46)	A- (3.71)	100%	**87%**
	2004	12	A- (3.68)	B+ (3.43)	100%	100%
	2004 (Outcome 2)	12	B (3.08)	B+ (3.29)	100%	92%
	2005 (Outcome 2)					
	As can be seen from the above data, all students, except one in 2003, met the expectations of receiving above a grade of "C" on the presentations. In 2004, the panel of faculty and staff assessing the student were specifically asked to rate the students' knowledge in relation to the first Program Outcome. For this year, both the composite and specific data are given.					
3 – a, b, c, d, g, k	A panel of faculty and staff rate the students' abilities to solve the engineering problem of producing the given grades of paper on our existing paper machines. As this problem is too large for any one student to do alone, the students in the class work as one combined design and engineering team to accomplish this goal. They must use the proper tools to complete their individual sections of the project, while coordinating through the supervising students with the other teams. As in the previous outcome, separate assessments were made beginning in the 2004 year; previous years represent composite data.	We expect the average grade to be a B- on Run A and a B on the Run B. We expect 80% of the students to achieve a grade of C or better on Run A and 90% of the students to achieve a grade of C or better on Run B.				

	PSE 468 Seminar Assessment: Outcome #3: Team Problem Solving	

		Average Grade		Above "C"	
Year	**Students**	**Run A**	**Run B**	**Run A**	**Run B**
Benchmark		B- (2.70)	B (3.00)	80%	90%
2002	9	B	B+	89%	100%
2003	8	B+ (3.46)	A- (3.71)	100%	**87%**
2004	12	A- (3.68)	B+ (3.43)	100%	100%
2004 (Outcome 3)	12	B (2.94)	B+ (3.27)	92%	92%
2005 (Outcome 3)					

As can be seen from the above data, all students except one in 2003 met the expectations of receiving above a grade of "C" on the presentations. In 2004, the panel of faculty and staff assessing the student were specifically asked to rate the students' knowledge in relation to the first Program Outcome. For this year, both the composite and specific data are given.

5 – g	A panel of faculty and staff rate the students' abilities to communicate orally through the seminar and discussion following the paper machine runs. As in the previous outcome, separate assessments were made beginning in the 2004 year; previous years represent composite data.	We expect the average grade to be a B- on Run A and a B on the Run B. We expect 80% of the students to achieve a grade of C or better on Run A and 90% of the students to achieve a grade of C or better on Run B.

<table>
<tr><td rowspan="10"></td><td colspan="6">PSE 468 Seminar Assessment: Outcome #5: Communication</td></tr>
<tr><td></td><td></td><td colspan="2">Average Grade</td><td colspan="2">Above “C”</td></tr>
<tr><td>Year</td><td>Students</td><td>Run A</td><td>Run B</td><td>Run A</td><td>Run B</td></tr>
<tr><td>Benchmark</td><td></td><td>B- (2.70)</td><td>B (3.00)</td><td>80%</td><td>90%</td></tr>
<tr><td>2002</td><td>9</td><td>B</td><td>B+</td><td>89%</td><td>100%</td></tr>
<tr><td>2003</td><td>8</td><td>B+ (3.46)</td><td>A- (3.71)</td><td>100%</td><td>87%</td></tr>
<tr><td>2004</td><td>12</td><td>A- (3.68)</td><td>B+ (3.43)</td><td>100%</td><td>100%</td></tr>
<tr><td>2004 (Outcome 5)</td><td>12</td><td>B (3.04)</td><td>B+ (3.29)</td><td>100%</td><td>100%</td></tr>
<tr><td>2005 (Outcome 5)</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="6">As can be seen from the above data, all students except one in 2003 met the expectations of receiving above a grade of “C” on the presentations. In 2004, the panel of faculty and staff assessing the student were specifically asked to rate the students’ knowledge in relation to the first Program Outcome. For this year, both the composite and specific data are given.</td></tr>
<tr><td>4 – g, i, j</td><td colspan="2">Students can demonstrate an understanding and ability of the need for life-long learning by improving their performance during the course of a semester. All students in PSE 468 must give a seminar and answer questions in a discussion-type setting based on their results of two semi-commercial paper machine runs (Run A and Run B). Since their performance are assessed essentially the same way in Run A and Run B, an improvement in performance from Run A to Run B can demonstrate the ability for life-long learning.</td><td colspan="4">For the four outcomes rated individually above, we expect that the students’ performance during the seminars and discussion will improve from Run A to Run B.</td></tr>
</table>

PSE 468 Seminar Assessment: Outcome #4: Life-long Learning

		Improvement in Outcome from Run A to Run B			
Year	**Students**	**#1**	**#2**	**#3**	**#5**
Benchmark		+0.01	+0.01	+0.01	+0.01
2002	9			+0.30	
2003	8			+0.25	
2004	12			**-0.25**	
2004	12	+0.31	+0.21	+0.33	+0.25
2005					

The students generally demonstrated improvement from Run A to Run B with respect to the quality of the seminar and discussion based on their results and analysis. Since the outcomes were individually assessed by the faculty and staff, the students showed on average, an improvement of 0.27 (on a 4-point scale). This demonstrates that the students were able to learn from their experience on the first run, demonstrating an ability and understanding of life-long learning.

In PSE 468 (Papermaking Processes), students are given the assignment of producing four grades of paper on a semi-commercial paper machine at the college. To do this, they are required, based on their independent research and talking with paper and chemical company representatives, discover the raw materials and develop the processes needed to produce those grades. During the process, they must scale up the process from the laboratory scale (handsheets) to a laboratory paper machine, and finally to a semi-commercial machine. At each scale up step, the students demonstrate their ability to learn from previous results, as well as learn from one paper grade to another.

Table 31. . Instrument 5: PSE 468 Papermaking Processes Report.

<table>
<tr><th rowspan="2">Program Outcome
(PEN-ABET)</th><th>Specific Assessment Metric</th><th>Expectations</th></tr>
<tr><th colspan="2">Responses and Action</th></tr>
<tr><td rowspan="2">5 – g</td><td>The students in PSE 468 (Papermaking Processes) must produce a final report for each of the two paper machine runs, each encompassing two grades of paper. These reports are assessed, by section, according to the rubric attached. The report is assessed independently by at least two people and the scores averaged to produce the final rating. In 2006, in lieu of PSE 468 (which was not taught), data from PSE 498, an independent study similar to PSE 468 were used. Only a single report was available.</td><td>We expect that the mean written quality of the report to be above average (score = 3.0) based on the rubric given. We also expect that all sections will be average (score = 2).</td></tr>
<tr><td colspan="2">PSE 468 Report Assessment: Outcome #5: Written Communication

<table>
<tr><th></th><th></th><th colspan="2">Mean Report Grade</th><th colspan="2">Above “2”</th></tr>
<tr><th>Year</th><th>Students</th><th>Run A</th><th>Run B</th><th>Run A</th><th>Run B</th></tr>
<tr><td>Benchmark</td><td></td><td>3.0</td><td>3.0</td><td>100%</td><td>100%</td></tr>
<tr><td>2001</td><td>12</td><td>2.9</td><td>3.2</td><td>100%</td><td>100%</td></tr>
<tr><td>2002</td><td>9</td><td>3.6</td><td>3.3</td><td>100%</td><td>100%</td></tr>
<tr><td>2003</td><td>8</td><td>3.0</td><td>3.3</td><td>100%</td><td>100%</td></tr>
<tr><td>2004</td><td>12</td><td>3.4</td><td>3.4</td><td>100%</td><td>100%</td></tr>
<tr><td>2005</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>2006</td><td>8</td><td>3.7</td><td></td><td>100%</td><td></td></tr>
</table>

In general, the students demonstrate the ability to communicate effectively in writing. The report that is produced in this course is a challenging assignment. The report is a single report that must be coordinated amongst the various teams in the class. In addition, the report must be completed within a relatively short time frame after the actual production run, typically 7 to 10 days. The data show that the students are able to do very well with the written report, with only one report barely missing the benchmark.</td></tr>
</table>

4 – f, i, j	To demonstrate the ability for life-long learning, the students are expected to learn from the various process scales and demonstrate how they applied the knowledge of one scale to the process of the next higher scale. This is often challenging as there are occasional equipment differences between the two machines and there are significant differences between machine paper and handsheets. The students must account for these differences and make adjustments to their processes as necessary. The final reports, together with the interim reports are assessed according to the attached rubric to determine if the students demonstrated the ability to learn in a number of facets: 1. Did they obtain knowledge from outside the classroom to complete their task? 2. Did they make changes to their proposed process based on the results of the previous scale? 3. In their discussion, were the students able to integrate knowledge from a number of sources in a way perhaps not previously seen?	We expect that the rubric score of the reports to be at least 2.

PSE 468 Report Assessment: Outcome #4: Life Long Learning

		Rubric Score	
Year	**Students**	**Run A**	**Run B**
Benchmark		3	3
2001	12	2	3
2002	9	4	4
2003	8	3	3
2004	12	3	4
2005			
2006*	8	3.5	

The students in PSE 468 (Papermaking Processes) adequately demonstrated the ability to learn during the scale-up process. The details given in the reports indicate that they were able to apply their knowledge from class, combining with information that they got from representatives of supplier companies, and information that they had to get from sources other than the instructor (e.g., the pilot plant director).

It is apparent by the students' performance that they are aware of the need for life-long learning in order to complete the tasks assigned in the course.

4 – f, i, j	During the course of PSE 468, the students make two paper machine runs on our semi-commercial paper machine. We expect the performance of the students, as measured by their report grades to improve from Run A to Run B.	We expect the mean grade on Run B to be higher than the mean grade on Run A, demonstrating the students' ability to learn from past experiences and improve their performance.

As shown in the Table above, the students' performance improved or consistent from Run A to Run B in 3 of the 4 years from 2001 to 2004. In 2002, the mean grade dropped from 3.6 to 3.3. However, this was in the instructor's opinion an exceptional class that performed on a very high level on the initial run, perhaps causing the expectations of the graders for the second run. In any case, the class this year scored quite high on both runs compared to classes of other years.

The students understand the need and expectation for improvement from Run A to Run B, thus demonstrating their understanding of the need for life-long learning.

Table 32. Rubric for Assessing Written Communication.

Level 0: Unacceptable	Level 2: Average	Level 4: Exceptional
• Text rambles, points made are only understood with repeated reading, and key points are not organized • Little or no structure or organization; no subheadings or proper paragraph structure used • Graphs, tables or diagrams are used, but no reference is made to them • Work is not presented neatly • Spelling/grammar errors present throughout more than 1/3 of the paper • No figures or graphics are used at all • The writing style is inappropriate for the audience and for the assignment • The prescribed format is not followed	• Articulates ideas, but writing is somewhat disjointed, superfluous or difficult to follow • Material are generally organized well, but paragraphs combine multiple thoughts or sections and sub-sections are not identified clearly • Uses graphs, tables, and diagrams, but only in a few instances are they applied to support, explain or interpret information • Work is not neatly presented throughout • One or two spelling/grammar errors per page • Figures are present but are flawed-axes mislabeled, no data points, etc. • Style is informal or inappropriate, jargon is used, improper voice, tense… • The prescribed format is only followed in some portions of the paper	• Articulates ideas clearly and concisely • Organizes written materials in a logical sequence to enhance the reader's comprehension (paragraphs, subheading, etc.) • Uses graphs, tables, and diagrams to support points-to explain, interpret, and assess information • Written work is presented neatly and professionally • Grammar and spelling are correct • Figures are all in proper format • Uses good professional writing style • Conforms to the prescribed format (if any)

Adapted from: http://www.ce.udel.edu/ABET/Current%20Documentation/Outcome_12a.html

Table 33. Rubric for Assessing Lifelong Learning from Paper Machine Run Reports

Level 0: Unacceptable	Level 2: Average	Level 4: Exceptional
• Requires detailed or step-by-step instructions to complete a task • Has trouble completing even the minimum required tasks • Is unable to recognize own shortcomings or deficiencies • Assumes that all learning takes place within the confines of the class • Shows little or no interest in outside learning resources • Cannot use materials outside of what is explained in class	• Requires guidance as to expected outcome of task or project • Completes only what is required • Sometimes is able to avoid repeating the same mistakes • Seldom brings information from outside sources • Has some trouble using materials and concepts that are in a different format from that taught in class	• Demonstrates ability to learn independently • Goes beyond what is required in completing an assignment and brings information from outside sources into assignments • Learns from mistakes and improves the process in subsequent trials • Demonstrates capability to think for one's self • Demonstrates responsibility for creating one's own learning opportunities • Is able to understand, interpret, and apply learned materials and concepts in a format different from that taught in class (e.g. different nomenclature, understand equation from different textbook)

Adapted from: http://www.ce.udel.edu/ABET/Current%20Documentation/Outcome_12a.html

Table 34. . Instrument 6: PSE 468 Papermaking Processes Student Cross Evaluations.

Program Outcome (PEN-ABET)	Specific Assessment Metric	Expectations
	Responses and Action	
All – All	At the conclusion of PSE 468 (Papermaking Processes), the students in the class are asked to evaluate each other in terms of the published Learning Outcomes for the Paper Engineering program. These rankings are based on a scale of 0 to 10, with 0 indicating that the student has no ability in that area, a 5 indicating an average ability, and a 10 indicating that the student has an exceptional ability in that area. For 2006, PSE 498 was used in lieu of PSE 468, which was not offered this year.	We expect the mean rating of the students will be greater than 6.5, indicating better than average ability. In addition, for each outcome, no more than 1 student will be ranked by their peers as being below average in ability (score of 5), and no student will be ranked below average (score of 5) in more than 2 outcomes.

PSE 468 Student Peer Evaluation: Average Scores

Year	Average Rating of Outcome							
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
2003	7.31	7.13	6.92	7.48	7.13	7.52	7.48	7.27
2004	7.01	6.76	6.92	7.51	6.94	7.62	6.85	6.55
2005								
2006	7.72	7.89	8.29	8.71	7.65	8.47	8.38	7.78

In general, the students rank their peers as being of above average ability with respect to the outcomes.

PSE 468 Student Peer Evaluation: Students Scoring Below Average

Year	Number of Below Average Students							
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
2003	0	0	0	0	0	0	0	0
2004	1	0	1	0	0	1	0	0
2005								
2006	0	0	0	0	0	0	0	0

PSE 468 Student Peer Evaluation: Outcomes Below Average by Student

Year	Number of Students	Students with Below Average Outcomes			
		0	**1**	**2**	**3 or more**
2003	8	0	0	0	0
2004	12	11	0	0	**1**
2005					
2006	9	9	0	0	0

Table 35. Instrument 7: PSE 481 Engineering Design.

Program Outcome (PEN-ABET)	**Specific Assessment Metric**	**Expectations**
	Responses and Action	
2 – a, b, c, e, k	The three main guiding threads in a design project are scope, schedule and budget, which are progressively refined and made more detailed as the design progresses over the semester. Thus, at the very beginning of a design project, the students have to make a rough cost estimation and potential profitability analysis of their project (along with a preliminary scope and schedule) in order to arrive at decision of whether to proceed further or not. This is further assessed by in-class interaction and exploration with the students on the future direction of the design project, and by evaluation of the design team's weekly class presentations and written summaries (10% of total grade) and engineering log book (10% of total grade). The overall progress of a design team is assessed from two mid-semester progress reports (25% of total grade) and one final technical design report (45% of total grade).	It is expected that the students perform at a benchmark level of 80% in the different instrument categories shown in Table 37.

This capstone design course (PSE 481) involves the execution of a real-world engineering design project during the fall semester at Solvay Paperboard, a paperboard mill located in Solvay, New York. Each design team maintains an engineering logbook containing all relevant approaches, data and calculations in an organized fashion. Every week, each team submits a brief written summary of its progress and makes a brief in-class presentation. There are extensive discussion and communication between the design teams, instructors, mill personnel, and external vendors with continuous monitoring of the progress of a design team towards the design goal. The results of the work of each team are summarized in a technical design report, which is submitted near the end of the semester. Two mid-semester progress reports are also required. In addition, at the end of the semester, each design team makes a presentation of its completed project to the Paper Science and Engineering department and prepares a poster of its project. The students undergo safety training at the mill so that they can operate safely in an industrial environment and professional and ethical responsibilities of engineers are communicated via videos and in-class discussion. Most classes are held at the mill site.

Table 36. Capstone design projects.

Year	Design Project	Number of Students
2001	(a) LI Disk Thickener Improvement Project (b) L2 Fractionation By-Pass System	(a) 2 (b) 2
2002	(a) PM 3 Blow Boxes Air Filter Upgrade (b) Design Evaluation of PM 2 Dryer Section	(a) 2 (b) 2
2003	(a) Installation of a Lumpbreaker Roll or a Steam Box over the Couch Roll on PM3 (b) Limiting Microbial Growth within the PM3 Starch System of Solvay Paperboard	(a) 1 (b) 1
2004	(a) Redesign of PM2 Light Reject Lines (b) Steam Shower in the Press Section of PM1 (c) Design of New Doctor Systems for PM1	(a) 2 (b) 2 (c) 1
2005	(a) Syphon Upgrades for PM1 and PM2 (b) Web-Break Camera System for PM3	(a) 2 (b) 2

Table 37. Student scores in various categories (BM = Benchmark score).

Year	Weekly summary and class presen-tation **(10)** **BM = 8**	Engineering logbook and weekly meeting with instructors **(10)** **BM = 8**	Progress report #1 **(10)** **BM = 8**	Progress report #2 **(15)** **BM = 12**	Techni-cal design report **(45)** **BM = 36**	Project presenta-tion (and poster) **(10)** **BM = 8**	Total **(100)** **BM = 80**
2001a	8	8	8.75	14.25	39.38	8.5	86.88 (A-)
2001b	7	8	10	15	36	6	82 (A-)
2002a	9	7	8.75	13.5	43.88	8.5	90.63 (A)
2002b	8	7	7.5	10.5	36	7.5	76.5 (B+)
2003a	9.5	8.5	8.75	14.63	39.38	7.5	88.25 (A-)
2003b	8.5	8	8.75	12.88	39.5	8.5	86.13 (A-)
2004a	9.25	7	9.25	12.75	40.5	8.5	87.25 (A-)
2004b	9.5	8	9.25	13.88	41.63	9	91.25 (A)
2004c	9.75	5.5	9	13.88	43.88	9	91 (A)
2005a	8.25	8	8.25	13.88	43.88	8.5	90.75 (A)
2005b	8	8.5	8.25	12	40.5	8.5	85.75 (A-)

Table 36 and Table 37 show the capstone design projects and data of student performance for the years 2001-2005. In general, the student scores in the various instrument categories shown in Table 37 (except for the category "Engineering logbook and weekly meeting with instructors") are averages of two independent assessments. These assessments are made by Dr. S. G. Chatterjee (Associate Professor, Paper Science and Engineering, SUNY-ESF) and Dr. J. Iribarne (Engineering and Technical Services Manager, Solvay Paperboard). In addition, the design team presentation of the individual projects at the Paper Science and Engineering department is assessed by members of the attending public.

From Table 37, the team-average scores in the different categories can be computed; these are shown in Table 38 for the years 2001-2005.

Table 38. Design team-average scores.

Category	Mean Score				
	2001	**2002**	**2003**	**2004**	**2005**
Weekly summary (10)	7.5	8.5	9	9.5	8.13
Engineering logbook (10)	8	7	8.25	6.83	8.25
Progress report #1 (10)	9.38	8.13	8.75	9.17	8.25
Progress report #2 (15)	14.63	12	13.76	13.50	12.94
Technical design report (45)	37.69	39.94	39.44	42.00	42.19
Project presentation (10)	7.25	8	8	8.83	8.5
Total (100)	**84.44**	**83.57**	**87.19**	**89.83**	**88.25**

The percentage of design teams performing at or above the benchmark level of 80% in the various categories, which were obtained from Table 37 and Table 38, is reported in Table 39 for the years 2001-2005 while Table 40 shows the design team score ranges and scores in the different categories averaged over a period of 5 years.

Table 39. Design team performance.

Category	Percentage of teams at or above benchmark score (%)				
	2001	**2002**	**2003**	**2004**	**2005**
Weekly summary	50	100	100	100	100
Engineering logbook	100	0	100	33	100
Progress report #1	100	50	100	100	100
Progress report #2	100	50	100	100	100
Technical design report	100	100	100	100	100
Project presentation	50	50	50	100	100
Total	**100**	**50**	**100**	**100**	**100**

Table 40. Design team score ranges and average scores over five years.

Category	Score Range (2001-2005)	Average Score (2001-2005)
Weekly summary (10)	7.5 – 9.5	8.53
Engineering logbook (10)	6.83 – 8.25	7.67
Progress report #1 (10)	8.13 – 9.38	8.74
Progress report #2 (15)	12 – 14.63	13.37
Technical design report (45)	37.69 – 42.19	40.25
Project presentation (10)	7.25 – 8.83	8.12
Total (100)	**83.57 – 89.83**	**86.66**

Assessment of Outcome #2 - The ability to conceptualize problems in terms of unifying principles, design and conduct experiments, and analyze and interpret data (conceptualize): The design team scores in the different categories shown in Table 37 are used to assess this outcome.

It can be concluded from Table 37 to Table 40 that, in general, students satisfied this outcome quite satisfactorily. In those categories in which the benchmark level was not reached by 50% or more of the design teams, an improvement can be observed over the years (Table 39). For example, during the years 2003-2005, the percentage of design teams at or above the benchmark level was 100% in almost all of the categories (Table 39). Table 40 shows that over a 5-year period (2001-2005), the design team performance exceeded the benchmark level in all the categories except one (engineering logbook).

In the 2005 end-of-course questionnaire, the students assessed that this outcome was satisfied at a class average level of 4.3 (out of 5).

<table>
<tr>
<td rowspan="2">3 – a, b, c, d, g, k</td>
<td>The real-world design problem is undertaken generally in groups of two students in each team. It is emphasized in the first class handout that proper planning and scheduling, and equitable division of responsibilities within each team are essential for the successful completion of the design project. The progress of each design team is regularly monitored through the semester via weekly class meetings, student weekly reports, progress reports, and engineering logbook as mentioned earlier.</td>
<td>It is expected that the students perform at a benchmark level of 80% (36/45) in the category “Technical design report” shown in Table 37.</td>
</tr>
<tr>
<td colspan="2"><u>Assessment of Outcome #3</u> - The ability to solve a real engineering problem in a team environment using appropriate design techniques (team problem solving): The successful solution of the design problem, as exemplified in the final technical design report submitted by each team (45% of total grade), which makes specific recommendations to Solvay Paperboard, is used to assess this outcome.

It can be observed from Table 37 – Table 39 that students satisfied this outcome very well since the percentage of design teams at or above the benchmark level was 100% during the period 2001-2005 (Table 39). We note that in 2003 and 2004, the class consisted of 2 and 5 students, respectively; this resulted in design teams that were constituted of only one person. Table 40 shows that over a 5-year period (2001-2005), the average score for the technical design report was 40.25 (out of 45) and it ranged over 37.69 – 42.19, which can be compared to the benchmark level of 36.

In the 2005 end-of-course questionnaire, the students assessed that this outcome was satisfied at a class average level of 4.7 (out of 5).</td>
</tr>
<tr>
<td>5 – g</td>
<td>In the first class handout, it is emphasized that effective communication will be a major part of the course. Details of making technical presentations and report writing are given to the class and the design projects also involve communicating with mill personnel and external vendors.</td>
<td>It is expected that the students perform at a benchmark level of 80% in the instrument categories that involve oral and written communication (weekly summary and class presentation, progress reports #1 and #2, technical design report, project presentation and poster) shown in Table 37.</td>
</tr>
</table>

	<u>Assessment of Outcome #5</u> - Well-developed written and oral communication skills (communication): This outcome is assessed by monitoring and evaluating weekly class presentations and written summaries, progress reports, technical design report, and design-team e-mails, and communications with mill personal and external vendors. In addition, each team presents their design to the Paper Science and Engineering (PSE) department and develops a poster of their design towards the end of the semester. The attendees at the design seminar evaluate the presentation. From the data presented in Table 37 – Table 40, it can be concluded that in general the students met this outcome at a reasonably high level. However, in 2001, one design team did not attain the benchmark in the 'weekly summary' category while in 2002, one design team did not meet the benchmark for progress reports #1 and #2 (Table 37 and Table 39). Also, during 2001-2003, half of the design teams fell below the benchmark in the 'project presentation' category although the team scores in this category recovered in 2004 and 2005. Overall, as can be seen from Table 40, on average during 2001-2005, scores in the various instrument categories were all above the benchmark level, which indicates that this outcome was satisfied. Further evidence of good communication skills is available in the PSE 481 course notebook and in the student technical design reports, which contain examples of e-mail messages and communications between the design teams and mill personnel and external vendors. In the 2005 end-of-course questionnaire, the students assessed that this outcome was satisfied at a class average level of 4.7 (out of 5).	
6 – a, b, d, e, f, g, h, i, k	The design problems are real engineering projects at Solvay Paperboard with a good potential of being actually implemented. Classes are held at the mill site and the students perform their projects in a mill environment. The students also undergo safety training in the mill so that they can operate safely in an industrial setting.	It is expected that the design team performance, as assessed by Dr. J. Iribarne, (Engineering and Technical Services Manager, Solvay Paperboard), be at a benchmark level of 80% in the following instrument categories: weekly class presentations of team progress, two mid-semester progress reports, final technical design report, and team presentation of their design project.

	<u>Assessment of Outcome #6</u> – the ability to work in an industrial position within the pulp, paper, or allied industries (industrial experience): Dr. J. Iribarne, Engineering and Technical Services Manager at Solvay Paperboard, who is also co-instructor of this course, assesses this outcome by grading and offering feedback on weekly class presentations of team progress, two mid-semester progress reports, final technical design report, and design team presentation of their project to the PSE department. He plays an important role in acting as an advisor and facilitator in the communications on technical and other matters between the design team and external vendors and mill personnel.

Scores given by Dr. J. Iribarne in Various Categories (averaged over all teams)

Category	2001	2002	2003	2004	2005
Week. summary (10)	–	8.5	9	10	8
Prog. report #1 (10)	9.5	8.5	8.5	9	8
Prog. report #2 (15)	15	12	14	13	12
Tech. design report (45)	38.25	40.5	44	42	42.75
Project presentation (10)	–	–	–	9	–

The above list indicates that student performance in the various categories was consistently at or above the benchmark level of 80%, which implies that students have the ability to adapt to the industrial work environment and meet the technical manager's expectations, and, thus, attain Outcome #6.

This outcome was assessed at a class average level of 4.7 (out of 5) by the students in the end-of-course questionnaire in 2005.

Table 41. Instrument 8: Alumni Survey

Program Outcome (PEN-ABET)	**Specific Assessment Metric**	**Expectations**
	Responses and Action	
3 – a, b, c, d, g, k	Specific Questions relating to Outcome 3: The ability to solve real engineering problems in a team environment using appropriate design techniques (team problem solving).	It is expected that greater than 80% of students would be used to team problem solving.

<table>
<tr><td></td><td colspan="2">The results of the latest Alumni Survey are reported here. There were 16 respondents out of 58 that were sent this survey. However, of the 58, there is no location data for 24 graduates. Thus, we are examining 16/34. This survey covers the years 1999 to 2005 and has been modified from the previous Alumni Survey shown in the Self-Study. This modified survey has five specific questions relating to Objectives and eight specific questions relating to Outcomes, a series of 17 “General Questions”, which elicit more detailed career data from the respondents, and a set of three “Open-Answer Questions”, which the respondent can answer with an essay format. This revised Alumni Survey also asks the pertinent questions regarding the ESF program of study, job position and short history, salary history, and professional licensure (FE and PE Exam) activity. In addition to response to this survey by mail, response was made available on the ESF website. This new survey format is already yielding valuable information, which will aid in Objective Evaluation and Outcomes Assessment.

The responses for Outcome 3 were as follows: 44% - Strongly Agree; 44% - Agree; 12% - Neutral. Thus, 88% of graduates felt that they had developed “team problem solving” by the time of graduation.</td></tr>
<tr><td rowspan="2">4 - f, i, j</td><td>Specific Question relating to Outcome 4: An ability to engage in life-long learning (life-long learning).</td><td>It is expected that greater than 80% of students would be prepared for “life-long learning”.</td></tr>
<tr><td colspan="2">The responses for Outcome 4 were as follows: 63% - Strongly Agree; 37% - Agree. Thus, 100% of responding graduates feel that they were prepared for life-long learning at graduation as a result of their academic training.</td></tr>
<tr><td rowspan="2">6 - a, b, d, e, f, g, h, i, k</td><td>Specific Question relating to Outcome 6: The ability to work in an industrial position within the pulp, paper, or allied industries (industrial experience).</td><td>It is expected that greater than 80% of students will feel that their academic program and co-op has given them the ability to work in an industrial position.</td></tr>
<tr><td colspan="2">The responses for Outcome 6 are as follows: 50% - Strongly Agree; 44% - Agree; 6% - Neutral. Thus, 94% of graduates felt that they could work in an industrial environment when they graduated. One response was Neutral.</td></tr>
<tr><td>8 – h, j</td><td>Specific Question relating to Outcome 8: A knowledge of the broad, contemporary issues facing the engineer in global and societal contexts (contemporary issues).</td><td>It is expected that greater than 70% of students will have adequate knowledge of contemporary issues.</td></tr>
</table>

	The responses for Outcome 8 were as follows: 31% - Strongly Agree; 44% - Agree; 6% - Neutral; 19% - Disagree. Of all the Outcomes evaluated here, this is the weakest. 75% of the graduates felt that they had a knowledge of contemporary issues at the time of graduation. This result, which is lower than other expectations, is not too surprising, since being in academia somewhat shields students from issues, which assume more importance in the workplace. 19% disagree, which was the largest disagreement among these four Outcomes. A remedy to this Outcome could be specific seminars by industry and governmental personnel.

Achievement of Program Outcomes

While the assessment has been directed to the program outcomes, the discussion that follows will be based on the "a-k" statements of the EC 2000 criterion 3. We have concluded that the students that went through Paper Engineering satisfied all the expectations as specified by the program outcomes since the last accreditation. The tables above also correlate specific program outcomes to the 'a-k' outcomes discussed below.

a. an ability to apply knowledge of mathematics, science, and engineering

Of the eight selected instruments, six instruments have direct measures to this criterion, as shown in Table 28, Table 29, Table 30, Table 34, Table 35, and Table 41.

In Table 29, the prerequisite exams instrument measures the program outcome #1 directly. This is also one of the direct measures pertaining to the retaining of knowledge of mathematics, science, and engineering, a prerequisite to the ability to apply the knowledge. As described in Table 29, the students passing through the two courses have shown sound grasp of the background knowledge. At least 75% students have achieved better than the expectation.

In Table 28, pertaining to Outcome 6, one direct measure of the ability to apply knowledge of mathematics, science, and engineering is how students perform in the "real world". The assessment using this instrument shows that the students are well prepared, i.e., they possess and can apply the necessary knowledge in practice. In addition, as indicted by the assessment of program outcome, 87% of the employers found the paper engineering students to be academically prepared in 2000 and in the last year in which data was available, this number has reached 100%.

In Table 30, program outcomes 1, 2, and 3 have been assessed along with other outcomes. Instrument 4 is comprehensive in examining how well the students can apply the knowledge learned to actually make a specified grade of paper. Through the achievements pertaining to Program Outcomes 1, 2, and 3, one can conclude that the students possessed the ability to apply knowledge of mathematics, science, and engineering.

In Table 34, the instrument: student cross evaluation, is employed to assess all the program outcomes. Pertaining to Outcomes 1, 2, 3, and 6, the average ratings are all above 6.5 out of 10. There is 1 student being perceived as below average by peers in 2004, otherwise all students are perceived fairly by their peers. This instrument reinforces the achievements of Criterion 3 Statement a.

In Table 35, Program Outcomes 2, 3 and 6 have been assessed along with other program outcomes. Based on the achievements in student ability to conceptualize (Outcome 2), to actively participate in team problem solving (Outcome 3), and to engage in an industrial design problem (Outcome 6), one can infer that they have obtained the ability to apply knowledge of mathematics, science and engineering.

In Table 41, Program Outcomes 3 and 6 have been assessed along with other outcomes using the Alumni Survey instrument. 88% of graduates felt that they have developed team problem solving skills by graduation, while 94% of graduates felt positively that they have gained ability to work in an industrial setting. One can infer that at least 88% of graduates were confident that they possessed the ability to apply knowledge of mathematics, science and engineering by graduation.

Therefore, the assessments based on six out of ten instruments employed have all showed that the students graduating from the Paper Engineering program possess the 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

Six instruments out of the ten employed during this assessment have direct measures to this criterion, as shown in Table 28, Table 29, Table 30, Table 34, Table 35, and Table 41.

In Table 29, the prerequisite exams instrument measures Program Outcome #1 directly. This is also one of the direct measures of Statement b pertaining to retaining knowledge of mathematics, science, and engineering, a prerequisite of the ability to design and analyze. As described in Table 29, the students passing through the two courses have shown a sound grasp of background knowledge. At least 75% of students have achieved better than expectation.

In Table 28, pertaining to Outcome 6, one direct measure of the ability to design and conduct experiments, as well as analyze and interpret data is how students perform in the "real world". The assessment using this instrument shows that the students are well prepared, i.e., they possess and can apply the necessary knowledge in practice. In addition, as indicted by the assessment of program outcome, 87% of the employers found the Paper Engineering students to be academically prepared in 2000 and in the last year in which data was available, this number has reached 100%.

In Table 30, Program Outcomes 1, 2, and 3 have been assessed along with other outcomes. Instrument 4 is comprehensive in examining how well the students can design and conduct experiments, as well as can analyze and interpret data by actually making a specified grade of paper from scratch. Through the achievements pertaining to Program Outcomes 1, 2, and 3, one can conclude that the students possessed the ability to design and conduct experiments, as well as to analyze and interpret data.

In Table 34, the instrument: student cross evaluation, is employed to assess all the program outcomes. Pertaining to Outcomes 1, 2, 3, and 6, the average ratings are all above 6.5 out of 10. There is one student who was perceived as below average by peers in 2004, otherwise all students were perceived fairly by their peers. This instrument reinforces the achievements of Criterion 3 Statement b.

In Table 35, Program Outcomes 2, 3 and 6 have been assessed along with other program outcomes. Based on the achievements in student ability to conceptualize (Outcome 2), to actively participate in team problem solving (Outcome 3), and to engage in an industrial design problem (Outcome 6), one can infer that they have obtained the ability to design and conduct experiments, as well as to analyze and interpret data.

In Table 41, Program Outcomes 3 and 6 have been assessed along with other outcomes using the Alumni Survey instrument. 88% of graduates felt that they have developed team problem solving skills at graduation, while 94% of graduates felt positively that they have gained the ability to work in the industrial setting. One can infer that at least 88% of graduates are confident that they possessed the ability to design and conduct experiments, as well as to analyze and interpret data by graduation.

Therefore, the assessments based on six out of ten instruments employed have all showed that the students graduating from the Paper Engineering program possess the 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

Six instruments out of the ten employed during this assessment have direct measures to this criterion, as shown in Table 27, Table 28, Table 30, Table 34, Table 35, and Table 41.

In Table 27, the Paper Engineering orientation instrument measures Program Outcome 7 directly. This is also one of the direct measures to Statement c pertaining to the ability to evaluate realistic constraints such as environmental, social, political, ethical, health and safety. As described in Table 27, 100% students in 2005 demonstrated a sufficient understanding of the ethical responsibilities of an engineer.

In Table 28, Program Outcome 7 has been assessed along with other outcomes. Student performance in the industrial internship is an excellent measure of the 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. The assessment using this instrument shows that the students are prepared, with a score of at least 3.50 out of 5. However, there is still room for improvement.

In Table 30, Program Outcomes 2 and 3 have been assessed along with other outcomes. Instrument 4 is comprehensive in examining the ability to design a system, component, or process to meet desired needs within realistic constraints by actually making a specified grade of paper from scratch. Through the achievements pertaining to Program Outcomes 2 and 3, one can conclude that the students possessed the ability to design a system, component, or process to meet desired needs within realistic constraints.

In Table 34, the instrument: student cross evaluation, is employed to assess all the program outcomes. Pertaining to Outcomes 2, 3, and 7, the average ratings are all above 6.5 out of 10. There is one student perceived as below average by peers in 2004, otherwise all students were perceived fairly by their peers. This instrument reinforces the achievements of Criterion 3, Statement c.

In Table 35, Program Outcomes 2 and 3 have been assessed along with other program outcomes. Based on the achievements in student ability to conceptualize (Outcome 2) and to actively participate in team problem solving (Outcome 3), one can infer that they have obtained the ability to design a system, component, or process to meet desired needs within realistic constraints.

In Table 41, Program Outcome 3 has been assessed along with other outcomes using the Alumni Survey instrument. 88% of graduates felt that they have developed team problem solving skills at graduation. Thus, at least 88% of graduates were confident that they were prepared to design a system, component, or process to meet desired needs within realistic constraints by graduation.

Therefore, assessments based on six out of ten instruments employed have all shown that the students graduating from the Paper Engineering program possess the 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

Five instruments out of the ten employed during this assessment have direct measures to this criterion, as shown in Table 28, Table 30, Table 34, Table 35, and Table 41.

In Table 28, Program Outcome 6 has been assessed along with other outcomes. Student performance in the industrial internship is an excellent measure of the ability to function on multi-disciplinary teams. The assessment using this instrument shows that the students can contribute well individually on multi-disciplinary teams.

In Table 30, Program Outcome 3 has been assessed along with other outcomes. Instrument 4 is ideal in examining the ability to function on multi-disciplinary teams by actually making a specified grade of paper from scratch. Through the achievements pertaining to Program Outcome 3, one can conclude that the students possessed the ability to function on multi-disciplinary teams.

In Table 34, the instrument: student cross evaluation, is employed to assess all the program outcomes. Pertaining to Outcomes 3 and 6, the average ratings are all above 6.5 out of 10. There is one student perceived as below average by peers in 2004, otherwise all students were perceived fairly by their peers. This instrument reinforces the achievements of Criterion 3, Statement d.

In Table 35, Program Outcomes 3 and 6 have been assessed along with other program outcomes. Based on the achievements in student ability to conceptualize (Outcome 2) and to actively participate in team problem solving (Outcome 3), one can infer that they have obtained the ability to function on multi-disciplinary teams.

In Table 41, Program Outcomes 3 and 6 have been assessed along with other outcomes using the Alumni Survey instrument. 88% of graduates felt that they have developed team problem solving skills and 94% felt that they could work in an industrial setting at graduation. Thus, at least 88% graduates were confident that they were prepared to function on multi-disciplinary teams by graduation.

Therefore, assessments based on five out of ten instruments employed have all showed that the students graduating from the Paper Engineering program possess the ability to function on multi-disciplinary teams.

e. an ability to identify, formulate, and solve engineering problems

Six instruments out of the ten employed during this assessment have direct measures to this criterion, as shown in Table 28, Table 29, Table 30, Table 34, Table 35, and Table 41

In Table 29, the prerequisite exams instrument measures Program Outcome 1 directly. This is also one of the direct measures of Statement e of Criterion 3 pertaining to retaining knowledge of mathematics, science, and engineering, a prerequisite to the ability to identify, formulate, and solve engineering problems. As described in Table 29, the students passing through the two courses have shown sound grasp of background knowledge. At least 75% students achieved better than expected.

Table 28, which pertains to Outcome 6, one direct measure of the ability to identify, formulate, and solve engineering problems is how students perform in “real world”. The assessment using this instrument shows that the students are well prepared, i.e., they possess and can apply the necessary knowledge in practice. In addition, as indicted by the assessment of the program outcome, 87% of the employers found the paper engineering students to be academically prepared in 2000 and in last years, this number has reached 100%.

In Table 30, Program Outcomes 1 and 2 have been assessed along with other outcomes. Instrument 4 is comprehensive in examining how well the students can identify, formulate, and solve engineering problems by actually making a specified grade of paper from scratch. Through the achievements pertaining to Program Outcomes 1 and 2, one can conclude that the students possessed the ability to identify, formulate, and solve engineering problems.

In Table 34, the instrument: student cross evaluation, is employed to assess all the program outcomes. Pertaining to Outcomes 1, 2, and 6, the average ratings are all above 6.5 out of 10. There is one student perceived as below average by peers in 2004, otherwise all students were perceived fairly by their peers. This instrument reinforces the achievements of Criterion 3, Statement e.

In Table 35, Program Outcomes 2 and 6 have been assessed along with other program outcomes. Based on the achievements in student ability to conceptualize (Outcome 2) and to engage in an industrial design problem (Outcome 6), one can infer that they have obtained the ability to identify, formulate, and solve engineering problems.

In Table 41, Program Outcome 6 has been assessed along with other outcomes using the Alumni Survey instrument. 94% of graduates felt positively that they have gained the ability to work in an industrial setting. One can infer that at least 94% graduates were confident that they possessed the ability to identify, formulate, and solve engineering problems by graduation.

Therefore, assessments based on six out of ten instruments employed have all showed that the students graduating from the Paper Engineering program possess the ability to identify, formulate, and solve engineering problems.

f. an understanding of professional and ethical responsibility

Seven instruments out of the ten employed during this assessment have direct measures to this criterion, as shown in Table 27, Table 28, Table 30, Table 31, Table 34, Table 35, and Table 41.

In Table 27, the Paper Engineering orientation instrument measures Program Outcome 7 directly. This is also one of the direct measures of Statement f pertaining to an understanding of professional and ethical responsibility. As described in Table 27, 100% of students in 2005 demonstrated a sufficient understanding of the ethical responsibilities of an engineer.

In Table 28, Program Outcomes 4, 6 and 7 have been assessed along with other outcomes. Student performance in an industrial internship is an excellent measure of the understanding of professional and ethical responsibility. The assessment using this instrument shows that the students are prepared, with a score of at least 3.50 out of 5. However, there is still room for improvement.

In Table 30 and Table 31, Program Outcome 4 has been assessed along with other outcomes. Instruments 4 and 5 pertain to actually making a specified grade of paper from scratch. Through achievements pertaining to Program Outcome 4, one can conclude that the students possessed an understanding of professional and ethical responsibility.

In Table 34, the instrument: student cross evaluation, is employed to assess all the program outcomes. Pertaining to Outcomes 4, 6, and 7, the average ratings are all above 6.5 out of 10. There is one student perceived as below average by peers in 2004, otherwise all students were perceived fairly by their peers. This instrument reinforces the achievements of Criterion 3, Statement f.

In Table 35, Program Outcome 6 has been assessed along with other program outcomes. Based on the achievements in students meeting the technical manager's expectations during the course of the design project, one can infer that they have obtained an understanding of professional and ethical responsibility.

In Table 41, Program Outcomes 4 and 6 have been assessed along with other outcomes using the Alumni Survey instrument. 100% of graduates felt that they were prepared for life-long learning as a result of their academic training and 94% felt that they could work in an industrial setting at graduation. Thus, at least 94% of graduates are confident that they have an understanding of professional and ethical responsibility by graduation.

Therefore, the assessments based on seven out of ten instruments employed have all showed that the students graduating from the Paper Engineering program possess an understanding of professional and ethical responsibility.

g. an ability to communicate effectively

Six instruments out of the ten employed during this assessment have direct measures to this criterion, as shown in Table 28, Table 31, Table 34, Table 35, and Table 41.

In Table 28, Program Outcome 6 has been assessed along with other outcomes. In particular, one question has been asked "in which areas would you like to see more proficiency: technical skills, teamwork skills, basic knowledge, communication, or safety." Student performance in the industrial internship is an excellent measure of the ability to communicate effectively. The assessment using this instrument shows that the students are well prepared.

Program Outcomes 3 (in Table 30) and 5 (in Table 30 and Table 31) have been assessed along with other outcomes. These instruments pertain to actually making a specified grade of paper from scratch. Through the achievements pertaining to Program Outcomes 3 and 5, one can conclude that the students have possession of the ability to communicate effectively.

In Table 34, the instrument: student cross evaluation, is employed to assess all the program outcomes. Pertaining to Outcomes 3, 5, and 6, the average ratings are all above 6.5 out of 10. There is one student perceived as below average by peers in 2004, otherwise all students were perceived fairly by their peers. This instrument reinforces the achievements of Criterion 3, Statement g.

In Table 35, Program Outcomes 3, 5 and 6 were assessed along with other program outcomes. Based on the achievements in the group design projects and communicating in the presentations, one can infer that they have obtained an ability to communicate effectively.

In Table 41, Program Outcomes 3 and 6 have been assessed along with other outcomes using the Alumni Survey instrument. 88% of graduates felt that they had developed team problem solving skills and 94% felt that they could work in an industrial setting at graduation. Thus, at least 88% of graduates are confident that they have an ability to communicate effectively by graduation.

Therefore, assessments based on six out of ten instruments employed have all showed that the students graduating from the Paper Engineering program possess an ability to communicate effectively.

h. the broad education necessary to understand engineering solutions in a global, economic, environmental, and societal context

Of the eight selected instruments, six instruments have direct measures of this criterion, as shown in Table 28, Table 29, Table 30, Table 35, and Table 41.

In Table 29, the prerequisite exams instrument measures Program Outcome 1 directly. This is also one of the direct measures of Statement h of Criterion 3 pertaining to retaining knowledge of mathematics, science, and engineering. As described in Table 29, the students passing through the two courses have shown a sound grasp of background knowledge. At least 75% students achieved better than expected.

In Table 28, Program Outcomes 6 and 8 have been assessed along with other outcomes. One direct measure of the broad education necessary to understand engineering solutions in a global, economic, environmental, and social context is how students perform in the “real world”. The assessment using this instrument shows that the students are well prepared, i.e., they possess the necessary knowledge for practice. In addition, as indicted by the assessment of the program outcome, 87% of employers found the Paper Engineering students to be academically prepared in 2000 and in the last years, this number has reached 100%.

In Table 30, Program Outcome 1 has been assessed along with other outcomes. Through the achievements pertaining to Program Outcome 1, one can conclude that the students have the broad education necessary to understand engineering solutions.

In Table 34, the instrument: student cross evaluation, is employed to assess all the program outcomes. Pertaining to Outcomes 1, 6, and 7, the average ratings are all above 6.5 out of 10. There is one student perceived as below average by peers in 2004, otherwise all students were perceived fairly by their peers. This instrument reinforces the achievements of Criterion 3, Statement h.

In Table 35, Program Outcome 6 has been assessed along with other program outcomes. Based on the achievements in student ability to engage in industrial design problem solving (Outcome 6), one can infer that they have obtained the broad education necessary to understand engineering solutions in a global, economic, environmental, and social context.

In Table 41, Program Outcomes 6 and 8 have been assessed along with other outcomes using the Alumni Survey instrument. 75% of graduates felt that they had knowledge of contemporary issues and 94% of graduates felt positively that they have gained the ability to work in an industrial setting at the time of graduation. One can infer that at least 75% graduates are confident that they possess the broad education necessary to understand engineering solutions in a global, economic, environmental, and social context by graduation. However, there is a concern that 19% of graduates felt that they didn't have enough knowledge of the broad, contemporary issues facing the engineer in global and societal context. A remedy to this outcome could be specific seminars by industry and governmental personnel.

Therefore, the assessments based on six out of ten instruments employed have all showed that the students graduating from the Paper Engineering program possess the broad education necessary to understand engineering solutions in a global, economic, environmental, and social context.

i. a recognition of the need for, and an ability to engage in life-long learning

Six out of the eight selected instruments have direct measures of this criterion, as shown in Table 28, Table 30, Table 31, Table 34, Table 35, and Table 41.

In Table 28, Program Outcomes 4 (an ability to engage in life-long learning) and 6 (the ability to work in an industrial position within the pulp, paper, or allied industries) have been assessed along with other outcomes. One direct measure of the recognition of the need for, and the ability to engage in life-long learning is how students perform in the "real world". The assessment using this instrument shows that the students have recognized the need for, and an ability to engage in life-long learning.

In Table 30 and Table 31, program outcome 4 (ability to engage in life-long learning) has been assessed along with other outcomes. Through the achievements pertaining to program outcome 4, one can conclude that the students have possessed the recognition of the need for, and the ability to engage in life-long learning.

In Table 34, the instrument: student cross evaluation, is employed to assess all the program outcomes. Pertaining to Outcome 4, the average rating is above 7 out of 10. There was no student perceived as below average by peers. This instrument reinforces the achievements of Criterion 3, Statement i.

In Table 35, Program Outcome 6 has been assessed along with other program outcomes. Based on the achievements in student ability to engage in industrial design problem solving (Outcome 6), one can infer that they have obtained the recognition of the need for, and the ability to engage in life-long learning.

In Table 41, Program Outcomes 4 and 6 have been assessed along with other outcomes using the Alumni Survey instrument. 100% of graduates felt that they were prepared for life-long learning and 94% of graduates felt positively that they have gained the ability to work in an industrial setting at the time of graduation. One can infer that at least 94% of graduates are confident that they possess the recognition of the need for, and the ability to engage in life-long learning.

Therefore, the assessments based on six out of ten instruments employed have all shown that the students graduating from the Paper Engineering program possess the recognition of the need for, and the ability to engage in life-long learning.

j. a knowledge of contemporary issues

Five out of the eight selected instruments have direct measures to this criterion, as shown in Table 28, Table 30, Table 31, Table 34, and Table 41.

In Table 28, Program Outcomes 4 (an ability to engage in life-long learning) and 8 (a knowledge of the broad, contemporary issues facing the engineer in global and societal contexts) have been assessed along with other outcomes. One direct measure of possessing the knowledge of contemporary issues is how students perform in the “real world”. The assessment using this instrument shows that the students are well prepared, i.e., they possess the necessary knowledge of contemporary issues necessary for practice.

In Table 30 and Table 31, Program outcome 4, which is a direct equivalent of Statement j, has been assessed along with other outcomes. Through the achievements pertaining to Program Outcome 4, one can conclude that the students have a knowledge of contemporary issues.

In Table 34, the instrument: student cross evaluation, is employed to assess all the program outcomes. Pertaining to Outcomes 4 and 8, the average ratings are all above 6.5 out of 10. There are no students who were perceived as below average by peers. This instrument reinforces the achievements of Criterion 3, Statement j.

In Table 41, Program Outcomes 4 and 8 have been assessed along with other outcomes using the Alumni Survey instrument. 100% of graduates felt that they were prepared for life-long learning and 75% of graduates felt positively that they have gained the knowledge of contemporary issues at the time of graduation. One can infer that at least 75% graduates are confident that they possess knowledge of contemporary issues. However, there is a concern that 19% of graduates felt that they didn’t have enough knowledge of the broad, contemporary issues facing the engineer in global and societal context. A remedy to this outcome could be specific seminars by industry and governmental personnel.

Therefore, the assessments based on five out of ten instruments employed have all showed that the students graduating from the Paper Engineering program possess the knowledge of contemporary issues.

k. an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Five out of the eight selected instruments have direct measures to this criterion, as shown in Table 28, Table 30, Table 34, Table 35, and Table 41.

In Table 28, Program Outcomes 6 (industrial experience) has been assessed along with other outcomes. One direct measure of possessing an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice is how students perform in the "real world". The assessment using this instrument shows that the students are well prepared, i.e., they possess an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

In Table 30, Program Outcomes 2 (the ability to conceptualize problems in terms of unifying principles, design and conduct experiments, and analyze and interpret data) and 3 (the ability to solve a real engineering problem in a team environment using appropriate design technique) have been assessed along with other outcomes. Through the achievements pertaining to Program Outcomes 2 and 3, one can conclude that the students possess an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

In Table 34, the instrument: student cross evaluation, is employed to assess all the program outcomes. Pertaining to outcomes 2, 3 and 6, the average ratings are all above 6.5 out of 10. There is one student being perceived as below average for his/her performance regarding to outcome 6 (industrial experience) by peers. Otherwise, all the students have been rated fairly well by peers. This instrument reinforces the achievements of criterion 3 statement k.

In Table 35, Program Outcomes 2, 3 and 6 have been assessed along with other outcomes. Based on the achievements in the group design projects and communicating in presentations, one can infer that they have obtained an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

In Table 41, Program Outcomes 3 and 6 have been assessed along with other outcomes using the Alumni Survey instrument. 88% of graduates felt that they have developed "team problem solving" and 94% of graduates felt positively that they could work in an industrial setting at the time of graduation. One can infer that at least 88% graduates are confident that they have an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Therefore, the assessments based on five out of ten instruments employed have all showed that the students graduating from the Paper Engineering program possess an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Finally, we refer the reader to Table 51 in the "Professional Component" chapter and to the section titled "Access to Modern Engineering Tools" in the chapter on "Facilities" where the use of such tools in different courses in the curriculum are described

Curriculum Improvements

A significant number of changes were made to the Paper Engineering Curriculum during the time frame of the previous self-study (2000-01). These are summarized below and discussed in further detail in Criterion 4.

1. Consolidation of pulping courses
2. Review of course prerequisites
3. Dropping botany requirement
4. Four year engineering program
5. Mandatory PSE Orientation for all students
6. Addition of pulp and paper laboratory skills course
7. Addition of unit operations laboratories
8. Implementation of general education program**.**

These changes have had a significant impact on the curriculum and represented a major change in the curriculum that had not been previously seen since the early 1980's. Such a major change should only occur infrequently with changes in between representing only minor changes to the curriculum.

A number of program changes have occurred in the past five years since the last self-study:

EAC/ABET Accreditation (effective October 2001). The most significant change since the last self study is, of course, the accreditation of the program through EAC/ABET.

Elevation to program level (September 2004). Prior to 2004, PSE offered a single bachelor's program with two options: the Science Option and the Engineering Option. Only the Engineering Option was accredited through EAC/ABET. This accreditation at the option level caused some concern within the system at SUNY, which caused some difficulty with the registration process at the state level. To alleviate this concern and to better differentiate between the two paper-related curricula offered, the options were elevated to separate programs, with the curricula remaining the same. Thus, the Faculty now offers two programs: Paper Engineering and Paper Science. This has allowed us to more clearly differentiate between the two programs.

Addition of unit operations laboratories (ongoing). Through discussions with the students, feedback from employers (summer and permanent), and discussion amongst the faculty, it was decided that several of the engineering classes would benefit from unit operations laboratories. Several supervisors from the summer internships have commented on the fact that the students need more "practical" experience. As a Faculty, we recognize that theory is reinforced when the concepts are put into practice. The results of this effort have been seen in the courses listed below:

1. PSE 371 (Fluid Mechanics): pump efficiencies; friction loss calculations
2. PSE 372 (Heat Transfer): heat exchanger calculations; heat transfer coefficients
3. PSE 477 (Process Control): process control simulations

These laboratories would allow students to put into practice the theory learned in the classroom concurrently with the course lectures. Students use the classroom theory in practice in two of their upper division courses: PSE 468 (Papermaking Processes) and PSE 481 (Engineering Design), the two capstone design courses. In the first course, for example, students are involved with heat transfer calculations in the dryer section of a paper machine and process control simulations around a paper machine headbox. Depending on the project assignment in PSE 481, students will draw on their knowledge to accomplish their design project. We are continuing this process of implementing practical unit operations laboratory experiences as detailed in the upcoming changes in the curriculum listed below.

Finally, a number of curricular changes have recently been approved and are being implemented beginning with the students entering the program in September 2006 and later. The changes include:

1. PSE 361 (Engineering Thermodynamics) moved from the fall semester to the spring semester. This move is consistent with most engineering programs that teach thermodynamics. Our teaching this course in the junior year is a holdover from being an upper division program. In addition, this move from fall to spring would allow Forest Engineering students to take this course, potentially consolidating two thermodynamics courses into one.
2. ERE 440 (Water Pollution Engineering) moved from the spring semester to the fall semester where it is already offered. This move will allow an improvement in the teaching efficiency of courses.
3. PSE 372 (Heat Transfer) and PSE 473 (Mass Transfer) are replaced by BPE 335 (Transport Phenomena) and PSE 436 (Unit Operations) to coordinate with the new courses being offered in conjunction with the Bioprocess Engineering program. In addition, this will allow the second course, PSE 436, to better address the concerns of employers and students that they need a certain amount of practical knowledge on unit operations.
4. Three science courses are grouped, with students needing to take two of the three, allowing some flexibility in the program based on feedback from students. In addition, the categorization of courses allows additional courses to be made available with minimal changes necessary in the curriculum itself.
5. Five engineering courses are grouped, with students needing to take four of the five, allowing some flexibility in the program.

Review Materials Available

The following material will be available for review at the time of the visit.

1. SUNY-ESF College Catalogs (current and past)
2. Syracuse University Undergraduate Bulletin (current)
3. ESF Student Handbook
4. PSE Student Handbook Supplement
5. PSE Advisors Handbook
6. Course Notebooks/Textbooks including Faculty Course Assessment Reports
7. Assessment Notebooks including Program Outcome Assessment Reports
8. Evaluation Notebooks including Program Objective Evaluation Reports
9. Computer with web-based information

10. General Education Program Description
11. General Education Assessment Methods

Summary

The program is well satisfying both the specific Program Outcomes to Paper Engineering as well as the ABET ‘a-k’ as demonstrated above. The improvements in the assessment of the outcomes since the last self-study has made the entire process much more systematic. Much of the effort in assessment has been systematized in a series of reports that can be produced at the end of each semester and builds on the comments received during the previous accreditation visit. In addition, the feedback received through the assessment process as well as through other mechanisms has led to improvements in the curriculum that will be implemented starting in the 2006-07 academic year. We are currently in the middle of an ongoing revision process for the outcomes and objectives of the program.

4. Professional Component

Describe how the engineering faculty assures that the curriculum devotes adequate attention and time to each curricular component area and describe how students are prepared for engineering practice as required by Criterion 4.

Note that instructional material and student work verifying the proper classification of course content must be provided for the evaluation team at the time of the visit. These materials may include all or part of the documentation used to demonstrate Program Outcomes and Assessment.

As a minimum:

Describe how students are prepared for engineering practice through the curriculum, which culminates in a major design experience.

Describe how the engineering experience incorporates engineering standards and realistic constraints as described in Criterion 4.

Describe how the program curriculum devotes adequate attention and time to the professional component, which includes mathematics and basic sciences, engineering topics, and general education. Note that transcript analyses for a sampling of recent graduates will be requested by the team chair prior to the visit.

The information contained in Appendix I presents supporting documentation and will be useful to the evaluation process.

Complete Table I-1, *Basic-Level Curriculum*. List the courses in the order in which they are given in the curriculum and classified in the appropriate categories to clearly indicate how the program meets the Professional Component (Criterion 4) as well as Program Criteria (Criterion 8).

Complete Table I-2, *Course and Section Size Summary*.

In Appendix I.B., *Course Syllabi*, provide standard descriptions for courses used to satisfy the mathematics and basic sciences, and engineering topics required by Criterion 4. The format should be consistent for each course, must not exceed two pages per course, and, at a minimum, contain the information listed below:

The Faculty has expended considerable effort in developing and improving the Paper Engineering program. Proposed changes to the curriculum go through a well-established processes at SUNY-ESF. Curriculum matters are discussed in PSE Faculty Committees, Faculty retreats and regular Faculty meetings. We also participate in campus activities and workshops on teaching, learning, and research, as well as coordinate our efforts with the other engineering units at ESF.

The first section following describes the curriculum offered during the 2005-2006 academic year. This curriculum applies to all students entering as first-year students beginning in the Fall 2001 semester and includes the SUNY-wide General Education requirements. In all cases, students are governed by the catalog under which they matriculated. The changes that were approved during the past academic year will take effect in the 2006-2007 academic year. The second section describes the processes that are in place to change courses and curriculum. These processes assure that curricula at SUNY-ESF are changed only under the strictest of review policies.

2005-2006 Curriculum

Table 42 summarizes the courses taken by a student who enters the program as a first-year student during the 2005-2006 academic year by broad categories. This is the curriculum that has been in place since the 2001-2002 academic year. Table IA in the appendix breaks down the curriculum on a course-by-course basis. Both these tables show that the curriculum meets the minimum credit hours set by the EC2000 criteria. The curriculum includes 51 credits of math and basic science (36.4% of total credits) compared to the minimum of 32 credits (or 25% of total credits). The curriculum also includes 57 credits of engineering and engineering science courses (40.7% of the total) compared to the minimum of 48 credits (37.5% of the total). In addition, the general education component includes at least 16 credits of humanities and social sciences as required by EC2000. Table 47 represents a "typical" schedule for a student entering as a first-year student. There is some flexibility in the sequencing of the general education courses, allowing students to take the courses that they need or that can be fit into their schedule.

Approximately one-third of the students participate in the co-op program. Students participating in the co-op program typically work for a summer and an adjacent semester (either spring and summer *or* summer and fall) for a total work period of seven months. This does, however, usually necessitate the student going to college for a total of five years (including the work experience) in order to finish the program. The student benefits in three ways in participating in a co-op:

- the student gains valuable work experience in a real-life engineering setting;
- the student earns money while working for the company (typically $10-18 per hour depending on experience and class level);
- the student's course schedule is spread out over nine semesters rather than eight, thus lightening the course load.

Students obtain co-op positions through an interview process that starts in the fall of each year. Company representatives interview students on campus, thus making it convenient for the students to obtain the positions that they want. Within the limitations of the companies that interview and the locations that are available, accommodations are attempted for those student that have geographical restrictions.

Table 42. Summary of 2005-2006 Paper Engineering curriculum.

1. Math and Basic Science	**51 credits**
Calculus through differential equations	15 credits
Probability and statistics	3 credits
Inorganic chemistry (with laboratory)	8 credits
Organic chemistry (with laboratory)	8 credits
Physical chemistry	6 credits
Quantitative analysis (with laboratory)	3 credits
Calculus-based physics (with laboratory)	8 credits
2. General Education	**39 credits**
Math and Science[1]	12 credits
Other learning outcomes (includes humanities and social science)	21 credits
Technical writing and research	3 credits
Information management	3 credits
3. Other courses	**5 credits**
Engineering graphics	1 credit
Wood properties	3 credits
Orientation	1 credit
4. Engineering courses (without design)	**31 credits**
Introduction	4 credits
Technology and engineering courses	14 credits
Process control	3 credits
Environmental engineering	3 credits
Other engineering disciplines	7 credits
5. Engineering course (with design)	**20 credits**
Engineering calculations	3 credits
Engineering thermodynamics	3 credits
Transport phenomena	9 credits
Design economics	3 credits
Internship	2 credits
6. Capstone design courses	**6 credits**
Engineering design	3 credits
Papermaking processes	3 credits
Total Credit Hours	**140 credits**

[1]Also counted in Math and Basic Science

General Education Requirements

The Board of Trustees of the State University of New York requires all SUNY campuses to implement a General Education program for all students of at least 30 credit hours. SUNY-ESF has implemented General Education guidelines, which each academic unit adopted and as a results modified their undergraduate program to accommodate the requirements. We have determined that meeting the General Education Program fulfills the ABET requirements for Humanities and Social Sciences.

The SUNY Board of Trustees identified ten Knowledge and Skills Areas and two Competency Areas. The Board of Trustees has granted SUNY-ESF a waiver for one of these areas, Foreign Language, due to the specialized and focused nature of the programs at SUNY-ESF. Of the Knowledge and Skills Areas, the nine required at SUNY-ESF are:

1. Mathematics
2. Natural Sciences
3. Social Sciences
4. American History
5. Western Civilization
6. Other World Civilizations
7. Humanities
8. The Arts
9. Basic Communication

The two Competency Areas are:

1. Critical Thinking
2. Information Management

To fulfill the General Education Requirements in Paper Engineering at ESF, each student will demonstrate knowledge and competency in the listed Knowledge and Skills Areas in at least 27 hours of coursework. Students need to take at least one three-credit course in each of the nine areas. By necessity, Knowledge and Skills areas 1, 2, 3, 7, and 9 have specific courses that are otherwise required for the program that satisfy these requirements. For areas 4, 5, 6, and 8, students can choose from a list of courses published in the college catalog and the student handbook. Areas 3, 4, 5, 6, 7, 8 collectively satisfy the ABET requirement for humanities and social sciences. Table 44 outlines the implementation of the SUNY General Education requirements for the Paper Science and Engineering programs. Satisfying the SUNY General Education requirements also supports the learning outcomes for the Paper Science and Engineering Program. Table 45 outlines the correspondence between the General Education requirements and the learning outcomes discussed in Criterion 3.

The College assesses the General Education Program in a college-wide process. The assessment is overseen by the Provost’s Advisory Council on Effectiveness (PACE). For each of the competency areas, specific outcomes have been determined. Table 43 summarizes these outcomes. It must be remembered that many of these courses are taken at Syracuse University. Close coordination is required to assure that the outcomes are being met. Supporting material regarding the General Education Assessment Methods will be available at the time of the visit.

Competency area 1 is integrated throughout the curriculum while competency area 2 is addressed by a first-year computing methods course (APM 153), and information literacy course (ESF 200), as well as being integrated throughout the rest of the curriculum. In addition, the competency areas are in concurrence with the Program Outcomes for the program discussed in Criterion 3. Table 46 maps the Competency Areas to the Program Outcomes.

Table 43. Learning Outcomes for General Education Courses.

Knowledge Area	Learning Outcome
1. Mathematics	Students will show competence in the following quantitative reasoning skills: • Arithmetic; • Algebra; • Geometry; • Data analysis; and • Quantitative reasoning.
2. Natural Sciences	Students will demonstrate: • Understanding of the methods scientists use to explore natural phenomena, including observation, hypothesis development, measurement and data collection, experimentation, evaluation of evidence, and employment of mathematical analysis; and • Application of scientific data, concepts, and models in one of the natural sciences.
3. Social Sciences	Students will demonstrate: • Understanding of the methods social scientists use to explore social phenomena, including observation, hypothesis development, measurement and data collection, experimentation, evaluation of evidence, and employment of mathematical and interpretive analysis; and • Knowledge of major concepts, models and issues of at least one discipline in the social sciences.
4. American History	Students will demonstrate: • Knowledge of basic narrative on American history: political, economic, social, and cultural, including knowledge of unity and diversity in American society; • Knowledge of common institutions in American society and how they have affected different groups; and • Understanding of America's evolving relationship with the rest of the world.
5. Western Civilization	Students will demonstrate: • Knowledge of the development of the distinctive features of the history, institutions, economy, society, culture, etc., of Western civilization; and • Relate the development of Western civilization to that of other regions of the world.

6. Other World Civilizations	Students will demonstrate: • Knowledge of either a broad outline of world history, or • The distinctive features of the history, institutions, economy, society, culture, etc., of one non-Western civilization.
7. Humanities	Students will demonstrate: • Knowledge of the conventions and methods of at least one of the humanities in addition to those encompassed by other knowledge areas required by the general education program.
8. The Arts	Students will demonstrate: • An understanding of at least one principal form of artistic expression and the creative process inherent therein.
9. Basic Communication	Students will: • Produce coherent texts within common-level written forms; • Demonstrate the ability to revise and improve such texts; • Research a topic, develop an argument, and organize supporting details; • Develop proficiency in oral discourse; and • Evaluate an oral presentation according to established criteria.
Competency Area	
1. Critical Thinking	Students will: • Identify, analyze, and evaluate arguments as they occur in their own or others' work; and • Develop well-reasoned arguments.
2. Information Management	Students will: • Perform the basic operations of personal computer use; • Understand and use basic research techniques; and • Locate, evaluate and synthesize information from a variety of sources.

Table 44. Implementation of General Education Requirements for Paper Science and Engineering.

Knowledge Area	Courses Satisfying Requirement
1. Mathematics	Calculus I, II (MAT 285, 286)
2. Natural Sciences	General Chemistry I, II (FCH 150, 151, 152, 153) Organic Chemistry I, II (FCH 221, 222, 223, 224) General Physics I, II (211, 221, 212, 222)
3. Social Sciences	Introduction to Economics (FOR 207)
4. American History	Elective*
5. Western Civilization	Elective*
6. Other World Civilization	Elective*
7. Humanities	Writing, Humanities, and the Environment (CLL 290)
8. The Arts	Elective*
9. Basic Communication	Writing and the Environment (CLL 190)
Competency Area	
1. Critical Thinking	Integrated throughout curriculum including other General Education courses
2. Information Management	Information Literacy (ESF 200), Computing Methods for Engineers and Physical Scientist (APM 153), integrated in program courses.
*Electives chosen from an approved list in conjunction with the academic advisor. This list appears in the College Catalog and PSE Student Handbook Supplement.	

Table 45. Correspondence between Knowledge and Skills Area and Program Outcomes.

Knowledge Area	Supported Learning Outcome
1. Mathematics	1. a sound knowledge of science and engineering as applied to paper science and engineering
2. Natural Sciences	
3. Social Sciences	8. a knowledge of the broad, contemporary issues facing the engineer in global and societal contexts
4. American History	
5. Western Civilization	
6. Other World Civilization	
7. Humanities	
8. The Arts	
9. Basic Communication	5. well-developed written and oral communication skills

Table 46. Correspondence between Competency Areas and Program Outcomes.

Competency Area	Supported Program Outcome
1. Critical Thinking	2. the ability to conceptualize problems in terms of unifying principles, design and conduct experiments, and analyze and interpret data
2. Information Management	3. the ability to solve a real engineering problem in a team environment using appropriate design techniques 4. an ability to engage in life-long learning 5. well-developed written and oral communication 6. the ability to work in an industrial position within the pulp, paper, or allied industries

Relationship to Curriculum of Previous Years

The curriculum requirements of the Paper Engineering program continuously evolve to meet our constituents' needs. In order to graduate, students must meet the requirements that are published in the catalog at the time that they first enter the Paper Engineering Program. Students may elect, if they choose, to fulfill the requirements of that catalog or the current catalog. They may not, however, pick and choose between the requirements of two catalogs nor change to an earlier catalog. Thus, at any particular time, different students may be required to meet different requirements in order to graduate. The curriculum plan sheets are used to keep track of a particular student's requirements for graduated based on their date of entering the program. Table 49 gives an overview of the changes in the curriculum over the past several years and subsequent sections detail the specific changes that were made and the driving factors involved in the changes.

Relationship to Other Programs in the Faculty

The Paper Engineering program is one of two programs offered by the Faculty of Paper Science and Engineering at SUNY-ESF. The other program, Paper Science tends to be more chemistry and technology oriented and it not being sought for accreditation by ABET. The Science Program consists mainly of chemistry, engineering, and specialized courses relating to the manufacture and use of pulp and paper products. The technical elective concentration allows the student to select a subject area of interest in which to specialize. This program prepares the student for careers in the technical management or technical representative areas with opportunities to extend interests in other directions. Table 48 depicts a typical four-year curriculum for the science program. Table 49 summarizes and compares the two programs.

Table 47. Paper Engineering curriculum.

Fall			Spring		
	Freshman				
FCH 150	General Chemistry Lecture I	3	PHY 211	General Physics	3
FCH 151	General Chemistry Lab I	1	PHY 221	General Physics Lab	1
MAT 295	Calculus I	4	FCH 152	General Chemistry Lecture II	3
CLL 190	Writing and the Environment	3	FCH 153	General Chemistry Lab II	1
PSE 132	PSE Orientation Seminar	1	MAT 296	Calculus II	4
	General Education	3	APM 153	Computing Methods	3
	General Education	3	ERE 225	Engineering Graphics	1
			FOR 207	Introduction to Economics	3
		18			19
	Sophomore				
FCH 221	Organic Chemistry I	3	FCH 223	Organic Chemistry II	3
FCH 222	Organic Chemistry Lab I	1	FCH 224	Organic Chemistry II Lab	1
MAT 397	Calculus III	4	PHY 212	General Physics II	3
PSE 300	Intro to Papermaking	3	PHY 222	General Physics II Lab	1
PSE 302	Pulp and Paper Laboratory Skills	1	APM 485	Differential Equations	3
PSE 370	Principles of Mass and Energy Balances	3	CLL 290	Writing, Humanities, and the Environment	3
	General Education	3		General Education	3
		18			17
	Junior				
FCH 380	Analytical Chemistry I	3	FCH 361	Physical Chemistry II	3
FCH 360	Physical Chemistry I	3	WPE 386	Structure and Properties of Wood	2
PSE 361	*Engineering Thermodynamics*	*3*	WPE 390	Fiber Identification Laboratory	1
PSE 371	Fluid Mechanics	3	PSE 350	Pulping and Bleaching Processes	3
CLL 405	Writing for Science Professionals	2	PSE 351	Pulping and Bleaching Laboratory	2
ESF 200	Library Research	1	PSE 372	Heat Transfer	3
			PSE 480	Engineering Design Economics	*3*
		15			17
	Summer				
PSE 304	Summer Mill Experience	2			
		2			
	Senior				
PSE 465	Paper Properties	4	PSE 467	Papermaking Wet End Chemistry	3
PSE 473	Mass Transfer	3	PSE 466	Paper Coating and Converting	2
PSE 477	Process Control	3	PSE 468	Papermaking Processes	3
ERE 223	Statics and Dynamics	*4*	ERE 440	Water Pollution Engineering	3
PSE 481	Engineering Design	*3*	*APM 395*	Probability and Statistics for Engineers	*3*
				*Other Engineering Elective	*3*
		17			17

		*Other *Engineering Elective*	
TOTAL CREDITS	140	Student must take 1 of the following:	
Lower Division	72	ELE 231 Electrical Science I	3
		ERE 362 Mechanics of Materials	3

Table 48. Paper Science curriculum.

Freshman

Fall			Spring		
FCH 150	General Chemistry Lecture I	3	PHY 211	General Physics	3
FCH 151	General Chemistry Lab I	1	PHY 221	General Physics Lab	1
MAT 295	Calculus I	4	FCH 152	General Chemistry Lecture II	3
CLL 190	Writing and the Environment	3	FCH 153	General Chemistry Lab II	1
PSE 132	PSE Orientation Seminar	1	MAT 296	Calculus II	4
	General Education	3	APM 153	Computing Methods	3
	General Education	3	ERE 225	Engineering Graphics	1
			FOR 207	Introduction to Economics	3
		18			19

Sophomore

Fall			Spring		
FCH 221	Organic Chemistry I	3	FCH 223	Organic Chemistry II	3
FCH 222	Organic Chemistry Lab I	1	FCH 224	Organic Chemistry II Lab	1
MAT 397	Calculus III	4	PHY 212	General Physics II	3
PSE 300	Intro to Papermaking	3	PHY 222	General Physics II Lab	1
PSE 302	Pulp and Paper Laboratory Skills	1	APM 485	Differential Equations	3
PSE 370	Principles of Mass and Energy Balances	3	CLL 290	Writing, Humanities, and the Environment	3
	General Education	3		General Education	3
		18			17

Junior

Fall			Spring		
FCH 380	Analytical Chemistry I	3	FCH 361	Physical Chemistry II	3
FCH 360	Physical Chemistry I	3	WPE 386	Structure and Properties of Wood	2
PSE 371	Fluid Mechanics	3	WPE 390	Fiber Identification Laboratory	1
CLL 405	Writing for Science Professionals	2	PSE 350	Pulping and Bleaching Processes	3
ESF 200	Library Research	1	PSE 351	Pulping and Bleaching Laboratory	2
	**Technical Elective*	*3*	PSE 372	Heat Transfer	3
		15			14

Summer

PSE 304	Summer Mill Experience	2
		2

Senior

Fall			Spring		
PSE 465	Paper Properties	4	PSE 467	Papermaking Wet End Chemistry	3
PSE 473	Mass Transfer	3	PSE 466	Paper Coating and Converting	2
PSE 477	Process Control	3	PSE 468	Papermaking Processes	3
	**Technical Elective*	*3*	ERE 440	Water Pollution Engineering	3
	**Technical Elective*	*3*		**Technical Elective*	*3*
		16			14

**Technical Elective*

TOTAL CREDITS	133
Lower Division	72

Minor Areas of Study

The college currently offers several minor areas of study. Students in both Paper Engineering and Paper Science can take minors at SUNY-ESF. Participation in the minor programs requires students to carefully plan their curriculum, especially in the upper division. All minors require some special courses that may only be offered at certain times of the year. In addition, the Business Management Minor is taught in conjunction with the Management Program at Syracuse University. At the time of application to a minor, the student should indicate that course that he or she is intending to take to satisfy the minor as well as when these courses will be taken. With this proper planning, the Management School will help facilitate getting seats in these highly sought after classes.

Business Management Minors. The management minor was developed primarily for the Paper Science program by concentrating the electives in management-specific courses, but can also be taken by Paper Engineering students. The student combines a strong technical background with a firm base in management. The student should have completed a course in microeconomics and an accounting course prior to entering the junior year. The details and requirements of the Business Management Minor are found in the College Catalog.

Urban Environmental Science Minor. While many people often associate the environment with wild lands and linked rural areas, many of the most important environmental and quality of life issues of the coming decades will be related to the urban environment. ESF offers a campus-wide minor in urban environmental science. All students, but perhaps especially those with an intimate knowledge of the challenges facing city inhabitants, will find this program stimulating and provocative---and will find professors interested in working with them to learn about and develop improved urban environments. Graduates of the program can make important professional contributions on issues ranging from urban forestry and urban wildlife, to urban air and water quality, population growth and urban sprawl, and environmental justice and equality. Specifically for the paper industry, many of the newer recycled paper mills (for example, Solvay Paperboard here in Syracuse) are being located in urban areas to be near their concentration of raw materials. The details of the minor can be found in the college catalog.

Computer and Information Technology Minor. The Computer and Information Technology Minor is available to all ESF undergraduate students maintaining a minimum cumulative GPA of 2.8, who desire to develop greater skills in computer science and information technology applications. Through an understanding of the basic principles behind software development, a student can more effectively use these tools in their chosen fields. The required courses in the minor represent core knowledge of computer science and information literacy while the electives allow the student to focus on a particular aspect of the technology. An understanding of a high level programming language and calculus is necessary for many of the electives offered as part of this minor. The details of the minor can be found in the college catalog.

Construction Management Minor. The construction management minor is available to all ESF undergraduates and prepares students for management careers in the construction industry. The basic objective of the minor is to provide a fundamental understanding of the various methods used to take a design into the field and build a quality structure in the most efficient and effective manner with minimal environmental impacts. Eighteen credit hours (6 courses) are required to complete the minor. Four courses are required, with an additional two courses selected from the list of five courses elective courses. A cumulative grade point average of 2.0 or higher is required for the construction management courses. Admission to the minor requires sophomore status, a cumulative grade point average of 2.5 or higher, and permission of the Construction Management and Wood Products Engineering faculty chair. The details of the minor are given in the college catalog.

Table 49. Summary of Programs in Paper Science and Engineering.

	Paper Science	Paper Engineering	Paper Science + Minor
Credit Hours (1999 and before)	137	153	140
Credit Hours (2000)	134	148	140
Credit Hours (2001)	133	140	133-136
Credit Hours (2002-2005)	133	140	133-139
Credit Hours (2006 and after)	132	140	132-136
Semesters for graduation	8	8	8
Specialized Upper Division Courses Required	12 credits of technical electives	19 credits of engineering courses	12-18 credits of approved courses
Summer internship required	Yes	Yes	Yes
Co-op required	No	No	No
Co-op possible	Yes	Yes	Yes

Relationship of courses to program outcomes

The courses and specific instructional activities therein need to support the learning outcomes of the program. Information in the Criterion 2 section cross-references the learning outcomes with all the courses in the curriculum. Table 50 provides information regarding the specific instructional activities in various courses that help achieve the program outcomes. Please note that this table does not attempt to list all the instructional activities in a course that support the outcomes but is given to provide an overview of the integration of the curriculum with respect to the program outcomes. Greater details of the specific courses are given in the course syllabi in the appendix and in the course notebooks that will be available at the time of the visit.

Table 50. Paper Engineering program outcomes and illustrations of specific instructional activities to support and achieve outcomes.

Program Outcome	Course(s) / Instructional Activity
1. a sound knowledge of science	The mathematics, chemistry, physics, and other

and engineering as applied to paper science and engineering (sound knowledge);	science courses at the lower division provide the technical background for subsequent engineering courses. The following upper division courses build on those science fundamentals: FCH 360/361 (Physical Chemistry I, II) WPE 386 (Fiber Identification Laboratory) WPE 390 (Structure and Properties of Wood) PSE 300 (Introduction to Papermaking) PSE 350 (Pulping and Bleaching Processes) The fundamentals of engineering are given in the following courses: APM 153 (Computing Methods for Engineers…) PSE 132 (PSE Orientation) PSE 350 (Pulping and Bleaching Processes) PSE 351 (Pulping and Bleaching Laboratory) PSE 370 (Principles of Mass and Energy Balances) PSE 371 (Fluid Mechanics) PSE 372 (Heat Transfer) PSE 473 (Mass Transfer) PSE 465 (Paper Properties) PSE 466 (Coating and Converting) PSE 467 (Wet End Chemistry) PSE 477 (Process Control) PSE 480 (Engineering Design Economics) PSE 361 (Engineering Thermodynamics) FCH 360/361 (Physical Chemistry I/II) ERE 223 (Statics and Dynamics) ERE 225 (Engineering Graphics) ERE 440 (Water Pollution Engineering) ELE 231 (Electrical Science I) ELE 394 (Electrical Engineering Laboratory) ERE 362 (Mechanics of Materials)
2. the ability to conceptualize problems in terms of unifying principles, design and conduct experiments, and analyze and interpret data (conceptualize);	The lower division laboratory courses (Chemistry and Physics) give students the basic knowledge of experimental design, execution, and data interpretation. Subsequent upper division courses build on that foundation. APM 153 (Computing Methods for Engineers…): Students must design and test algorithms for problems based on basic engineering and scientific principles.

	APM 395 (Engineering Statistics): Students analyze data to determine the significance of data FCH 360/361 (Physical Chemistry I/II): Many basic principles are taught that are built on in later classes. FCH 380 (Analytical Chemistry): The final results or end-points are a result of basic chemistry, e.g., acid-base and oxidation-reduction reactions. ERE 440 (Water Pollution Engineering): Homework problems; design projects in which students design experiments, take data, and analyze results. PSE 302 (Pulp and Paper Laboratory Skills): Students understand the testing methods involved in papermaking and the rationale behind the methods. PSE 350 (Pulping and Bleaching Processes): On completion of the course the students understand the raw material and type of pulping process to produce a specific type of fiber and further, the impact of the pulping process variables on the fiber properties. They also understand the rationale behind using various process sequences, e.g. in pulp bleaching. PSE 351 (Pulping and Bleaching Laboratory): Laboratory is experimental and requires analysis and interpretation of data. PSE 465 (Paper Properties): Sections of the laboratory component of this course are intended to provide structured experimental analysis of various chemical and mechanical properties of paper. Selected laboratories require the student to develop an experimental plan to determine the composition and process of an unknown product. PSE 467 (Wet End Chemistry): Wet End Chemistry encompasses the concepts of interface and colloidal science and thermodynamics. PSE 473 (Mass Transfer): The kinetic theory of gases is used as the foundation in teaching gas phase diffusion. The basis for the mathematical similarities in momentum, heat, and mass transfer is explored.

	PSE 465 (Paper Properties): Students investigate the properties of paper and the effect of raw material on the ultimate sheet properties. PSE 468 (Papermaking Processes): Students must interpret machine data in terms of unit operations and fundamental engineering principles PSE 480 (Engineering Design Economics): One major project involving the application of principles learned in class to the economic analysis of the pulp and paper industry or a process design problem.
3. the ability to solve a real engineering problem in a team environment using appropriate design techniques (team problem solving);	ERE 225 (Engineering Graphics): Students work on a project as a team. Ere 440 (Water Pollution Engineering): Design of clarifier, activated-sludge system in class projects, often working in teams of two. PSE 302 (Pulp and Paper Laboratory Skills): Students perform various laboratory exercises in student teams. PSE 304 (Summer Internship): Students work in an industrial environment, which often involves teams consisting of both peers and supervisors. PSE 351 (Pulping and Bleaching Laboratory): Laboratory exercises and reports are done in teams, including setting of desired outcomes. PSE 371 (Fluid Mechanics): Student laboratory exercises are team efforts. PSE 372 (Heat Transfer): Laboratory experiments deal with practical, industry-related problems such as obtaining the maximum heat flow. PSE 473 (Mass Transfer): The use of realistic design problems reinforces the concepts of the class. PSE 465 (Paper Properties): Laboratories are conducted in 4 to 5 person teams. Reports from the individuals are required, as are collaborative group reports. PSE 468 (Papermaking Processes): The entire class forms a team to run our pilot-scale paper machine. Sub-teams are formed by the students as needed during the semester. The team organization is determined by the students. PSE 481 (Engineering Design): Students work

	in design teams of 2 to 3 students.
4. an ability to engage in life-long learning (life-long learning);	Many classes only touch on the introduction to the subject being taught, especially in the engineering fields. For example, in PSE 372 (Heat Transfer), the basic theories of gas kinetics, flux, driving force, and resistance should prepare the students to study other transport phenomena on their own. The following classes open the door to future learning in a field: PSE 371 (Fluid Mechanics) PSE 372 (Heat Transfer) PSE 473 (Mass Transfer) Other courses explicitly address the issues of life-long learning. PSE 304 (Summer Mill Experience): Students engage in project work at industrial settings which require self-study of the processes involved ESF 200 (Information Literacy): Students learn how to find and use information sources in databases to augment the information given in classes. PSE 468 (Papermaking Processes): Students must obtain information from mills and suppliers to support their work on developing the paper grades. Students also interact with representatives of supplier companies in a similar manner in which they will do in industry.
5. well-developed written and oral communication skills (communication);	Writing and communication are integrated throughout the curriculum. Many of the lower-division laboratory courses require preparation of laboratory reports. In addition, several courses specifically address writing: ESF 200 (Information Literacy): Students write reports based on a review of the literature for a specific topic in papermaking. CLL 190 (Writing and the Environment): Students write papers. CLL 290 (Writing, Humanities, and the Environment): Students write reports on topics related to the environment. CLL 405 (Writing for Science Professional): Students write and present a paper on a topic germane to Paper Science and Engineering

	Many upper division courses include both written and oral expression of answers or laboratory work. For example: APM 153 (Computing Methods…): Students must write and document several computer programs. ERE 225 (Engineering Graphics): Preparation of Engineering Drawings. PSE 132 (PSE Orientation): As part of the Fall semester portion of the class students must develop a resume. In many cases this is the first time that the student has used this form of communication. In addition the students are exposed to proper techniques of interviewing for jobs. PSE 350 (Pulping and Bleaching Processes): Primarily as part of the examination process, students learn that good written communication skills are absolutely necessary to convey their comprehension of the course material and concepts to the instructor. PSE 351 (Pulping and Bleaching Laboratory): Laboratory reports are well-structured and evaluated critically with feedback and the ability to improve included. PSE 370 (Principles of Mass and Energy Balances): Students must clearly explain in both written and oral form the answers to problems. PSE 465 (Paper Properties): The students present written laboratory reports and homework. Examinations generally require communication through long answers. Oral presentations are given as a group in at least one of the lab activities. PSE 466 (Coating and Converting): Examinations generally require communication through long answers. PSE 468 (Papermaking Processes): Oral presentation and written report of semester-long design project. PSE 480 (Engineering Design Economics): Written project reports. PSE 481 (Engineering Design): Two progress reports, one final technical design report,

	weekly class presentation, final presentation of the design to the PSE Faculty at end of semester. Other courses that include the evaluation of written work include: ERE 440 (Water Pollution Engineering). PSE 371 (Fluid Mechanics). PSE 372 (Heat Transfer). PSE 473 (Mass Transfer).
6. the ability to work in an industrial position within the pulp, paper, or allied industries (industrial experience);	PSE 304 (Summer Mill Experience): Students work in an industrial position as Engineering Interns. PSE 305 (Co-op Experience): Students work in an industrial position for an extended period as Engineering Interns. PSE 468 (Papermaking Processes): Students are responsible for the entire project, from design to implementation. PSE 481 (Engineering Design): The design projects are conducted in conjunction with a local paperboard mill. Many courses prepare students with the knowledge needed to perform well in industrial positions though the practical knowledge gained by the student. These include: PSE 302 (Laboratory Methods) ELE 231 (Electrical Science I)
7. understand the professional and ethical responsibility of an engineer (ethics);	APM 153 (Computing Methods for Engineers…): The class discusses the ethics of working together and giving proper credit for other people's work. PSE 132 (PSE Orientation): Discussions of the responsibilities of a student and an engineer; professional behavior in terms of resumes, interviewing, and work experiences. PSE 304 (Summer Mill Experience): Instructors discuss appropriate behavior, safety issues, and ethics regarding working at a mill. PSE 372 (Heat Transfer), PSE 473 (Mass Transfer): Ethics and sound logic in process equipment design are stressed. PSE 465 (Paper Properties): In the introductory lecture of the laboratory, the ethics of recording and reporting observations obtained in a lab or industrial setting are discussed. The importance of laboratory or engineering notes are discussed

	in the same session. PSE 467 (Wet End Chemistry): Discussions on environmental issues of colloidal and surface science. PSE 468 (Papermaking Processes): Students take on the role of supervisors and are responsible for evaluations of their peers PSE 480 (Engineering Design Economics): Class discussions of ethics. PSE 481 (Engineering Design): Two or three videos on professional and engineering ethics are shown to the class and discussed. ERE 440 (Water Pollution Engineering): Class discussions on ethical responsibility of an engineer.
8. a knowledge of the broad, contemporary issues facing the engineer in global and societal contexts (contemporary issues).	The SUNY-wide General Education Requirements give students the ability to place technical activities in a broader social and environmental context PSE 304 (Summer Mill Experience): Students working in an industrial setting learn first-hand the issues facing an engineer PSE 305 (Co-op Experience): Students working in an industrial setting for extended periods learn first-hand the issues facing an engineer. PSE 350 (Pulping and Bleaching Processes): The student learns the societal impact of the industry using renewable resources and recycled materials as the process raw materials, having efficient chemical recovery systems, and pursuing environmentally benign pulping and bleaching processes. PSE 466 (Coating and Converting): The international aspects of paper coating are discussed. The differences between segments of the global market, and how it impacts the product and coating process are also discussed. PSE 467 (Wet End Chemistry): Environmental issues are discussed. PSE 480 (Engineering Design Economics): Class discussions of global and societal issues. ERE 440 (Water Pollution Engineering): Class discussions of global and societal issues.

Vertical Integration of Courses

Vertical integration of courses is very important to the curriculum of Paper Science and Engineering. There is, of course, the obvious integration where one course is a prerequisite for a subsequent course. The important sequences of this type include the following:

- Mathematics (Calculus I, II, and III, Differential Equations)
- Chemistry (General Chemistry I and II, Organic Chemistry I and II, Analytical Chemistry)
- Basic Engineering (Principles of Mass and Energy Balances, Fluid Mechanics, Heat Transfer, Mass Transfer)

From a standpoint of keeping students on track for graduation, the critical sequences are the Mathematics sequence leading into the basic engineering sequence. Also important is the Chemistry sequence, which leads into the upper division Pulping and Bleaching courses. Quite often, getting behind in one of these sequences will lead to delayed graduation.

There are, however, other examples of vertical integration in the curriculum, which do not depend strictly on the course prerequisites. These integration threads tend to be more in the lines of specific skills or knowledge that is needed in the course. By necessity, many of these lines of integration lead to the two capstone courses in the curriculum. That is, while certain courses are listed as prerequisites to the capstone courses, we expect students to draw knowledge and skills from all the courses that they have previously taken.

Table 51 summarizes the use of the MATLAB software package throughout the PSE curriculum. Students may also be using it in other courses to solve engineering problems.

Other examples of vertical integration of the curriculum include the integration of knowledge from other classes into the senior level courses. For example, in PSE 468 (Papermaking Processes), students use a simulation of the wet end of a paper machine to investigate the control of a headbox. This requires that the student expand on the concepts learned in PSE 477 (Process Control) regarding single-input, single-output control (SISO) systems to a multiple-input, multiple output (MIMO) system. Using the simulation, students must decide which controlling variables should be used to control various aspects of the headbox system. This exercise, in a senior level class, integrates the knowledge of several courses.

Furthermore, being an engineering discipline, many of the upper division engineering courses draw on the basic knowledge of mathematics, physics, and chemistry. Thus, students are often reminded of how subsequent classes relate to their basic courses. There also exist opportunities for more explicit integration between courses that will be explored to a greater extent in the future. For example, in the fall we will begin to explore greater integration between PSE 465 (Paper Properties) and PSE 468 (Papermaking Process). The paper grades that will be made in PSE 468 will be made available to the students in PSE 465 and exploration of these grades could be incorporated into the laboratory work involved in that class.

Table 51. Use of MATLAB software throughout PSE curriculum.

Course	Activity demonstrating integration

APM 153 (Computing methods for engineers and physical scientists)	Students are introduced to MATLAB and taught structured programming. Students write and run programs in the MATLAB environment
APM 485 (Differential Equations)*	Students use MATLAB differential equation solvers to solve and graph differential equations numerically to supplement their fundamental understanding of differential equations.
PSE 370 (Principles of Mass and Energy Balances)	MATLAB is used to solve systems of equations. SIMULINK is introduced as a dynamic simulator of processes.
PSE 477 (Process Control)	MATLAB and SIMULINK are used to investigate control system dynamics.
PSE 468 (Papermaking Processes)	MATLAB and SIMULINK are used to dynamically model the operation of a paper machine wet end and screening systems.
*Implemented in Spring 2000. Will be re-implemented when faculty positions are filled.	

Capstone Design Courses

The students in the Paper Engineering program at SUNY-ESF take two capstone design courses. PSE 468 (Papermaking Processes) is taken by all Paper Science and Engineering students regardless of the ~~option~~ program that they select. PSE 481 (Engineering Design) is required only of the engineering students but can be taken as an elective by the science program students. The objectives of both courses is to provide a major, semester-long design project near the culmination of the student's curriculum. The experience is based on the knowledge and skills acquired in earlier coursework and practical industrial experience. Teamwork, critical thinking, evaluation, assessment, and process and product design are important facets of both courses, which encourages students to develop skills that will assist them in appreciating the important of life-long learning. PSE 481 and PSE 468 are taken in the fall and spring of the student' senior year, respectively. Greater details of each of the courses are given in the discussion below, in the course syllabi, and in the course notebooks.

PSE 468: Papermaking Processes. In this class, the students are part of a combined planning team representing the Technical Support and Quality Control departments of a paper company. Students are given four grades of paper for which they have to design the product and develop the process to produce this paper within the constraints of our existing paper machines and auxiliary equipment. The assignment involves:

- Developing a project plan to investigate the grades of paper and produce them on the pilot paper machine;
- Researching the literature and contacting manufacturers to determine the specific properties of the assigned products;

- Planning and implementing a laboratory experiment to determine the furnish, testing several alternatives;
- Designing trials on the laboratory paper machine to investigate the process of papermaking with respect to the grades of paper being made;
- Revising the project plan and timetable as necessary based on the laboratory results to meet the goals of the project;
- Appraising the faculty of the process being made through periodic status reports and weekly staff meetings;
- Writing, editing, and revising a final laboratory report and orally presenting and defending the work done to faculty and staff.

The course involves the structured guidance, assessment, and evaluation of the students' work and their progress towards becoming engineers. As much as possible, the environment and the operation of the class are designed to give students a "real world" experience in a team-oriented project. Students are expected to be driven largely by their own initiative: setting schedules and deadlines for reports, assigning work to student teams, arranging pilot plant resources, and communicating progress and difficulties to the faculty. Students receive guidance and advice from both faculty and staff on many aspects of the project including the application of engineering and product design, project management skills, people management skills, and organization.

Assessment and evaluation are done continuously during the semester and takes on several different forms involving many people.

- Instructor and Teaching Assistant Assessment and Evaluation. Student progress is assessed regularly throughout the semester. These assessments are often real-time, occurring orally at the time of the activity. For example, during the staff meetings, suggestions may be made to improve the management of the meeting by the student leader. Feedback is also given in written form in terms of periodic performance evaluations. Instructor assessments may focus on a number of factors including basic knowledge, communication skills, and teamwork strategies. Assessments are made both on an individual basis and a team basis.
- Peer Assessment. Students assess each other by identifying strengths, areas for improvement, and insights into the design process. In this way, each member of the team provides assessments of the other members' contributions to the project's success.
- Peer Evaluation. Each team member evaluates the other team members that they work closely with and this evaluation is factored into that student's final grade for the class. These evaluations are done on a 360^{o} basis, with the student leaders evaluating their team members' contributions and the team members evaluating the leadership qualities and efficacy of the team leaders. With the evaluation guidelines provided, students are exposed to an ongoing system of performance assessment throughout the semester, which helps prepare them for the evaluation process in the industry.
- Oral Presentations. Students give two oral presentations during the semester, one after each of the two large paper machine runs. The presentations are made before an audience of peers, faculty, and staff. After each teams presentation, a question and

answer-type discussion follows to probe the understanding of the team members' contributions to the project. The students are evaluated on their presentation skills, ability to understand and clearly explain their reasoning, and their professional demeanor.

- Design Reports. Two final reports and several interim reports are handed in during the semester. While the final reports are one total report from the entire class (usually divided into sections written by different teams), the interim reports tend to reflect the work of teams of 2 to 6 students. The reports are evaluated based on guidelines and specifications given in class. The reports should document the entire design process.

PSE 481: Engineering Design. At present, Professor Siddharth G. Chatterjee of the PSE Faculty of SUNY-ESF and Dr. Jose Iribarne, Engineering Manager of Solvay Paperboard are instructors in this course. Solvay Paperboard is a linerboard mill located at Solvay, New York. Classes are held at Solvay Paperboard every Monday evening during the fall semester.

This capstone course involves the execution of a major engineering design project (engineering analysis, design and cost/profitability estimation) during the fall semester of the academic year. At the beginning of the semester, depending on the class size, the students are organized into separate design teams generally consisting of two or three students per team. Course requirements, grading policy, open-ended and real-world design problems, and some guidelines for achieving the overall design objectives are given to the students. Each design team is required to maintain an engineering logbook containing all relevant approaches, data, and calculations in an organized fashion. Every week each team submits a brief written summary of its progress over the previous week, discusses their weekly summary in the class, and proposes action plans for the forthcoming week. Exhaustive in-class discussions are conducted and the instructors and the design teams explore future directions for the evolving projects. The results of the work of each design team are summarized in two progress reports during the course of the semester and one technical design report that is submitted near the end of the semester. Each team also makes a presentation of its completed design project to the PSE department and develops a poster of their project at the end of the semester. The formats of the progress and technical design reports, and methods of making technical presentations are supplied by the instructors. It is emphasized to the class that proper planning and scheduling, and equitable division of responsibilities within each team are essential for successful completion of the design project. To make the students understand the professional and ethical responsibilities of an engineer, two or three videos (*Introduction to Applied Ethics and the Professional*, *Engineering Ethics: The Case of Challenger*, and *Ethics and Scientific Research*) are shown to the class and a discussion of the ethical issues involved is conducted

At the end of the semester, a composite grade is calculated for each design team. This grade includes the following: weekly summaries and class presentations (10%), engineering logbook and weekly meetings with instructors (10%), mid-semester progress report #1 (10%), mid-semester progress report #2 (15%), technical design report (45%), and project presentation and poster (10%).

The following design projects have been implemented during the past decade:

- Syphon Upgrades for PM1 and PM2 (Solvay Paperboard, Fall 2005)
- Web-Break Camera System for PM3 (Solvay Paperboard, Fall 2005)

- Redesign of PM2 Light Reject Lines (Solvay Paperboard, Fall 2004)
- Steam Shower in the Press Section of PM1 (Solvay Paperboard, Fall 2004)
- Design of New Doctor Systems for PM1 (Solvay Paperboard, Fall 2004)
- Installation of a Lumpbreaker Roll or a Steam Box over the Couch Roll on PM3 (Solvay Paperboard, Fall 2003)
- Limiting Microbial Growth within the PM3 Starch System of Solvay Paperboard (Solvay Paperboard, Fall 2003)
- PM 3 Blow Boxes Air Filter Upgrade (Solvay Paperboard, Fall 2002)
  Design Evaluation of PM 2 Dryer Section (Solvay Paperboard, Fall 2002)
- L1 Disk Thickener Improvement Project (Solvay Paperboard, Fall 2001)
- L2 Fractionation By-Pass Project (Solvay Paperboard, Fall 2001)
- Heat Exchangers for Paper Machine Showers (Solvay Paperboard, Fall 2000)
- Design of a Second Cooked Starch System (Solvay Paperboard, Fall 1999)
- Design of a Caustic Addition System for the L2 Hydrapurge (Solvay Paperboard, Fall 1999)
- Control Program for Batch Digester (PSE Department, Fall 1998)
- Double Pipe Heat Exchanger (PSE Department, Fall 1998)
- Engineering Design and Cost Estimation of a Multiple-Effect Evaporation System for Concentrating Weak Black Liquor (PSE Department, Fall 1997)
- Re-design of Stock Preparation System in Walters Hall (PSE Department, Fall 1996)
- Design of a DMF Recovery and Purification Plant (PSE Department, Fall 1995)

Curriculum Revision Process

The process to make curriculum and course changes is well defined at SUNY-ESF through faculty governance. Each course taught at SUNY-ESF has an official course description, which is kept on file at the Registrar's office. These course descriptions outline the course title and number, prerequisites, resources needed, credit hours, safety and health concerns, and general course topics. Within these descriptions, instructors are allowed to make changes to the detailed course content as they see fit. However, to make substantial changes beyond the course description requires that the Faculty sponsoring the change go through the process given in Table 52. The purpose of this process is to assure that changes in course content do not adversely affect other programs on campus (for those courses that are shared between Faculties) and that there is consistency between programs in the level of the courses being offered. The forms needed to complete the process can be found on the Committee on Instruction's website at eww.esf.edu/coi. Official course descriptions of all courses pertinent to the Engineering ~~Option~~ Program are given in the appendix.

Table 52. Process of changing courses and curriculum at SUNY-ESF.

Step 1. A faculty member or curriculum committee proposes a new course or a change in existing course (or curriculum).

Step 2. A faculty member completes course change form (Revised and Approved by Faculty in 1997) and submits the proposal through his/her own Faculty review process.

Step 3. The proposal is approved by the sponsoring Faculty.

Step 4. The proposal is sent to the Committee on Instruction (COI) email address, with an initial cover letter that is addressed to other Faculties, Library, Computing Services, ITS, Physical Plant, and Environmental Health & Safety for their comments. COI sends a campus mail to alert all faculty members and support units about the proposal.

Step 5. Faculty members evaluate the proposal and return their comments to their own Faculty Chairs within 2 weeks of the Intranet post date. Faculty Chairs compile aggregate comments and return them to the Chair of the proposing Faculty.

Step 6. Proposal is revised by sponsoring Faculty as necessary.

Step 7. Proposal is forwarded to Chair of COI with a second cover letter that includes the responses to comments received from Faculties and Support Units. Please note the meeting schedule. A representative of the proposing Faculty is invited to represent any proposal at the COI meeting.

Step 8. The COI meets and makes a decision on the proposal. There are three possible outcomes:

a) The proposal is forwarded by the Chair of COI to Executive Chair of Faculty Governance for consideration at next Faculty Meeting (continue to Step 9.); or
b) The proposal is returned to the sponsoring Faculty for revisions (return to Step 6); or
c) The proposal is denied (return to Step 2); or Stop proposal

Step 9. The Proposal is discussed & voted upon at Faculty Meeting where it is:

a) Approved and added to the College Catalog; or
b) Not approved and returned to the sponsoring Faculty

Past curriculum changes

In an effort to continuously improve both undergraduate programs as well as the graduate program, the Faculty has made several changes to the curriculum and the two programs over the past years. Many of these changes were in response to the needs of many of our constituents and through a process of discussion in PSE Faculty committees. In addition, additional changes have currently been approved for implementation in the 2006-07 academic year. The following details the changes that were previously made and gives some of the feedback on the changes after their implementation.

1. Review and revision of prerequisites. In 1999, the Faculty recognized that the prerequisites for courses in the PSE curriculum were sometimes overly prescriptive. This led to an extremely rigid curriculum, which left few options for students going part-time or for students that took a co-op position for a semester. The Faculty critically reviewed the prerequisites for all courses and limited the prerequisites to only those that were necessary for the course. This allows greater flexibility for students taking courses, especially after taking a semester off to work for a co-op as well as allowing students to incorporate minors into their programs with greater ease.

- Since this change, there have been fewer scheduling difficulties with respect to classes. Students returning from a co-op have been able to schedule a sufficient number of classes so that they can continue on track to their degree even though they have missed one semester of courses. As described below, we are continuing this theme of flexibility of coursework with some of the upcoming changes described below.

2. Streamlining of pulping instruction. In 2000, the Faculty reviewed the teaching of pulping and bleaching technology in the curriculum. At that time, several classes touched on the subject of pulping including PSE 300 (Introduction to Papermaking), ERE 496 (Introduction to Pulping and Bleach Chemistry), PSE 301 (Pulp and Paper Processes), and PSE 461 (Pulping Technology). As these courses evolved over the years and different instructors taught them, redundancies slowly worked their way into the curriculum. After evaluating the content of each course, the pulping and bleaching topics were rearranged into three courses to be taken in the sophomore/junior year. One advantage of this arrangement is that the students are taking the laboratory course (PSE 351) and the lecture course (PSE 350) during the same semester. PSE 300 now gives an overview of pulping and bleaching.

- This change has streamlined the educational process and resulted in a more coherent presentation of the necessary material in a more efficient manner. Because of the success of this analysis and changes, we have currently implemented a process of a regular review of all the courses in the curriculum as described below.

3. Addition of pulp and paper laboratory skills course. The PSE program has a very active summer internship and co-op program. Often, we are placing students in summer jobs in the pulp and paper industry after their sophomore year or even after their freshman year in some cases. To make the most effective use of these summer experiences, the student needs a rudimentary understanding of the processes in the industry as well as the common laboratory techniques. Before working in the industry in a technical position, PSE students must have taken both PSE 300 (Introduction to Papermaking) and PSE 302 (Pulp and Paper Laboratory Skills).

The second course, PSE 302, was added in Fall 2000 to assure that students that will be working in the industry have some laboratory skills.

- We are finding that our students are better prepared for their summer internships having had this course. Students are able to step into their duties more quickly with less training needed on the part of the employer.

4. Requirement of orientation course for all students. All PSE students are now required to take PSE 132 (PSE Orientation Seminar). The seminar is a two-part course. The first part is a three-day orientation that is held at a remote campus site in the Adirondacks in May. Most students attend this orientation before starting their first semester at ESF. Using this location as a base, the students tour mills and visit wood harvesting operations. At this time, new students get an orientation to the PSE program, discuss the options available in PSE, and register for courses for the following semester.

The second part of PSE 132 is a weekly meeting with the students during their first Fall semester on campus. At these meetings, students work on their resumes for summer internship interviews, get a safety orientation, learn about the student group available, and learn about available campus resources. The students in PSE 304 (Summer Mill Internship) and PSE 305 (Co-op Experience) also give seminars on their experience.

- Feedback from the students on the three-day orientation program have been generally positive. The students tend to find the mill tours the most helpful as many of them have never been in a paper mill up to this point. They also tend to find the information about the program to be helpful in addition to being able to interact with faculty and staff in an informal setting. Several changes have been made to the orientation program over the past several years, including additional mill tours and a cookout on the last day of orientation.

5. Addition of unit operations laboratories. Through discussions with the students, feedback from employers (summer and permanent), and discussion amongst the faculty members, it was decided that several of the engineering classes would benefit from unit operations laboratories. Several supervisors from the summer internships have commented on the fact that the students need more "practical" experience. As a Faculty, we recognize that theory is reinforced when the concepts are put into practice. The courses targeted were PSE 371 (Fluid Mechanics), PSE 372 (Heat Transfer), PSE 473 (Mass Transfer), and PSE 477 (Process Control).

- We have found that the implementation of these activities have increased the understanding of the students of the basic concepts of fluid mechanics and heat transfer, as well as the use of simulation to investigate the behavior of dynamic systems. Building on this incorporation of practical knowledge into the curriculum, changes in the instruction of transport phenomena will be changing as discussed below.

6. Implementation of general education program. The high value of an ESF undergraduate education is well known. The accomplishments of graduate from its array of programs are remarkable across a wide range of societal need in relatively specialized areas of science, management, and policy, engineering and design. Increasingly, ESF graduates must deal with new knowledge and societal change in a global context. This calls for educational preparation that provides students with knowledge, skills, and competencies that are useful and important for all educated persons regardless of their profession as well as preparation for advanced courses leading to a specific profession. This preparation, termed general education, is a basic component of preparation during the first two years of college, whether at ESF or a transfer college that is implemented in a somewhat different manner by each of the Faculties. Learning outcomes and competencies are fundamental to each of the general education requirements developed by each Faculty. The general education program described is consistent with the ABET humanities and social sciences requirement.

6. Removal of botany requirement. Beginning Fall 2001, EFB 226 (Botany) is no longer required of PSE students. Historically, all students at ESF were required to take Botany. Through Faculty discussions and feedback from students and the SPPF curriculum committee, it was decided that the content of the course did not substantially contribute to the program. The fact that Botany was the only common course among the eight programs at ESF was not a sufficient justification to keep it in the curriculum. Another driving force was a desire to reduce the total number of credits in the program (especially the engineering program) to be more in line with other programs on campus and more consistent with other engineering programs at peer universities. This desire was to reverse a slow increase in the number of credit hours that had been occurring over the past several years.

- Since this change, the missing subject matter of botany has not affected the quality of the program or the graduates.

7. Move PSE 370 to sophomore year. Over the past 10 years, ESF has been increasing its freshman enrollment. Prior to this time, ESF was strictly an upper division college with students taking their freshman and sophomore years at other institutions and then transferring to ESF. With the increasing freshman program (approximately half of the incoming students at ESF now come as freshman, see Criterion 1), some of the engineering and technology courses that needed to be taught at the junior level previously, could now be offered to freshman. Several years ago, PSE 300 (Introduction to Papermaking) was moved back to the sophomore year for those students in residence during that year. Starting in Fall 2001, students that start as freshman or transfer as sophomores will take PSE 370 (Principles of Mass and Energy Balances) during the Fall semester of their sophomore year (provided they have met the prerequisites for the course). This gives students exposure to engineering topics sooner in their college career. Additionally, this is typically when mass and energy balances are typically introduced in engineering programs.

- This change starts the students in their core engineering courses sooner in the program. This has been a very effective change since it makes the students aware of how to do engineering calculations and makes them aware of engineering resources that are available to them earlier in their education. This change has also made the junior year a bit less onerous as it spreads out the technical courses. As described below, these changes that are removing the upper-division vestiges continues in the modifications made below.

8. Four-year engineering program. Prior to 1999, the engineering option was 153 credits and a 9-semester program. During the past three years, the Faculty has worked to revise the curriculum to reduce the credit load to be an 8-semester program. Through many of the changes discussed above, the engineering ~~option~~ program is currently 140 credits. A primary driving force behind this effort was to bring credit parity between the ~~options~~ programs offered in PSE.

Through discussions with students, we learned that many would have considered the engineering program if it did not require an additional semester of college. Currently, the science program is 133 credits compared to the engineering program of 140 credits. If a student also does a minor with the science program, 133 to 139 credits would be required. With this change, we expect to see more students elect the engineering program.

- These changes, together with the advent of EAC/ABET accreditation, have caused a significant change in the proportion of students in the Paper Engineering program as compared to the Paper Science program. This has led us to make significant changes in the Paper Science program to now make that program more appealing to a new cohort of students, particularly those that may be more interested in chemistry or management, for example, but less interested in engineering. These changes will make the differentiation between the Paper Engineering and Paper Science programs much more significant.

2006-07 Curriculum Changes

The Paper Engineering Program (and Paper Science program) undergo continuous review by the Faculty. However, significant changes tend to occur periodically, typically on about a five-year cycle. Recently approved are a number of changes in the Paper Engineering program as described below. These changes will be effective in the 2006-07 catalog. The changes are detailed below:

1. **PSE 361 (Engineering Thermodynamics).** PSE 361 moved from the fall semester to the spring semester. This move is consistent with most engineering programs that teach thermodynamics. Our teaching this course in the junior year is a holdover from being an upper division program. In addition, this move from fall to spring would allow Forest Engineering students to take this course, potentially consolidating two thermodynamics courses into one. This effort builds on the success of the moving of PSE 370 from the junior year to the sophomore year.
2. **ERE 440 (Water Pollution Engineering).** ERE 440 moved from the spring semester to the fall semester where it is already offered. This action will consolidate the offering of this course between the Forest Engineering and Paper Engineering programs resulting in a greater efficiency of instruction.
3. **New Transport Phenomena Sequence**. PSE 372 (Heat Transfer) and PSE 473 (Mass Transfer) are replaced by BPE 335 (Transport Phenomena) and PSE 436 (Unit Operations) to coordinate with the new courses being offered in conjunction with the Bioprocess Engineering program that will be offered starting in Fall 2006. This change continues the effort to reinforce theory with practical experience. PSE 436 will be a laboratory-focused course that will put into practice the theory taught in the transport phenomena course.
4. **Science Electives.** Three science courses are grouped, with students needing to take two of the three, allowing some flexibility in the program.
5. **Engineering Electives.** Five engineering courses are grouped, with students needing to take four of the five, allowing some flexibility in the program. Both of these changes will allow students to tailor their elective offerings to their interest will

allowing the faculty to include new offerings in these two categories without having to make major revisions to the curriculum.

6. **Curriculum Review Process.** We have also recently engaged in a systematized review process of the courses that make up the curriculum. The objectives of this review are to assure that the course objectives for each course are appropriate for the course, that the objectives support the program outcomes, and that the prerequisites for the courses properly prepare students for each course. To accomplish this, the Curriculum Committee of PSE will review one course per meeting starting with the senior level courses and working backwards through the curriculum. We expect that this review will result in improvements in the courses in supporting the programs. Based on the number of courses in the curricula, we expect each course to be reviewed on approximately a three-year cycle.

Table 53 summarizes the curriculum layout for the Paper Engineering program effective with the 2006-07 year.

In addition, we have been strengthening the presentation of the ethical. Leadership, and professional skills component of the education of Paper Engineering and Paper Science students. This was initially done as an experimental course consisting of several modules to cover a variety of these issues and offered by a guest lecturer who is a professional engineer, Dr. William Tully. Following to the success of the modules on a trial basis, the modules are being dispersed throughout the Paper Engineering curriculum. The activity in the PSE 132 class represents an evolution of the ethical training of our students. The ethics module was then implemented in this class on a trial basis with success. It appears that students became aware of the ethical decisions that they may need to make during their career. In the future, this module will be part of the preparation for PSE 304 (Mill Experience). The ethical training will prepare students for their work experience during the summer and will be expected to incorporate a discussion of ethics as it relates to their summer positions in their reports that are due upon return from their internships. The modules on the other professional skills will be incorporated into PSE 481, the engineering capstone design course.

Summary

The discussion in Criterion 4 demonstrates that the curriculum, which culminates in two major capstone design courses, prepares students for engineering practice. As described in Criterion 3, the summer internship is particularly valuable in demonstrating our students' abilities to function as engineers. The design experiences in both PSE 481 and PSE 468 are sufficiently "real-world" like to have the student think about the engineering standards and constraints involved in many engineering decisions, including the necessary for considering such items as long-term planning, economics, and feasibility. This section also describes how the various courses in the curriculum collectively address the professional component of the program. Various modules on the professional skills are being incorporated into the curriculum. Greater details can be found on the professional component in the Course Descriptions in Appendix I.

Table 53. Curriculum layout effective with the 2006-07 academic year.

Paper Engineering Curriculum

Fall 2006

Freshman

Fall			Spring		
FCH 150	General Chemistry Lecture I	3	PHY 211	General Physics	3
FCH 151	General Chemistry Lab I	1	PHY 221	General Physics Lab	1
MAT 295	Calculus I	4	FCH 152	General Chemistry Lecture II	3
CLL 190	Writing and the Environment	3	FCH 153	General Chemistry Lab II	1
PSE 132	PSE Orientation Seminar	1	MAT 296	Calculus II	4
FOR 207	Introduction to Economics	3	APM 153	Computing Methods	3
	General Education	3		General Education	3
		18			18

Sophomore

FCH 221	Organic Chemistry I	3	FCH 223	Organic Chemistry II	3
FCH 222	Organic Chemistry Lab I	1	FCH 224	Organic Chemistry II Lab	1
MAT 397	Calculus III	4	PHY 212	General Physics II	3
PSE 300	Intro to Papermaking	3	PHY 222	General Physics II Lab	1
PSE 302	Pulp and Paper Laboratory Skills	1	APM 485	Differential Equations	3
PSE 370	Principles of Mass and Energy Balances	3	PSE 361	Engineering Thermodynamics	3
ERE 225	Engineering Graphics	1	CLL 290	Writing, Humanities and the Environment	3
	General Education	3			
		19			17

Junior

FCH 380	Analytical Chemistry I	3	WPE 386	Structure and Properties of Wood	2
FCH 360	Physical Chemistry I	3	WPE 390	Fiber Identification Laboratory	1
ERE 440	Water Pollution Engineering	3	PSE 350	Pulping and Bleaching Processes	3
PSE 371	Fluid Mechanics	3	PSE 351	Pulping and Bleaching Laboratory	2
CLL 405	Writing for Science Professionals	2	BPE 335	Transport Phenomena	3
ESF 200	Information Literacy	1	PSE 480	Engineering Design Economics	3
	**Elective*	*3*		General Education	3
		18			17

Summer

PSE 304	Summer Mill Experience	2
		2

Senior

PSE 465	Paper Properties	4	PSE 468	Papermaking Processes	3
PSE 436	Pulp and Paper Unit Operations	3	APM 395	Probability and Statistics for Engineers	3
PSE 481	Engineering Design	3		**Elective*	*3*
	**Elective*	*3*		**Elective*	*3*
	**Elective*	*3*		**Elective*	*3*
		16			15

*Electives include:

Science Directed Electives	6 cr
Engineering Directed Electives	12 cr
Total Electives	**18 cr**
TOTAL CREDITS	**140**

5. Faculty

Demonstrate that the faculty has the competencies to cover all of the curricular areas of the program and show that the faculty is of sufficient number to accommodate student-faculty interaction, advising and counseling, service activities, professional development, and interaction with practitioners and employers, as required by Criterion 5.

As a minimum:

Discuss the adequacy of the size of the faculty and draw conclusions in that regard.

In support of those conclusions, describe the extent and quality of faculty involvement in interactions with students, in advising, in service, in professional development, and in interactions with industry.

Discuss the competence of the faculty members to cover all of the curricular areas of the program and draw conclusions in that regard.

In support of those conclusions, describe the education, diversity of backgrounds, engineering experience, teaching experience, ability to communicate, enthusiasm for developing a more effective program, level of scholarship, participation in professional societies, and registration/licensure as Professional Engineers of the faculty members.

The information contained in Appendix I presents supporting documentation and will be useful to the evaluation process.

Complete Table I-3, *Faculty Workload Summary,* and summarize the course load and other activity for each faculty member for the full academic year in which the Self-Study Report is being written. An updated report for the current year is to be provided at the time of the visit.

Complete Table I-4, Faculty Analysis, which summarizes information about each faculty member.

In Appendix I.C., provide current summary curriculum vitae for all faculty members with the rank of instructor and above who have primary responsibilities for course work associated with the program. Include part-time and adjunct faculty members. The format should be consistent for each curriculum vita, must not exceed two pages per person, and, at a minimum, contain the information listed below:

Size of the Faculty

The Faculty of Paper Science and Engineering currently has eleven full-time faculty members, all of whom have their Ph.D. in a variety of fields. Currently three of the positions are vacant. A fourth position at the M.S. level also remains unfilled since 1999. The Faculty currently uses three part-time faculty members that teach undergraduate courses. The size of the faculty, supplemented by the use of qualified adjunct faculty, is adequate to deliver the current courses necessary for the programs in the Faculty of Paper Science and Engineering. However, as discussed below, the size of the faculty is expected to increase in the near future.

Competence of the Faculty

Since Paper Science and Engineering touches a wide range of fields from chemistry and chemical engineering to silviculture and computer sciences, the faculty needs a wide variety of backgrounds. Table 54 summarizes the degrees held by the full-time instructors of PSE. All instructors have B.S and Ph.D. degrees in appropriate field while most also hold M.S. degrees. As can be seen, we come from a wide variety of backgrounds, not just paper science and engineering. This breadth of background gives students a widely varying perspective on the paper industry and its relationship to other fields. This also emphasizes the fact that the field of Paper Science and Engineering does indeed draw upon many other fields.

Table 54. Number of faculty holding degrees by area of study. Part-time faculty are indicated in parentheses.

Area of Study	B.S./B.A.	M.S.	Ph.D.
Chemical engineering	4 (1)	4 (1)	5 (1)
Chemistry	1 (1)	1 (1)	(1)
Wood Chemistry			1
Computer sciences		1	
Paper Science and Engineering	1		1
Silviculture and Forest Management/Forestry	2	2	1
Biology	(1)		(1)
Bioengineering		(1)	(1)

Because of the wide variety of topics that encompass Paper Science and Engineering, we recognized that it will be necessary to maintain teaching expertise in these many areas. In Fall 2005, the faculty members were polled regarding their teaching and research interests. The results of this poll with respect to teaching interests are summarized in Table 55. In the analysis of these results, the faculty members were divided into those faculty that achieved their highest degree (Ph.D.) before 1980 (2 members identified) and those that achieved their degree after 1980 (6 members identified). This was done to give an indication of the relative longevity of the faculty members and to indicate what expertise is at risk.

Table 55 shows that the breadth of the teaching expertise is sufficient to deliver the necessary courses for the Paper Engineering program. However, there is quite a dichotomy of expertise between the “older” and “younger” faculty. Many of the younger faculty expressed their teaching interests as generally engineering areas while the older faculty indicated their interests more as chemistry and wood and material properties. The conclusion drawn from this survey indicates that new faculty should have teaching expertise in the areas of wood chemistry, pulping, and bleaching or paper physics and fiber processing.

Some required courses are taught by engineering and other faculty outside the Faculty of Paper Science and Engineering as summarized in Table 56. Paper Science and Engineering students take one engineering course from Syracuse University, four from the Faculty of Construction Management and Wood Products Engineering, and two courses from the Faculty of Environmental Resources and Forest Engineering. The engineering programs at Syracuse University and the Forest Engineering program at SUNY-ESF are ABET-accredited and the course instructors are highly qualified. The instructors in the Faculty of Construction Management and Wood Products Engineering have various engineering degrees and have extensive consulting experience.

The faculty, together with the college as a whole, have the competence and the expertise to deliver the courses for the program in Paper Engineering.

Table 55. Faculty teaching interests of full-time faculty as a function of highest degree date.

Subject Area	Number of faculty members expressing teaching interest Highest Degree before 1980 (n=2)	Highest Degree after 1980 (n=6)
Paper physics/properties		2
Fiber processes/papermaking	1	1
Wood properties	1	1
Colloidal and surface chemistry		1
Wood chemistry	1	1
Pulping and bleaching	2	1
Transport phenomena		4
Environmental engineering		1
Engineering design		1
Simulation and control		2
Separations		2
Kinetics and reactor design		1
Bioprocess Engineering		3
Mathematics		2
Computing		1

Table 56. Faculty Affiliations for engineering and other courses taught to Paper Science and Engineering students.

Courses	Faculty Affiliations
ELE 231: Electrical Science I	L.C. Smith College of Engineering, Syracuse University
WPE 386: Structure and Properties of Wood WPE 390: Fiber Identification Laboratory ERE 223: Statics and Dynamics ERE 362: Mechanics of Materials	Faculty of Construction Management and Wood Products Engineering, SUNY-ESF
APM 395: Probability and Statistics for Engineers ERE 225: Engineering Graphics	Faculty of Environmental Resources and Forest Engineering, SUNY-ESF
PSE 132: PSE Orientation PSE 300: Introduction to Papermaking PSE 302: Pulp and Paper Laboratory Skills PSE 351: Pulping and Bleaching Laboratory PSE 370: Principles of Mass and Energy Balances PSE 371: Fluid Mechanics PSE 372: Heat Transfer PSE 465: Paper Properties PSE 466: Paper Coating and Converting PSE 467: Papermaking Wet End Chemistry PSE 468: Papermaking Processes PSE 473: Mass Transfer PSE 477: Process Control PSE 480: Engineering Design Economics PSE 481: Engineering Design ERE 440: Water Pollution Engineering	Faculty of Paper Science and Engineering, SUNY-ESF
PSE 350: Pulping and Bleaching Processes PSE 361: Engineering Thermodynamics APM 153: Computing Methods for Engineers and … APM 485: Differential Equations	Adjunct Faculty

Faculty Background and Experience

Table 54 has already summarized the wide variety of degrees among the faculty in Paper Science and Engineering. Table 57 shows the competency areas with greater detail being given in the curriculum vitae in the appendix. The staff is clearly competent to deliver instruction in the components of the Paper Science and Engineering programs. The faculty size is sufficient to meet all the teaching needs of the program, as well as support the advising, counseling, service, research, and professional responsibilities of the program. The diversity of disciplines and experience among the faculty required to teach Paper Science and Engineering exists among the members. Future potential deficiencies due to retirements have been identified and will form the basis for the upcoming searches. In addition, several members have industrial experience, which facilities the close interaction with the industry, which is very important to this Faculty. Also, since SUNY-ESF is a Ph.D. granting institution, all faculty members have active research programs in their area of expertise. The ongoing research program guarantees that the faculty will remain at the forefront of their fields.

Table 57. Competency areas for the Faculty of Paper Science and Engineering members.

Faculty Member	Highest degree and area of specialty
T. Amidon	Ph.D., Silviculture, SUNY-ESF Pulping, bleaching, recycling, papermaking, renewable raw materials
S. Chatterjee	Ph.D., Chemical Engineering, Rensselaer Polytechnic Institute Environmental engineering, process and plant design
R. Francis	Ph.D., Chemical Engineering, University of Toronto Pulping, bleaching, wood chemistry
D.S. Keller	Ph.D., Environmental and Resources Engineering, SUNY-ESF Surface chemistry, material science, paper structural properties, paper physics
Y.-Z. Lai	Ph.D., Wood Chemistry, University of Washington Alkaline pulping, bleaching, wood chemistry
S. Liu	Ph.D., Chemical Engineering, University of Alberta Chemical kinetics, fluid particle systems, process optimization, fiber properties, mass transfer, applied mathematics
B. Ramarao	Ph.D., Chemical Engineering, Clarkson University Transport Phenomena; Colloidal and Interface Science, Separations Processes, Control
G.M. Scott	Ph.D., Chemical Engineering, University of Wisconsin Biotechnology, recycling, process modeling, papermaking
W. Amato	Ph.D., Chemical Engineering, Syracuse University Process control, thermodynamics, mathematics
J. Cornell	Ph.D., Environmental and Forest Biology, SUNY-ESF Computing methods and programming
L. Schroeder	Ph.D., Organic Chemistry, Lawrence University (The Institute of Paper

	Chemistry) Pulping, bleaching, wood and carbohydrate chemistry

Professional Development

Faculty engage in a number of activities related to professional development. The purpose of this type of activity is two fold: First, it provides information and for self-improvement. Second, it consists of activities that help others to improve their skills and knowledge outside the classroom.

Table 58. Illustrative recent professional development activities of the Faculty of Paper Science and Engineering.

Faculty Member	Activities
T. Amidon	Participant in Agenda 2020 program development
S. Chatterjee	Took the TAPPI Short Course: "Introduction to Pulp and Paper Technology Short Course", January 8-11, 2002, Caribe Royale Resort, Lake Buena Vista, FL. Attended “Best Assessment Processes VII” symposium, Rose-Hulman Institute of Technology, Terre Haute, IN, April 8-9, 2005.
R. Francis	Attended Faculty Mentoring Colloquium at SUNY ESF, May 14-19, 2001
D.S. Keller	Attended Tappi Coating and Graphic Arts Conference, 2002; Attended Advanced Technology Symposium, Montreal 2002; Chair, Progress in Paper Physics Seminar, Finger Lakes, NY
Y.-Z. Lai	Participated in Grenoble Workshop, Grenoble, France, June 2001
B. Ramarao	Chaired session at ‘Nanotechnology in Forest Products Industry – Tappi’, Atlanta 2006; Chaired session at AIChE Annual Meeting, Cincinnati OH;
L. Schroeder	Regular attendance at Empire State TAPPI Meetings; Editor, Journal of Wood Chemistry and Technology, Keynote speaker at Empire State TAPPI meeting – January 2002, Faculty Advisor – Championship DOE Energy Challenge 2001 student team; Treasurer – Empire State TAPPI
G.M. Scott	Attended Engineering Criteria 2000 Workshop, Baltimore, MD, 2000; Attended Tappi Pulping Conference, 1993-2003; Attended Tappi Recycling Symposium, 1994-2000; Best Assessment practices VII, 2005; Forum on Energy, 2006

Research Activities

The faculty's extensive research activities benefit the undergraduate students in many ways.

1. They provide advanced education and training opportunities for the undergraduates. Students can pursue advanced degree programs such as MS, MPS or PhD degrees in Environmental and Resource Engineering or in Bioprocess Engineering with different areas of study. This is a critical opportunity for the undergraduate program as industries of the future will demand a workforce that is globally competitive.
2. Undergraduate students get opportunity to participate in leading edge research and technology projects. Some of these include the integrated forest biorefinery and nanotechnology applications in the forest products industry.
3. Research activities penetrate the undergraduate program. The courses are considerably influenced by faculty research. Course topics, lectures, assignments and projects draw liberally from faculty research. This enables the courses in being at the leading edge of new technology developments and also exposes the students early on to critical issues and drivers in the industry and its role in society.
4. The strong research program of the Empire State Paper Research Institute keeps the faculty in close contact with our industrial research partners. These same companies represent the employers of both our undergraduate and graduate students. The graduate students, as part of the research program, also serve as teaching assistants for many of the undergraduate classes. The research activities inform and enrich the undergraduate program by providing laboratory equipment and facilities (see Criterion 6) that are also used for undergraduate laboratories. Table 59 summarizes some of the research projects in which the faculty members are currently engaged. The CV in the appendix detail the level of scholarship of the faculty with illustrative publications.

Table 59. Illustrative sponsored research activities of the Faculty of Paper Science and Engineering.

Faculty Member	Activities
T. Amidon	Leader of Integrated Forest Biorefinery – Advanced processes for energy, industrial chemicals and materials from wood and forest resources.
S. Chatterjee	Biodiesel production from crude tall oil; Water closure in paperboard mills; Wastewater treatment with submerged packed bed biological reactor (biological aerated filter)
R. Francis	Alkaline pulping; non-chlorine bleaching ; brightness reversion of paper (private sector financial support for all three projects).
Y.-Z. Lai	O_2 delignification; Enzyme-induced lignin oxidation
S. Liu	Kinetics and reactor design for wood processing – extraction; Continuous

	and batch pulping processes, pulp manufacturing processes, solid fluid operations and multiphase flows.
B. Ramarao	Moisture Transport in paper materials; Liquid water transport and drying processes of paper; Dewatering and drainage of pulp suspensions and filtration.
G.M. Scott	Biological Modification of Loblolly Pine Chips with Ceriporiopsis subvermispora Prior to Kraft Pulping; Xylan Extraction from Short Rotation Willow Biomass; A Study of the Lignolytic Enzymes of Phlebia Subserialis, and a Comparative Analysis of White-Rot Fungi on Picea Abies; Biologically-Assisted Extraction of Xylan from Wood; Kinetics of the Xylan Extraction Process; Use of Manganese Peroxidase as a Pulping and Bleaching Agent

Instructional Support Staff

As mentioned above, all PSE courses are taught by faculty members, except under extremely unusual circumstances. However, several of the support staff, play a key role in several instructional activities that bear mentioning in this section. The details of the full duties of these personnel and the others in the Faculty are given in Criterion 7. Listed in Table 60 are the activities of several staff members that impact directly on undergraduate instruction. Much of this instructional activity by staff is directed at one of the capstone design courses: PSE 468 (Papermaking Processes) and various laboratory courses. In addition to being the machine operators, these staff people are available to answer questions, give advice, and help the students develop and execute their project plan. Several of these staff members have had industrial experience in the pulp and paper industry and pulp and paper research.

Table 60. Staff members highly involved in instructional activities.

Staff Member	**Activities**
R. Appleby	As the Pilot Plant Coordinator, Mr. Appleby plays an integral role in PSE 468 (Papermaking Processes). Mr. Appleby participates in the students' staff meetings, runs the paper machine, and advises students on the practical operational issues of our paper machines. He also actively participates in the subsequent seminars.
A. Brown	Provides instruction to fellow researchers on the proper use of laboratory equipment. Designs workable experiments around the available equipment. Also maintains and repairs the equipment.

L. Fagan	Supports student recruiting, summer employment, employment, coop internships, scholarships and awards and liaison with the Syracuse Pulp and Paper Foundation.
W. Burry	Instruction in laboratories for PSE 465 and PSE 302

Interactions with Students

In general, personnel in the Faculty of Paper Science and Engineering maintain a close working relationship with the undergraduate students. The faculty members do all of the lecturing for the courses. Graduate Teaching Assistants are used primarily as graders and not as deliverers of instruction, except in relatively rare cases when a faculty member is unavailable. Graduate Assistants are also instrumental in several of the laboratory courses taught in PSE. The project nature of much of the course work encourages faculty-student interactions in settings outside the classroom. A very favorable student-to-faculty ratio of about 7:1 allows students excellent access to the faculty members.

Seven PSE students and three students from other engineering programs on campus were recently involved in the DOE Energy Challenge.

Student Advising

Currently, seven of the eight faculty members engage students in undergraduate academic advising. The typical advising load is about 6 to 9 students per faculty member. With regards the PSE undergraduate exit survey regarding advising, students graduating from PSE are debriefed orally after completing an exit interview form that includes evaluation of all required courses and any elective courses the student wishes to comment on. Suggestions for improvement in the overall program and in individual courses are sought. The results are reviewed in general with the entire PSE faculty and in detail with individual faculty members when improvement suggestions are obtained. Feedback (including in the last two years) has prompted changes in course instructor, content, and the curriculum.

Improvements are continually made in the advising process. The PSE Student Handbook Supplement was produced for the first time in August 2000 and is updated annually. This book, which is distributed to all PSE students, answers many of the common questions that arise regarding the program and the curriculum. It also provides important information concerning the policies, regulations, and practices of the Faculty of Paper Science and Engineering including information about registration, petitions, the summer mill experience, co-op positions, and on-campus interviewing.

Recognizing that advising is a very important part of the faculty members' duties, a PSE Advisor's Handbook has been produced. The production of the Advisor's Handbook was part of a campus-wide effort to improve the quality of undergraduate advising. Together with the handbook, an advisor training session will be held for all PSE faculty in conjunction with the spring Faculty retreat. The handbook is updated about every two years with the next update scheduled for the summer of 2006.

Faculty Interactions with Industry

Several of the members of the faculty interact on a regular basis with pulp, paper and various allied industries. The extensive industrial contacts from the membership of the Empire State Paper Research Associates helps our faculty deepen and strengthen industrial interactions. The industrial contacts are of many types:

1. Work on pilot plant projects sponsored directly by industry. In the recent past (2004-2005), some of the companies which have sponsored projects with our faculty are: Specialty Minerals Inc, Andritz Inc., Cargill International, and International Paper.
2. Research projects sponsored by industrial members: Members of the Empire State Paper Research Associates Inc, sponsor a variety of research projects in our faculty. Undergraduate students are routinely employed in such research projects in addition to graduate students.
3. Faculty members travel to industrial locations and give seminars. In the recent past, these include visits to: International Paper Co., Cincinnati OH (T. Amidon, B. V. Ramarao & S. Liu); Specialty Minerals Inc., (T. Amidon, B. V. Ramarao); Hercules Inc (B. V. Ramarao); SAPPI Inc (R. Francis and T. Amidon); Andritz Inc., (R. Francis and T. Amidon);
4. Faculty members participate in a variety of industry and professional society sponsored conferences and symposia. These include: Meetings of the Empire State Paper Research Institute (124^{th} biennial meeting in Vancouver BC, 2006); C. W. Dence Memorial Symposium on Pulping and Bleaching, Vancouver BC 2006;

Faculty Activities in Professional Societies

All faculty members participate in professional societies. Many faculty members serve on boards affiliated with professional societies. For example,

Prof T. Amidon: Paper Industry Management Association, Tappi Agenda 2020 Research Directions Agenda; US Country Representative, International Energy Agency – Renewable fuels and forest products industry; Tappi – Chief Technology Officers' Committee Agenda 2020-American Forest & Paper Association.

Prof. B. V. Ramarao: Tappi – Nanotechnology in the Forest Products Industries – Member of directing committee & session chair. AIChE – Forest Products Division – Member of the board of directors & Chair of Programming for the Division; Associate Director – Empire State Paper Research Institute.

Prof. Gary M. Scott – Tappi ; ASCC-American Society for Engineering Education; PPERA – Pulp and Paper Education and Research Alliance.

Dr. Raymond C. Francis – Tappi; Organizer of Symposium – Carlton W. Dence Memorial Symposium on Pulping and Bleaching, Vancouver BC (2006).

Dr. Yuan Zong Lai – participates in Tappi – presenting papers. Has organized sessions and symposia in various international and national locations on pulping and bleaching.

Dr. Shijie Liu – participates in Tappi and AIChE. Has helped organize ESPRA conferences and symposia.

More details are provided in the individual CVs of the faculty.

Summary

The current faculty members are adequate for the current programs that are being offered. The faculty are active in their fields in terms of both teaching, research, and professional service. Several faculty actively consult with companies both within and outside the paper industry. An active research program allows the faculty members to bring insight from their research into the classroom.

However, at the time of this writing, Dr. Steven Keller has announced his resignation from the faculty effective August 2006. This opens up another faculty position, especially in the area of paper physics and chemistry. The faculty plans to fill some of these positions over the next year and has developed a plan to do so. In summary, the plan is fill the positions as follows:

1. **Assistant/Associate Professor** in Bioprocess Engineering: This member would teach upper division courses in support of our new program as well as engineering support courses that are in Paper Engineering.

2. **Joachim Chair of Paper Management and Manufacturing**. This position would be an endowed chair supported by the Joachim endowment. The faculty member would teach courses on management (e.g., PSE 456), pulp and paper manufacturing, and other professional courses specifically to the paper industry, especially those related to the professional skills that are a key component to EAC/ABET accreditation.

3. **Assistant/Associate Professor** in Paper Engineering and basic engineering and other fundamental courses.

6. Facilities

Describe classrooms, laboratory facilities, equipment, and infrastructure and discuss the adequacy of these facilities to accomplish program objectives, as required by Criterion 6. As a minimum: Discuss the adequacy of facilities and draw conclusions in that regard. In support of these conclusions, provide information concerning facilities such as classrooms, laboratories, and computing and information infrastructures that engineering students and faculty are expected to use in meeting the requirements of the program. Identify the opportunities students have to learn the use of modern engineering tools, including identification of the important tools and the depth of the student experience.

The facilities available to the Faculty of Paper Science and Engineering are more than adequate. We have a modern four-story building (plus a basement) with ample classroom, laboratory, office, and common space. We have large classrooms and laboratories that we share with the rest of ESF and also with Syracuse University. Over the last decade, at least $100,000 worth of purchased or donated equipment has been added to our laboratories annually. We also have access to the facilities of other engineering programs at ESF and Syracuse University. In addition, we have access to some facilities in the new Central New York Biotechnology Research Center (CNY-BRC), jointly established by the SUNY Upstate Medical University and ESF. This Center has partnered with the Metropolitan Development Association and Central New York (MDA) and the Syracuse VA Medical Center, and will collaborate with the institutions involved and Central New York industries to develop and commercialize new technologies.

Common Areas and Faculty Offices

The entire five floors (including basement) were painted and the main entrance to the building refurbished in 2001. New carpeting was recently added to most of the common areas. The metallic wall on the inside of our elevator was carpeted at the same time. The building is quite attractive and comfortable to students. Most of them stay in the building between classes.

Faculty offices are adequate, well maintained, and centrally located. Students and visitors should have no problem finding the office of any faculty member. There are meeting or conference rooms on the 2^{nd}, 3^{rd} and 4^{th} floors of the building to facilitate interactions between faculty and small student groups.

Laboratory Facilities

All of our laboratories that are available to undergraduates are described in Table 61 through Table 64. The room number, size and courses taught are listed for each room along with the condition of the laboratory and its adequacy for instruction.

Table 61. Laboratory Facilities (First Floor).

Program: Paper Science & Engineering

Walters Hall – First Floor

Facility and Room No.	Purpose of Laboratory, Including Courses Taught	Condition of Laboratory	Adequacy for Instruction	Number of Student Stations	Area (Sq.ft.)
Analytical Room 102	Wet Chemistry Lab FCH 380, PSE 302, 351, 468	Very good	Excellent	40	2266
Analytical Room 102D	Oven room FCH 380, PSE 302, 351, 468	Good	Good	6	340
Analytical Room 102C	Balance room FCH 380, PSE 302, 351, 468	Good	Good	6	215
Stockroom Room 102A, B, E	Chemical and other supplies (All courses)	Good	NA	0	850
Pulping and Bleaching Room 103	Pulping and Bleaching reactors PSE 302, 351, 468	Excellent	Very good	15	1325
Paper Properties and Coloring Room 104	Fiber preparations PSE 302, 351, 468	Excellent	Excellent	NA	1362
Papermaking Room 105	Paper machine support PSE 468	Good	Good	4	389
Paper Physics Room 106	Paper testing PSE 465	Good	Available for specialized instruction	4	305
Papermaking Room 108	Small paper machine PSE 468	Very good	Good	10	1300

Papermaking Room 112	Large paper machine PSE 468	Excellent	Excellent	15	6058
Process Control Room 113	Projects and demonstrations PSE 477	Good	Very good	6	392
Environmental Systems Room 115	Demonstrations of unit operations PSE 371, 372, 477	Excellent	Excellent	10	5403
Mechanical Pulping Room 115P	Sample preparations PSE 351	Excellent	Excellent	10	500
Machine Shop Room 116	Support to all laboratory courses	Good	NA	0	558
					Total Area: 21,641

Table 62. Laboratory Facilities (Second Floor).

Program: Paper Science & Engineering

Walters Hall – Second Floor

Facility and Room No.	Purpose of Laboratory, Including Courses Taught	Condition of Laboratory	Adequacy for Instruction	Number of Student Stations	Area (Sq.ft.)
Coating Room 202	Rheology and applications of Coating PSE 466	Very good	Available for specialized instruction	7	894
Analytical Room 203	Organic analyses PSE 351	Excellent	Available for specialized instruction	4	217
Bio-processing Room 204	Fermentation of carbohydrates	Very good	Available for specialized instruction	2	217
Computer Room 209A	Simulation exercises ERE 440, 441, PSE 473, 477, 480, 481	Very good	Excellent	8	305
Paper Testing Room 209B	Physical and Optical Properties of Paper PSE 302, 351, 465, 467, 468	Excellent	Excellent	25	878
					Total Area: 2,294

Table 63. Laboratory Facilities (Third Floor).

Program: Paper Science & Engineering

Walters Hall – Third Floor

Facility and Room No.	Purpose of Laboratory, Including Courses Taught	Condition of Laboratory	Adequacy for Instruction	Number of Student Stations	Area (Sq.ft.)
Papermaking Room 303	Surface and Colloidal Chemistry as related to paper PSE 465, 467, 468	Good	Available for specialized instruction	4	220
Papermaking Room 309	Analyses of fiber slurries PSE 465, 467, 468	Good	"	4	447
Pulping and Bleaching Room 312	Wood Chemistry PSE 351	Good	"	4	220
Electron Microscope Room 318	Physical properties of paper PSE 465	Very good	"	4	222
Electron Microscope Room 320	Physical properties of paper PSE 465	Very good	"	6	580
Pulping and Bleaching Room 322	Wood Chemistry PSE 302, 351	Good	"	8	1146
					Total Area: 2,835

Table 64. Laboratory Facilities (Fourth Floor).

Program: Paper Science & Engineering

Walters Hall – Fourth Floor

Facility and Room No.	Purpose of Laboratory, Including Courses Taught	Condition of Laboratory	Adequacy for Instruction	Number of Student Stations	Area (Sq.ft.)
Pulping and Bleaching Room 405	Wood Chemistry PSE 351	Good	Available for specialized instruction	4	220
Main Analytical Room 407	Qualitative and quantitative analyses PSE 351	Good	Excellent	8	451
Pulping and Bleaching Room 411	Wood Chemistry PSE 351	Good	Available for specialized instruction	4	220
Computer Room 415	General use	All new equipment	Excellent	8	222
Imaging and Photography Room 417	Microscopic analyses of paper PSE 465	Excellent	Available for specialized instruction	10	523
Surface Chemistry Room 422	Energetics of surfaces PSE 465, 467	Excellent	Available for specialized instruction	4	334
Pulping and Blealching Room 427	Wood Chemistry PSE 351	Good	Available for specialized instruction	4	221
Imaging and Photography Room 413	Imaging and Photography	Good	Available for specialized instruction	4	221
					Total Area: 2,412

Laboratory and Instructional Equipment

The Faculty has excellent laboratory resources in all areas of fiber chemistry, physics, and papermaking. Donations of high-priced equipment are almost continuous in our Faculty. We recently upgraded our papermaking and paper testing laboratories. The primary sources of funding were financial donations from an alumnus and equipment donations from three paper companies. The College financed the refurbishment of Walters 104 where the primary papermaking laboratory is located, while International Paper Co. donated an Escher Wyss refiner estimated at $125,000; Mead Paper Co. donated a sheet coater estimated at $150,000 and Eastman Kodak donated an M&K dynamic sheet former estimated at $150,000.

Mr. Edward K. Mullen, a 1947 graduate from our undergraduate program donated $200,000 in cash for a major upgrade of our paper testing laboratory. Mr. Mullen is the Chairman of the Board of the Newark Group, which has been a leader if not the leader in paper recycling for the past 30 years. The Newark Group owns more than 20 papermaking and converting installations. Mr. Mullen has also funded two endowed scholarships for our undergraduates and made financial contributions to the management option that is available to PSE students. The leadership of the Newark Group is permeated with our graduates and one of their vice presidents is on the board of directors of the Syracuse Pulp and Paper Foundation.

Current laboratories are generally grouped into nine categories, as listed below. They support both graduate research and undergraduate instruction in PSE. Some of the equipment along with their current estimated value are listed by category below.

Analytical Chemistry 102, 203, 407 Walters hall

- Several analytical balances, pH meters, ovens, and furnaces.
- A Perkin-Elmer 5100 PC Atomic Absorption Spectrophotometer.
- A wide assortment of chromatographic equipment with present value of at least $,2000,000.

Paper Physics 106, 107, 318, 320, 417 Walters Hall

- One Haake RV-3 Rotoviscometer ($20,000).
- One Molecular Dynamics Phosphor Imager SI ($32,000).
- One Jeol 100S Transmission Electron Microscopy ($20,000).
- One Toyoseiki Microtopograph ($30,000).
- Three Chambers with accurate humidity control (3 x $15,000).

Process Engineering and Control 103, 112, 113, 415 Walters Hall

- A stirred tank unit (2 vessels) to study the dynamics of first and second order systems
- A temperature control module (designed by faculty and students) for a batch digester
- A Bubble column with sophisticated process control for deinking

Environmental Systems 113 Walters Hall

Used for study of selected operations and process control, this laboratory contains a pilot-scale aerated sludge wastewater treatment plant with supply tanks, pumps, primary clarifier and associated flow metering and control equipment. This facility is also used for wastepaper deinking and recycling, as well as treatment of wastewater produced from this process. This facility is unique in PSE education. The value of the equipment in this facility is at least $500,000.

Pulping and Bleaching 102, 103, 104, 322 Walters Hall

- Two M & K digesters for pulping (2 x $30,000).
- Two Quantum Mixers (2 x $40,000).
- One KRK Chip Refiner ($150,000).
- One 70 ft^3 digester for the hemicellulose extraction or pulping

Bioprocess pit area of Walters Hall

- One 400 liter fermentation system from the New Brunswick Scientific. Current emphasis is on the production of ethanol and plastic polymers from wood – based materials.
- Additional laboratory fermentation vessels
- Bioseparation Equipment (membranes, etc.)

Papermaking 102, 108, 112, 422 Walters Hall

- #1 paper machine and support equipment including 48" Fourdrinier paper machine, 1800 gallon pulper, stock pumps, vacuum pumps, rotary sheeter and paper trimmer ($2,000,000).
- #2 paper machine and support equipment including 12" Fourdrinier paper machine, pulper, stock pumps and vacuum pumps ($600,000).
- One Micromeretics Auto Pore III Porosimeter ($25,000).
- One Escher Wyss Refiner ($125,000).
- One M&K Dynamic Sheet Former ($150,000).
- One Sheet Coater ($150,000).

Paper Testing 209B Walters Hall

- One MTS SinTech Tensile Tester ($55,000).
- One L&W Burst Tester ($32,000).
- Four JDC Precision Sample Cutters (4x$5,500).
- One TMI 84-22 Z-direction Tensile Tester ($19,000).
- One Technidyne Colortouch II Brightness Meter ($45,000).
- One Technidyne Glossmeter ($18,000).
- One TMI Stiffness Tester ($22,000).

- **Computer** 209A, 415 Walters Hall
- Nine Gateway 866 MHz Pentium III computers running MS Windows 2000 ($1,600 each). The computers are networked to the campus-wide system and are loaded with MS Office, Matlab (student version) and WinGEMS™ (professional version).
- Two Laser jet printers ($300 each).

Classroom Facilities

The College maintains classroom facilities, and the Registrar assigns classes to rooms of appropriate size. The two classrooms that host most of our PSE courses are equipped with state-of-the-art computerized audiovisual equipment.

The college maintains one unique classroom facility. A classroom equipped for distance learning is located in 16 Illick Hall. The facility has a complete suite of audio-visual equipment, and can be used in either a local classroom or in distance learning (send or receive) mode. In the past, we offered a course in air and water pollution online as a contribution to the SUNY Learning Network. We are prepared to offer several other online courses if a strong demand develops.

Computer Infrastructure

Paper Science and Engineering students have access to Faculty computing resources, College computer clusters, and all the computing resources at Syracuse University, including computer clusters, and mainframe computers. The College academic computer support personnel will install specific engineering-related software on the servers, at the request of an individual Faculty. Clusters can be scheduled for class computer exercises. Some details of these facilities are provided in Table 65.

Table 65. Computer facilities to which PSE students have access.

Location	Description
ESF Computer Cluster 14 Moon Library	24 E-3400 933 MHz Gateway Computers equipped with networked printers and standard word processing, spread sheet, etc. software
ESF Computer Cluster 156 Baker Lab	24 Dell E 4000 3.0 GHZ 512 MB of RAM Windows XP Version 2002, equipped with networked printers (one color) and standard word processing, spread sheet, etc. software
ESF Computer Cluster 143 Baker Lab	28 Dell E 4000 2.4 GHZ 256 MB of RAM Windows XP Version 2002, equipped with networked printers (one color) and standard word processing, spread sheet, etc. software.
ESF Computer Cluster	32 Dell Optiplex SX 280 Intel (R) Pentium (R) 4 CPU 3.4 GTZ Windows XP Version 2002 Computers, networked

149 Baker Lab	printers (one color), and standard word processing, spread sheet, etc. software.
PSE Computer Cluster 415 Walters Hall	9 866 MHz Gateway Computers, networked printer, and standard word processing, spreadsheet, etc. software. Specialized engineering software.
Syracuse University	UNIX mainframe computers, computer clusters in dormitories, academic buildings and Schine Student Center. Syracuse University Residence Halls are wired for internet access.

Access to Modern Engineering Tools

The curriculum has ample provisions where the students are introduced to modern engineering tools. These pertinent courses include APM 153 (Computing Methods), PSE 370 (Principles of Mass and Energy Balances), PSE 371 (Fluid Mechanics), PSE 372 (Heat Transfer), PSE 468 (Papermaking Process), PSE 473 (Mass Transfer), PSE 477 (Process Control), PSE 480 (Engineering Design Economics), and PSE 481 (Engineering Design). The highlights are as follows:

The first place in the curriculum where the students are introduced to modern engineering tools is APM 153. This is a computer-based course in mathematics and problem solving, which teaches the student how to develop algorithms to solve increasingly sophisticated problems in mathematics and engineering and to convert the algorithms into programs in Mathcad, Matlab, Excel, and Visual Basic.

In PSE 370, which is designed as an introduction to engineering calculations and problem solving, in addition to learning how to solve engineering problems with pencil, paper, and calculator, students also perform computer solutions using WinGEMS™ (a pulp and paper industry-specific process simulator), MathCad, Matlab, and Excel for solving mass and energy balance problems.

Over the last few years in PSE 480, the class has been assigned a project which involves the process design of a multiple-effect evaporation system for concentrating weak black liquor. Some preliminary process data were supplied in the problem statement and the class was asked to perform preliminary hand calculations and then use the process simulator WinGEMS™ for completing the calculations.

PSE 481 (Engineering Design), which represents one of the two capstone design courses in the Paper Engineering curriculum, involves the execution of an engineering design project at Solvay Paperboard, a paperboard mill located in Solvay, New York. During the semester-long duration of the design project, the students use and are exposed to a variety of proprietary and technical software belonging to the mill and external vendors.

Current and Future Improvements

No improvement in space is required or anticipated. We will continue to improve our equipment as funding and donations become available. As mentioned in the introduction, at least $100,000 of purchased or donated equipment is procured by our Faculty each year. In addition, state money is often available on an annual basis for both instructional and research needs. A most recent addition was a 400-liter fermentation system from New Brunswick Scientific, which is being used to study the kinetics of the production of ethanol and plastic polymers from wood and forest resources.

Summary

The current facilities available to the Faculty have been and are above adequate. The laboratory equipment available to our undergraduates is improving each year, our computer infrastructure is excellent, and our students have good access to modern engineering tools.

7. Institutional Support and Financial Resources

Describe the level and adequacy of institutional support, financial resources, and constructive leadership to achieve program objectives and assure continuity of the program, as required by Criterion 7.

As a minimum:

Discuss the adequacy of institutional support, financial resources, and constructive leadership necessary to achieve program objectives and draw conclusions in these regards.

Describe the processes used to determine the budget for the program.

Describe the adequacy of faculty professional development and how it is planned and funded.

Describe a plan and sufficiency of resources to acquire, maintain, and operate facilities and equipment required to achieve program objectives.

Discuss the adequacy of support personnel and institutional services necessary to achieve program objectives.

The information contained in Appendix I presents supporting documentation and will be useful to the evaluation process.

Complete Table I-5, *Support Expenditures.* Report the expenditures for support of the engineering program being evaluated. The information is to be supplied for each of the three most recent fiscal years.

The support available to the Faculty of Paper Science and Engineering is adequate, as will be discussed below. However, we recognize the changing dynamics and, sometimes, precarious nature of funding for public assisted higher education.

Leadership

The senior administration of the College understands the importance of the Paper Science and Engineering Programs and its close ties to a very important New York industry. The President, Dr. Cornelius Murphy, began his tenure on 15 May 2000, and came to the College after having been the Chief Executive Officer of O'Brien and Gere, Ltd., a nationally-known environmental engineering firm with headquarters in Syracuse, NY. Dr. Murphy understands the importance of engineering education and supports our programs. Dr. Bruce C. Bongarten is currently ESF's Provost and Vice President for Academic Affairs. He was Associate Dean for Academic Affairs at the Daniel B. Warnell School of Forest Resources at The University of Georgia. Dr. Bongarten assumed his position at ESF on July 1, 2005.

Former Provost, Dr. William P. Tully, continues to serve the College as director of the Division of Engineering, director of the Joachim Center for Forest Industry, Economy and Environment, and has a variety of related academic and scholarly responsibilities.

Budget

Funds available to the Faculty come from state allocations, continuing education activities, research funding, development activities, and pilot plant services. The Faculty Chair has final authority on expenditures from all accounts except research funding, for which the faculty Principal Investigator has sole authority. However, the Chair has little discretion in salary matters, given that unions that represent faculty and staff negotiate salaries on behalf of their members.

The mechanism by which the state allocation is derived is as follows. The Budget for the State of New York should be in place in April of every year. The allocation to the State University of New York is contained in the budget. The SUNY Central Administration staff works with each SUNY campus to determine a campus budget. In recent years, the campus allocation has been determined by a complex set of metrics.

The Provost, in consultation with each Faculty Chair, determines the allocation of state funds to a particular Faculty unit. The Provost has the option of funding activities such as faculty searches by special allocations above and beyond the normal allocation. Funds allocated to the Faculty have been adequate to maintain the quality of the program.

The state allocation covers salaries, wages, and benefits, with the remainder of the funds being at the discretion of the Faculty Chair. The state allocation is one source of funds to the Faculty, as funds accrue to the Faculty from several other mechanisms.

Funds accrue to the Faculty from the Office of Continuing Education by virtue of faculty involvement in continuing education activities. Such activities might include participation in the design and delivery of non-credit short courses, or work during the summer on grants managed by the Office of Continuing Education.

Sponsored research generates funds to support the Faculty in several ways. Some grants are designed to support and enhance undergraduate education directly. Some grants include funds to support undergraduates. Inevitably, some research equipment, computers, and software purchased from research funds is used in support of the undergraduate program, thus freeing state allocated funds for other purposes. Likewise, research funding is sometimes used for travel to professional conferences, again reducing the demand on state allocated funds for this purpose.

Service work performed in the pilot plant also supports faculty activities within the Faculty. The Pilot Plant is available for contract work to pulp, paper, and allied companies from throughout the United States. The payments for this work accrue in an ongoing account, which is used to repair and procure equipment for the pilot plant, as well as to support a graduate student. This account also supports the instructional mission of the Faculty through the purchase of supplies, especially for the paper machine runs as part of PSE 468 (Papermaking Processes).

The Empire State Paper Research Institute (ESPRI) is co-housed in Walters Hall and supported by the Empire State Paper Research Associates (ESPRA). ESPRA consists of about 12 member companies that support research through annual dues to the organization. The State of New York more than matches these funds. With this base level of research support, the faculty are able to maintain their expertise in their chosen fields. In addition, members of the faculty who are supported by the research side of the program, also teach some courses.

The Faculty of Paper Science and Engineering is also supported by the Syracuse Pulp and Paper Foundation. The primary support from this source is through the scholarships offered to the undergraduate students. SPPF is also supported by member companies who pay an annual donation to the foundation. In addition, the foundation has a substantial endowment (on the order of $4,400,000), which generates income that is used to provide scholarships to undergraduate students. All undergraduate students are eligible for a scholarship: The amount of the scholarship depends on the current cumulative grade point average of the student. In addition, SPPF supports the faculty financially in terms of recruiting, often funding recruiting trips for faculty members to community colleges. SPPF also subsidizes the PSE Orientation for new students.

Each Faculty unit also receives a yearly allocation from the Provost's Office via the Research Foundation more or less proportional to the amount of research overhead funds generated by the unit during the previous year. These funds accrue to the Faculty Chair, and have to be used to support opportunities to generate more research funding.

Table 66 summarizes the sources and amounts of funds available to the Faculty and comments on expenditure guidelines.

Table 66. Sources, amounts, and restrictions on funds available to the Faculty of Paper Science and Engineering (2005-2006).

Source	Amount	Comment
State Allocation: State Budget (non-salary)	$3,000	Faculty Chair has final authority on expenditure of state allocated funds, but little discretion in salary matters
State Allocation: Instructional Equipment	$4,000	Faculty Chair has final authority; must be spent in support of educational activities
Sponsored Research	$500,000	Multiple projects; Project Director has final authority
Research Foundation Sponsored Program Development	$12,000	Faculty Chair has final authority; must be spend to enhance Faculty research efforts
Continuing Education Program Development	$4,000 (ESPRI)	Faculty Chair has final authority; in consultation with faculty generating the funds
Empire State Paper	$240,000	ESPRI Director, currently also the chair, funds

Research Associates		research of interest to the paper industry
Syracuse Pulp and Paper Foundation	$85,000	Funds are for student scholarships
Joachim Foundation	$48,000	Funds industrial ecology related research
Federal Earmarks	$800,000	Faculty chair and principal investigators have final authority; funds specific research efforts as indicated by Congress
Pilot Plant	$140,000	Provides industry support on a direct payment for services basis

The data in the above table demonstrate success by the Faculty in attracting a substantial amount of sponsored research and other resources. Many of the larger research projects are multi-year efforts, and so the funds are or will be expended over two or three years. As will be demonstrated below, the funding has created opportunities to hire a substantial number of research-funded employees and graduate research assistants, all of who contribute to the academic success of the Faculty.

Personnel

Permanent employees. The Faculty employs several individuals in instructional support roles. These positions are detailed in Table 67.

Table 67. Staff associated with the Faculty of Paper Science and Engineering.

Name	Position	Duties	Years With Faculty
L. McKinkle	Secretary	Open and sort mail, maintain calendar for Faculty Chair, arrange meetings upon request, mail, fax, FedEx or send documents upon request, supervise work study, greet visitors, handle phone calls.	7
D. DeWitt	Administrative Assistant, SPPF	**ROUTINE OFFICE WORK IN SUPPORT OF SPPF ACTIVITIES, INCLUDING ACCOUNTING FUNCTIONS AND MAILINGS.**	3
L Fagan	Administrative	Manage endowments and distribute	5

	Manager, SPPF	scholarships. Serve as liaison between Faculty of PSE and pulp, paper and allied industry. Solicit donations from industry and individuals. Help interest prospective students in enrolling in PSE.	
R. Appleby	Pilot Plant Coordinator	Instruct undergraduate and graduate students in laboratory procedures, paper mill equipment, safety, material and process selection. Supervise PSE 468 and PSE 300 paper machine runs. Direct and manage Pilot Operations and Facilities including two paper machines and their support equipment, Environmental Laboratory, and educational/research laboratories. Assist faculty and staff with research activity. Perform public service including demonstrations, tours, consultation and referrals. Member of Campus Personal Safety Committee, Campus Quality of Work Life Committee, PSE Equipment Committee, PSE Safety Committee and Incoming Student Orientation Program (PSE 132), Member of Empire State TAPPI.	20
A. Brown	Senior Research Support Specialist (part time)	Provide instruction to fellow researchers on the proper use of laboratory equipment. Design workable experiments around the available equipment. Also maintain and repair the equipment.	44.5
W. Burry	Senior Instructional Support Specialist	Research – primary investigator Instruction – instructor/lecturer Safety committee – chair	10
K. Gratien	Senior Research Support Specialist	Conduct pilot plant and research work in the areas of pulping, bleaching, and papermaking.	1
K. Saladin	Senior Research Support Specialist	Conduct pilot plant and research work in the areas of pulping, bleaching, and papermaking.	1
S. Omori	Instructional Support	Procure/maintain/manage analytical	19

	Technician	equipment.	

Graduate Assistants. The Faculty has funds for Graduate Assistants allocated and can select graduate students to assist in the delivery of the undergraduate program. The Faculty had 12 and 14 Graduate Assistants during the 2003-2004 and 2004-2005 academic years, respectively. It is anticipated that these numbers will grow to 24 and 31 during the 2005-2006 and 2006-2007 academic years, respectively. The Graduate Assistants are used primarily as graders and laboratory assistants and are rarely responsible for delivery of formal instruction.

Personal supported by research and other funding mechanisms. As discussed previously, the Faculty has been successful in attaining funding from several research sponsors. The Faculty thus has direct supervisory responsibility for a number of individuals supported by research funding, as described in Table 68.

Table 68. Personnel supported by research within the Faculty of Paper Science and Engineering.

Title	Numbers
Post-Doctoral Associate	1
Research Project Assistant (graduate students)	8
RESEARCH AIDE (BOTH GRADUATE AND UNDERGRADUATE STUDENTS)	4
RESEARCH SUPPORT SPECIALIST	3
Project Staff Assistant	
Project Aide	

Faculty Development

The Faculty recognizes the importance of faculty development and routinely commits Faculty resources to that end. In addition, the College commits resources to this important endeavor.

Development begins with recruiting faculty and professional staff. The Provost provides funding in addition to the normal state allocation for this important activity. The College has been successful in recruiting and attracting highly qualified faculty and staff in recent years, including several recent hires in the faculty. Table 69 shows examples of other faculty development activities at the Faculty and College level.

Table 69. Examples of faculty development activities at the Faculty and College level.

Activity	Purpose	Comment
Mentoring	Provide untenured faculty formal interaction with senior faculty	Faculty Chair is responsible for assigning mentors and oversight as necessary.

Mentoring Conference	College activity for untenured faculty and their mentors to discuss scholarship issues in an informal atmosphere	Provost's Office funds and organizes the event; senior faculty and invited guests lead discussion.
Annual Teaching and Learning Conference	Forum to discuss teaching and learning issues at the College. Keynote speakers and discussion leaders are from other institutions.	Provost's Office funds event, organized by Office of Instruction, Evaluation, and Service.
Annual Workshop for Graduate Assistants	Provides orientation for newly appointed Graduate Teaching Assistants. Newly appointed faculty are invited to attend some sessions.	Provost's Office funds event, organized by Office of Instruction, Evaluation, and Service.

In addition to the College-wide activities described in Table 69, the Provost often provides funding to individual faculty for specific activities. The Faculty Chair can also elect to support a particular activity from the funding available to the Faculty unit. Table 70 provides recent examples of some activities supported by these means.

Table 70. Examples of faculty development activities for individual faculty members in the Faculty of Paper Science and Engineering funded through the Provost's office.

Faculty member	Activity
G. Scott	Participated in mentoring workshop (2001-2005); Sabbatical leave (2005); Attended ABET Workshop in Terre Haute, IN (2005) and Symposium on Teaching and Learning (2001-2005).
Y.-Z. Lai	**ATTENDED 11TH INTERNATIONAL SYMPOSIUM ON WOOD AND PULPING CHEMISTRY, NICE FRANCE (2001); GRENOBLE WORKSHOP ON ADVANCED METHODS FOR LIGNOCELLULOSICS AND PAPER PRODUCTS CHARACTERIZATION, GRENOBLE, FRANCE (2001); 2ND INTERNATIONAL SYMPOSIUM ON TECHNOLOGIES OF PULPING, PAPERMAKING AND BIOTECHNOLOGY ON FIBER PLANTS, NANJING, CHINA (2004); 12TH INTERNATIONAL SYMPOSIUM ON WOOD AND PULPING CHEMISTRY, MADISON, WISCONSIN (2003); AND 13TH INTERNATIONAL SYMPOSIUM ON WOOD AND PULPING CHEMISTRY, AUCKLAND, NEW ZEALAND (2005).**
B. Ramarao	AIChE Annual Meeting, (2005), Reno NV; Served on program committee, Tappi – Nanotechnology in Forest Products Industry, Atlanta; Serving as meeting program director, AIChE Division 17-Forest Products Division (2005-2007); Progress in Paper Physics Seminar 2004.
S. Chatterjee	Sabbatical leave (2004); Attended ABET Workshop in Terre Haute, IN (2005) and Symposium on Teaching and Learning at SUNY-ESF, (2001-2005).

R. Francis	Attended Tappi Engineering Pulping and Environmental Conference (2002, 2004, 2005); PAPTAC Annual Meeting (2003, 2004, 2006); Hardwood Industries Leadership Conference, Pennsylvania State University (2004); ABET Conference, Baltimore (3/11/2006). Was on sabbatical leave during July-December 2004 at Pennsylvania State University (PSU) for conducting collaborative research with the Energy Institute of PSU, which work is ongoing. Made presentations during 2005 and 2006 at Michigan State University, Alabama A&M University, University of Visosa (Brazil), Helsinki University of Technology (Finland), Cornell University, Tompkins Cortland Community College, and Adirondack Community College.

Summary

The support to the Faculty of Paper Science and Engineering is currently adequate. However, there is currently a need to replace faculty that have retired or resigned in recent years. The Faculty is currently seeking leave to fill several of the vacant positions as described in Criterion 5.

8. Program Criteria

The Faculty is seeking accreditation for the Paper Engineering program under the General Engineering Criteria. No program criteria are specified.