



Strategic Plan

December 2004

Updated September 27, 2005

Introduction and Background

Industrial Engineering (IE) at the University of Washington (UW) offers robust programs for B.S.I.E., M.S.I.E., and Ph.D. degrees that prepare students for careers in an increasingly diverse and dynamic technological world. Industrial engineers focus on the integration of humans, machines, materials, energy, and information to achieve optimum performance of systems. The design and control of these systems requires knowledge in mathematical, physical, social and economic sciences, and the use of scientific methods including operations research, statistical methods, human factors, and systems engineering. This focus on the "big picture" makes industrial engineering one of the most people and customer-oriented of the engineering disciplines.

UW IE prepares students to serve as organizational change agents. Students are encouraged to take a systems view when solving problems, recognize the organizational and societal impact of technical decisions, develop good oral and written communications skills, participate in teams, and take initiative. Industrial Engineering has 95 undergraduate and 36 graduate students as of October 2004. Students play an active role in the program through the IE Student Advisory Board, the student chapter of the Institute of Industrial Engineers, and Alpha Pi Mu, the IE student honor society.

The most recent Bureau of Labor Statistics Report on employment in Engineering showed that Industrial Engineering is the fourth largest engineering discipline in the United States (13.1% of all engineering positions), behind Electrical Engineering (19.8%), Civil and Environmental Engineering (18.6%) and Mechanical Engineering (14.5%). Projections for growth in these disciplines until 2012 are for 3-9% for each, except for Industrial Engineering, whose growth is predicted to be 10-20%. UW IE is poised to support the emerging need for IEs.

The IE faculty excels in research, teaching and service. Faculty teach in the areas of engineering design, engineering education, human factors, large-scale assembly, manufacturing, optimization, quality and reliability, supply chain management, system integration, and virtual reality. IE's research portfolio is regularly supported by federal agencies such as the National Science Foundation, Office of Naval Research, and Air Force Office of Scientific Research, as well as companies such as Boeing, Ford, and Kodak.

Adjunct professors from Civil and Environmental Engineering, Environmental Health, Management Science, Mathematics, Mechanical Engineering, and Technical Communication as well as national and international visiting scholars enhance IE's teaching and research efforts. Industry representatives regularly assist in teaching and provide research and internship opportunities.

At a retreat in Autumn 2003, the faculty discussed research areas around which our efforts could coalesce. Two focus areas emerged: Integrated Logistics Systems and Bio-Industrial Systems. Integrated Logistics builds on the long-time strengths of industrial engineering, including operations research and supply chain management. Bio-Industrial Systems applies industrial engineering techniques primarily in the areas of healthcare, medical equipment and pharmaceutical manufacturing, virtual medical education and training, and statistical applications in medical and biological research. See Appendix I for a more detailed description of these two research focus areas, including potential collaborators within the University and industry.

In 1983 John Fluke, Sr. endowed the John M. Fluke Distinguished Chair in Manufacturing Engineering to support the development of an IE department at the University of Washington. The Industrial Engineering Program was formally initiated in 1984 by faculty members from Mechanical Engineering with educational and research interests in industrial engineering. The undergraduate academic program (BSIE) has been accredited by the Accreditation Board for Engineering and Technology (ABET) since 1986. In 1998 the M.S. and Ph.D. degree programs in Industrial Engineering were approved by the State of Washington.

Vision

The vision for Industrial Engineering is to achieve national and international prominence in industrial engineering education and research. IE is dedicated to providing highly skilled and versatile undergraduate, graduate, professional, and life long continuing education; innovative, creative research; and the integration of these activities on a regional, national and international level. Through excellence in education, research, and in partnership with industry, government, and the citizens of Washington, IE will continuously improve the way it educates students to nurture personal and professional growth.

Mission

Through educational excellence, innovative research, and service to the profession, Industrial Engineering provides human and technological system solutions in an increasingly global environment.

Values

- Cutting-edge, collaborative and innovative research.
- Strong partnerships between the academic and business/non-profit/industrial environments.
- A commitment to diversity in its broadest sense.
- Student-centered approach with a commitment to quality and continuous improvement.

Recent Accomplishments

Since our previous strategic planning effort in 1999, the IE program has developed a growing list of accomplishments.

Academic Programs Overview

The number of undergraduate students in IE has increased from an average of seventy before 1997 to a present count of 95. Thus our long-term goal of 100 undergraduate students has been practically achieved. The average GPA of students entering the program has risen steadily from 3.28 in 1999 to 3.41 in 2004. Following successful ABET and program reviews, the undergraduate curriculum has been completely revised to increase flexibility for students, and improve coverage of current topics. A major recent accomplishment was a successful 5-year review of our new Master's and Ph.D. degrees in IE. IE's graduate program had 33 graduate students (16 M.S., 17 Ph.D.) in 1999. As of December 2004, there were 36 graduate students (10 M.S., 26 Ph.D.), which is approaching our long-term target of 50 (30 M.S., 20 Ph.D.).

The IE program is committed to diversity. Industrial Engineering actively recruits women and under-represented minorities. One half of the IE faculty are women and an African-American woman assistant professor was hired in Autumn 1999. As of December 2004 there were 43 women among 131 students. Under-represented minorities comprise 6 of 131.

"The passion that the faculty and staff have for the department and industrial engineering in general makes the UW a great place to learn. The faculty and staff truly want the students to succeed and accomplish great things." David Wong, 2004 graduate

Undergraduate Program

- *Curriculum Restructuring*

After two years of discussion with faculty, students, and industry, a new undergraduate curriculum was approved that provides a strong foundation in engineering, while adding flexibility to student course electives. This gives students and IE the ability to respond more quickly to the demands of a changing world.

- *Internship Program*

Another enhancement to the undergraduate student experience is the newly proposed Internship Program. In short, IE plans to provide 100% internship availability for our students. Primarily coordinated by the IE Visiting Committee, the program gives students valuable work experience while attending school. Such experience is crucial to putting prepared engineers in the field.

- *International Exchange Program*

In cooperation with seven institutions located in the United States, France, Spain, and the United Kingdom, UW IE was awarded a grant from the U.S. Department of Education. The \$205,000 3-year grant supports the PRESTIGE program – Preparing Engineering Students To Work In the Global Economy. The project is bringing together 300 American, English, French, and Spanish students into transnational design teams using information technology to create virtual shared environments that are increasingly typical of modern industry, and support the travel of 40 students for study and internships abroad.

- *Alpha Pi Mu*

A charter for a chapter of Alpha Pi Mu (APM) the IE honor society was granted in December 2000. APM recognizes students who have shown exceptional academic abilities in the industrial engineering field and encourages the advancement of engineering education. APM has been an active organization sponsoring workshops to encourage students to continue their education and providing outreach activities to local inner-city high schools.

- *BSIE/MBA Program*

Industrial Engineering created a five-year academic program with the Business School that leads to two degrees: a Bachelor of Science in Industrial Engineering and a Master of Business Administration. Students complete the usual BSIE degree requirements with one exception – the BSIE technical elective requirement is replaced with MBA elective courses. The first students graduated from the program in 2004.

- *Mock Interviews*

Mock Interviews were initiated by the IE Visiting Committee and the Puget Sound chapter of the Institute of Industrial Engineers. Mock Interviews allow students to practice their interviewing techniques in an informal setting with industry representatives. It has become one of the most popular events of the year.

- *Freshman Admissions Policy*

The faculty implemented a new freshman admissions policy to capitalize on the recruitment of high-quality incoming students. The goal is to integrate these students into the IE student community, provide them with IE program advising services, and start them thinking about the internship program as soon as they arrive at the University.

- *Scholarships*

The process for awarding undergraduate scholarships was restructured. The dollar amount of awards was increased and scholarships are now used for both recruitment and retention purposes. In addition to the Ron Crockett scholarship endowment, IE was awarded scholarship money from a successful proposal to the Boeing Corporation.

- *IE 101*

A new course introducing students to industrial engineering was developed and first offered in 2003. The Student Advisory Board began developing the concept for the course three years before. The goal of IE 101 is to attract new students and provide other majors with information about industrial engineering as a field. In addition to pre-majors, students from Accounting, Applied Math, Art, Architecture, Business Administration, Chemical Engineering, Civil and Environmental Engineering, Economics, General Studies, History, Information Sciences, Math, Philosophy, and Physics have completed the course.

- *New Student Orientation*

A new student orientation for undergraduates was instituted in 2000 to introduce new students to IE.

- *Revision of Recruitment and Informational Materials*

New undergraduate and senior design brochures were created. The IE web page was redesigned.

"IE is not so crowded that you get lost in it. You can show yourself both socially and academically while studying in one of the nation's top ranked IE programs with IE professors who are among the nation's best." Dr. Berkin Toktas, 2004 Graduate

Graduate Program

- *Recruitment*

A proposal to the Graduate School in 2001 resulted in a 40% increase of IE's allocation for recruitment support, giving IE an advantage in recruiting outstanding graduate students. More recent proposals increased travel monies available for students to present papers at conferences.

- *Teaching Assistant Coordinator*

Professor Zelda Zabinsky was appointed to fill the newly created position of Teaching Assistant Coordinator that provides consistency and uniformity regarding assignments and expectations.

- *Assistantship Policies*

Written policies were developed for the awarding of RA/TAs. IE now awards assistantships when possible on a yearly basis instead of quarterly to attract top-notch students.

- *Graduate Student Research*

In the academic year 2003-2004, the graduate students had a combined total of 35 publications and conference presentations.

- *Revision of Recruitment and Informational Materials.*

New graduate brochures, a graduate recruitment poster, and faculty research files were created. The IE web page was redesigned.

- *U.S. News and World Report Rankings*

The graduate program was ranked 25th in the nation in the 2005 edition of U.S. News and World Reports Best Graduate Schools.

"The Industrial Engineering faculty is involved in cutting edge research, which has long-term, global implications. The increasingly collaborative nature of the research means that not only are we working in a broader range of topics, but we are also impacting a wider range of needs. Each faculty member brings world-class expertise to individual and collaborative work." Dr. Richard L. Storch, IE Professor and Acting Director

Research

- *Center for the Advancement of Engineering Education*

Professor Cindy Atman is the director of the Center for Engineering Learning and Teaching. She is also the principle investigator on a \$10 million grant from the National Science Foundation to establish the new Center for the Advancement of Engineering Education. Center researchers are investigating the engineering learning experience and applying the findings to classroom practices. The leadership team consists of researchers from CELT and the UW College of Education. Partner universities include the Colorado School of Mines, Howard University, Stanford University, and the University of Minnesota.

- *Humanitarian Relief Efforts*

Professor Benita Beamon has ventured into a new field of research in partnership with Technical Communication and the Evans School of Public Affairs. By bringing together techniques from Supply Chain Management, Information Technology, and Public Policy, the research team is seeking to affect the way organizations handle humanitarian relief efforts. With a research grants from the Fritz Institute and the University of Washington, the team is developing an interdisciplinary Humanitarian Logistics Program at the University of Washington. Professor Beamon's research will have a global impact on how the world responds to disasters.

- *Human Interface Technology Laboratory*

The HIT Lab was established in 1989 by Professor Tom Furness. Over the past 15 years the Lab has advanced interfaces between humans and machines. The lab fosters a multidisciplinary environment involving 100 faculty, staff and students from the College of Engineering, College of Arts and Sciences, College of Architecture and Urban Planning, College of Oceans and Fisheries and the School of Medicine. In 2002 the UW entered into a partnership with the Canterbury Development Corporation and University of Canterbury to establish a HIT Lab NZ based in Christchurch, New Zealand. UW doctoral graduate, Mark Billingham, was named the director. Other HIT Labs are being planned for Singapore, Australia, Taiwan and France. The federation of HIT Labs will promote collaborative projects, merging of intellectual property and exchanges of students.

- *Safety in Pacific Northwest Orchards*

Professor Kailash (Kal) Kapur has been collaborating with researchers in the Department of Environmental Health on a project to identify and prevent injuries to workers in Pacific Northwest Orchards. In particular, this work has resulted in advances in ladder safety.

- *Multivariate Quality Control*

Professor Mastrangelo is continuing her on-going work in the area of modern quality technology. Specifically, she has been working in multivariate quality control applications to semiconductor manufacturing. She has also been involved in data analysis applied to emergency medical response delivery systems.

- *National Shipbuilding Research Program*

Professor Storch continues his long standing involvement in the National Shipbuilding Research Program, including participation in the Center of Excellence for Shipbuilding Technology. This Center supports research across a broad spectrum of topics, including distortion prevention in thin steel panels, laser welding and cutting technology, and wireless condition based maintenance applications.

- *PRESTIGE Program*

As a result of the growing globalization of industry, Professor Storch has become involved with an international consortium to foster understanding of global engineering design. The consortium is developing interchangeable teaching modules, provides for international exchange of students, and performs international, collaborative student design projects.

- *Air Traffic Flow Management*

As part of a five-year grant from the Boeing Company, Professor Zelda Zabinsky and Affiliate Professor Joyce Yen have been developing analytical models that will help address high air traffic volume under stochastic weather conditions. By offering solutions that can withstand some of this uncertainty, better use can be made of the airspace, therefore reducing delays and the impact of propagating effects.

- *Port Security*

Professor Zelda Zabinsky and a team of graduate students are exploring the different options available to keep up with increasing global trade while protecting commercial businesses from threats of terrorist attacks, illegal immigration, illegal drugs and other contraband. In 2002 the Ports of Seattle and Tacoma handled a combined 2.9 million containers and are considered one of the top three largest load centers in the nation. Professor Zabinsky is working to develop security measures that will offer greater port security.

- *Port of Tacoma Efficiency*

In order to better serve future and existing clients of the Port of Tacoma, a simulation study was performed to analyze sources of potential concern and overall system performance under increased demand. Professor Zelda Zabinsky is working in collaboration with the Port of Tacoma and Tacoma Rail to understand the implications of increased growth on delay times and resource utilization. Their efforts have been focused on developing a simulation model to accurately portray the Port activities, and incorporate techniques of statistical analysis to examine system performance under various scenarios.

- *Adjunct faculty*

Adjunct professors from Civil and Environmental Engineering, Environmental Health, Management Science, Mathematics, Mechanical Engineering, and Technical Communication have been appointed and added to IE's research endeavors.

"Since the IE department is relatively small, it offers individual attention to students. It is unique to have a university department make you feel like family." Chau Lam Hegg, graduate student.

Community

- *The IE Student Advisory Board*

The IE Student Advisory Board was initiated in May 1999 shortly after the last strategic plan was published. The SAB is a committee of undergraduate and graduate students who advise IE on a variety of issues. The SAB is unique in that it incorporates student representatives from all of the student groups in IE. The SAB has launched several initiatives including IE 101, the annual ski trip, the end of the year cruise and celebration, and the redesign of the Outstanding IE Awards. Students learn leadership skills by taking turns chairing meetings and serving as the secretary.

- *The IE Visiting Committee*

The first meeting of the IE Visiting Committee was held June 1999. IE is fortunate to have an active and supportive Visiting Committee representing industry and the community. Members of the committee are spearheading the new Internship Program, serve as interviewers in the yearly Mock Interviews, serve as judges for Senior Design, provide advice on IE initiatives, and contribute financially to the program.

Each June there is a joint meeting of the SAB and VC. It is the most popular meeting of the year.

- *Student Chapter of IIE*

The student chapter of the Institute of Industrial Engineers (IIE) has been revitalized under the direction of Professor Benita Beamon. The student chapter has received silver and gold awards from the National IIE for each of the past four years.

- *Alpha Pi Mu*

A charter for a chapter of Alpha Pi Mu (APM), the IE honor society, was granted to the University of Washington in December 2000. APM recognizes students who have shown exceptional academic abilities in the industrial engineering field and encourages the advancement of engineering education. APM has focused its efforts on high school outreach and graduate school opportunities.

- *The New IE Alumni Association*

The first meeting of the new IE Alumni Association was held recently. The group's first project was to organize an alumni gathering held on November 6, 2005, the day of UW Homecoming.

- *IE Publications*

The first edition of the new IE newsletter was launched Spring 2002 and continues to be published each year. Year-end research reports were published 2000-2003.

"Working in IE is like lean manufacturing: just enough people to get the job done well, highly responsive communication when it counts, and capitalizing on the strengths that each person brings to the department. IE values its staff AND we get to work with the best students on campus." Claire Fraczek, academic counselor

Operations

- *Facilities*

A successful minor modifications proposal garnered \$99,000 from the College to remodel existing space. A new undergraduate lab was established in room 153, a room three times the size of the previous lab. In addition, the number of computers available for student use was increased from 8 to 18. The graduate student area was cleaned of debris, 23 new cubicles installed, and a grad computer lab established. An IE Student Resource Center was established in MEB 105. A reorganization of administrative offices created the first designated advising area and provided a more visitor friendly environment.

A recent minor modifications proposal provided new computer tables for MEB 106 and ergonomically correct chairs for the graduate and undergraduate labs and offices. Construction for

Professor Beamon's Production Systems Lab was funded by the College of Engineering in AERB. Five offices were secured in Seig Hall for lecturers and visiting faculty.

- *Computing*

A proposal to the Student Technology Fee Committee garnered \$35,358 for new computers in the Undergraduate Computer Lab

- *Personnel*

The fiscal analyst was awarded the College of Engineering Outstanding Staff Award in 2003. The administrator was awarded the University Distinguished Staff Award in 2000.

The staff was successfully restructured in 1999. Later that year a successful proposal to the College gave IE the ability to hire a full-time computer support position. Previously computer support was provided by a part-time student helper and not adequate to address the needs of the program. IE has been able to recruit and retain many top-notch employees. Only one permanent staff position has turned over in the last several years and IE was able to hire an outstanding replacement.

- *Efficiency*

The staff spearheaded a program-wide effort to eliminate bureaucracy, construct simple, efficient administrative procedures and develop transparent procedures and policies where none existed. The effort is continuous. Recent projects include the remodeling of administrative areas.

- *Resources*

The staff has actively engaged in financial planning thereby increasing the amount of money available to IE in carry forward accounts by 56%.

Stakeholders

There are many individuals and organizations that have vested interests in the development and existence of Industrial Engineering at the University of Washington.

- ❖ **Students:** The most prominent stakeholders are our students, both undergraduate and graduate, who wish to take advantage of the abundant and increasing opportunities offered by a career in IE.
- ❖ **Industry:** Another set of stakeholders are the businesses and industries that employ industrial engineers, and apply the results of research that are relevant to industrial applications.
- ❖ **University Community:** The University of Washington as a whole benefits from IE through interaction with faculty in multidisciplinary efforts, courses that are offered to all UW students, research opportunities, and bringing the diversity of engineering disciplines to the UW.
- ❖ **Other Universities:** Other academic institutions are also stakeholders in the sense that faculty are members of the research community and there is a cross-fertilization between undergraduate and graduate students, and faculty of other academic institutions.
- ❖ **State of Washington:** As the only IE program in the state, IE has a significant impact on Washington through educating its citizens, attracting top notch students and money (research and industrial support) into the state, transferring research advances to local industry and the employment of IE alumni.
- ❖ **Professional Community:** The industrial engineering professional community is enhanced by the IE program at the UW as faculty and students participate in research conferences and lead research activities in furthering the field of IE.

Industrial Engineering Goals

There are two sets of goals discussed in this section. The first set supports the mission of UW IE directly and are, therefore, core to the fundamental purpose of the program. The second set are five year goals and provide for the long range viability and effectiveness of IE. Continuous improvement in all goals is a desired outcome of the process. Even though separated into two categories and listed in general priority orders, it should be emphasized that all goals are interrelated.

Goals that support the mission:

1. Educate successful graduates.

Ultimately, IE will be known by the quality of graduates. Our undergraduates are accepted into top-notch graduate schools as well as actively recruited by highly regarded employers. Similarly, our graduate students will become faculty members, in addition to attaining jobs in industry and consulting companies. It reflects well on us when our graduates take their places as productive members of the IE professional community.

2. Increase the quality and quantity of research.

IE seeks out research funding and competes successfully for these resources. In addition to federal funding, we look to corporate sponsors, private foundations and other governmental agencies for research opportunities. We pursue interdisciplinary research efforts with other departments and increase the number of publications in well-regarded journals by our faculty. IE strives not only to adapt to new technology, but to be on the cutting edge of it.

3. Integrate/link educational programs with research activities.

IE pursues opportunities that link our educational programs with our research efforts. We will create innovative learning opportunities for both graduate and undergraduate students.

4. Increase national and international reputation.

IE seeks to achieve national and international prominence in Industrial Engineering education and research. This goal is so intertwined with other goals, that it cannot stand alone. As we improve our undergraduate and graduate programs and increasingly attract research funding and publish the results, our reputation will improve.

Five Year Goals and Action Plan (to be achieved by 2009)

The following five-year objectives support the mission and vision of Industrial Engineering. A brief description of each objective is provided, followed by action steps and the metrics that will be used to measure achievement.

1. Establish a collaborative research focus area in Integrated Logistics Systems and Bio-Industrial Systems.

As mentioned previously, the faculty developed research focus areas around which their efforts could coalesce. Two focus areas emerged. Integrated Logistics Systems builds on the long-time strengths of Industrial Engineering, including operations research and supply chain management. Bio-Industrial Systems applies industrial engineering techniques primarily in the areas of healthcare, medical equipment and pharmaceutical manufacturing, virtual medical education and training, and statistical applications in medical and biological research. (See Appendix I for more detailed descriptions of these areas). This puts UW IE in a position to capitalize on the opportunities provided by Seattle and the Pacific Northwest.

Action steps:

Recruit a prestigious national or international scholar (by Autumn 2008).

Recruit a junior tenure track faculty member (by Autumn 2006).

Submit collaborative proposals targeted to these research focus areas reflecting regional and UW strengths (on-going).

Measurement of Progress:

- o Hire for the positions.
- o Research funding in the strategic research areas of Integrated Logistics Systems and Bio-Industrial Systems.

2. Increase faculty size.

IE hopes to increase faculty size over the next five years to increase course offerings, expand research opportunities, and enhance interactions with industry. IE faculty and IE as a whole will pursue collaborative projects with other units with an eye toward establishing new faculty positions. IE will also work to establish research faculty positions. As of December 2004, IE had 9 faculty lines, representing 7 2/3 FTEs. IE will work with the College of Engineering to maintain these positions and pursue additional strategies to increase the faculty size.

Action Steps:

Pursue joint faculty appointments with other units on campus, for example, Management Science, Environmental Health, Computational Finance, and Health Sciences (on-going).

Submit proposals to fund research faculty positions (on-going).

Measurement of Progress:

- o Number of faculty positions created from collaborations
- o Number of faculty positions created from research dollars
- o Number of new tenure track faculty positions

3. Foster research collaboration among IE faculty and between IE faculty and faculty from other departments.

Through research funding in the strategic research areas of Integrated Logistics Systems and Bio-Industrial Systems, new interdisciplinary research collaborations will be established. Existing collaborations have already arisen from the new focus areas including humanitarian relief efforts with Technical Communications and the Evans School of Public Affairs, ergonomics and system safety with the Department of Environmental Health, and computational finance with Statistics and the Business School. These new efforts will be strengthened. Efforts will be made to increase the interactions between the centers run by IE faculty members and the IE program.

Action Steps:

Seek new collaborative research projects among IE faculty (at least two proposals per year on average).

Pursue collaboration opportunities with other units (on-going with a goal of several proposals per year).

Measurement of Progress:

- o Number of collaborative projects among IE faculty and between IE faculty and other units
- o Amount of research money awarded for collaborative projects
- o RAs supported per faculty member
- o Interdisciplinary research centers established
- o Publications
- o Conference presentations
- o Service and leadership in professional societies

4. Continue to improve the accessibility of IE for women and traditionally under-represented minority students, faculty, and staff.

IE wants to attract the best and brightest students with the widest range of talents from all segments of society. Working productively with people of different backgrounds and experiences enhances student abilities to solve real-world problems in an increasingly diverse nation and world. Diverse viewpoints create a richer educational experience for everyone through creativity and innovation. IE provides a better education by being more reflective of the world at large.

Action Steps:

Give presentations about IE to the student chapters of the Society of Women Engineers, the American Indian Science and Engineering Society, the National Society of Black Engineers, and the Society of Hispanic Professional Engineers (annually).

Meet with advisors from the Minority Science and Engineering Program and the Mathematics, Engineering, Science Achievement Program (annually).

Work with Alpha Pi Mu to give presentations to inner-city schools about IE (annually).

Outline a program to support retention efforts (by Autumn 2006).

Measurement of Progress:

- o Outreach activities
- o Number of women and under-represented minorities applying to IE
- o Number of graduate and undergraduate women and under-represented minority students
- o Number of women and under-represented minority faculty and staff
- o Retention of women and under-represented minorities

5. Increase interaction with industry.

IE will initiate collaborative research and training efforts with industry with a focus on the IE Visiting Committee and Senior Design projects. IE will seek to increase the number of companies providing work opportunities (internship, co-op and career positions) to IE students and graduates.

Action Steps:

Offer 100% internship availability to students (by Autumn 2006).

Continue to actively engage the IE Visiting Committee (annually).

Conduct relevant research with industry support (on-going).

Increase the breadth of senior design course projects (on-going and add a new industrial partner annually).

Measurement of Progress:

- o Number of internships available
- o Percentage of students completing internships
- o Number of companies providing internships
- o Number of industrial research projects
- o Number of companies involved with Senior Design

6. Improve the faculty mentoring and development process.

IE faculty will increase efforts in mentoring faculty at all levels of their careers. IE will institute a formal mentoring process and provide development opportunities for all faculty and students in research and teaching.

Action steps:

- Design and adopt a formal mentoring process (by Autumn 2006).
- Provide professional development opportunities (on-going).

Measurement of Progress:

- o Number of successful promotion and tenure cases
- o Faculty retention

7. Continue to improve the graduate program.

A graduate degree program is critical to a viable Industrial Engineering program at the University of Washington. Established in 1998, the MSIE and PhD programs were reviewed positively by the Graduate School in 2003, but there is a need for continuous improvement.

Action Steps:

- Strategically increase number of graduate course offerings to complement developing research areas (by Autumn 2008).
- Enhance the MSIE curriculum (by Autumn 2007)
- Pursue a joint MSIE/MBA program (by Autumn 2007).

Measurement of Progress:

- o Number of students supported
- o Number of publications by students
- o Number of conference presentations by students
- o Fellowships, honors and awards for graduate students and recent graduates

8. Improve student research and professional development opportunities.

Professional activities are an important complement to classroom-based learning. IE wants to enhance the learning experience of students through research activities and involvement in professional societies and continue to attract high caliber students. As noted in the 2003 IE Review Committee Report "the undergraduate program is a strength of the IE Program and produces qualified enthusiastic students who are well appreciated by industry." IE will continue to improve opportunities for all students.

Action Step:

8a. Continue to integrate research and teaching (on-going).

Measurement of Progress:

- o Number of undergraduates involved in research
- o Number of undergraduates involved in UW Undergraduate Research Symposium
- o Number of graduate student presentations at IE seminars.

Action Step:

8b. Increase professional society involvement (on-going).

Measurement of Progress:

- o Increased number of students participating in IIE

Action Step:

8c. Continue to attract a steady number of high caliber students (on-going).

Measurement of Progress:

- o Higher GPA and GRE of entering students
- o Number of graduate students funded
- o Improved selectivity
- o Percentage of under-represented groups

Action Step:

8d. Continue to improve the undergraduate program (on-going).

Measurement of Progress:

- o Teaching evaluations
- o Peer teaching reviews
- o Participation in teaching workshops
- o Alumni Surveys

9. Pursue new sources of revenue.

Financial resources support IE's missions and goals. IE will continue to pursue internal and external resources by aggressively seeking out research funding and developing financial support in the local IE professional community. We will develop relationships with alumni and industrial donors to create a fundraising base.

Action Steps:

Formalize the IE Alumni Association (by December 2005).

Involve the Visiting Committee in financial endeavors (by Autumn 2007).

Continue to pursue research funding (on-going)

Work with the College of Engineering Development Representative (on-going).

Measurement of Progress:

- o Research funding totals
- o Development dollars
- o Funding from new initiatives

10. Obtain departmental status.

Industrial Engineering is critical to the State of Washington and the Pacific Northwest. Its graduates are performing important roles in manufacturing industries and the evolving services arena. Their skills are applied in wide-ranging areas including quality control, lean manufacturing, supply chain improvement, simulation, and more.

The IE Review Committee noted that the “Dean of the College of Engineering should provide the criteria necessary for the program to become a full department. In response to those criteria, the IE Program should develop a plan to identify and meet the conditions needed for achieving department status and communicate them to the IE faculty and staff.”

Once departmental status is achieved, the University of Washington will be in the unique position of having the only IE department in the State of Washington that offers both undergraduate and graduate degrees in IE.

Action Steps:

Plan for reaching departmental status outlined by the Dean of the College of Engineering (by Autumn 2006).

Submit a proposal to form a department (by January 2008).

Measurement of Progress:

- o Departmental status granted by the College of Engineering and the University of Washington

11. Co-locate student labs, faculty, administrative, and graduate student offices.

The IE Review Committee noted that “all IE Program faculty, staff, and graduate students should be in one well defined contiguous space that will encourage interaction.” Currently housed in five different buildings, this would be a welcome change.

Action Steps:

Work with the College of Engineering to explore space alternatives (on-going).

Measurement of progress toward goal attainment:

- o IE housed in one building

People

Professor **Cindy Atman** is a leader in engineering education research. She directs both the University of Washington's Center for Engineering Learning and Teaching (CELT) and the National Science Foundation funded Center for the Advancement of Engineering Education (CAEE). In these centers, she and her colleagues employ research methods from cognitive engineering and the learning sciences to investigate issues in engineering education. Professor Atman's primary research interests are in issues of engineering design learning and students as emerging engineering professionals. She and her colleagues have conducted detailed studies to document student design processes and developed measures that can be employed to assess student learning of the design process. This research has long-term implications for informing the way that we teach engineering design to students. Professor Atman received a National Science Foundation (NSF) Young Investigator award to pursue this research.

Professor Atman is a member of the Institute of Industrial Engineers, the Human Factors and Ergonomics Society, the American Society for Engineering Education, the American Association for the Advancement of Science, and the American Education Research Association. In 2002 she was awarded the ASEE Chester F. Carlson Award for Innovation in Engineering Education. She received her Ph.D. in Engineering and Public Policy from Carnegie Mellon University, and has experience in both industry and government.

Professor **Benita Beamon's** primary research interests lie in the development of analytical techniques for use in the design and performance of material handling, production/distribution, and transportation systems. More specifically, her work has focused on two major areas: Material Handling Systems and Supply Chain Systems. Her work in material handling systems analysis and design involves the analysis of current material handling performance measures and the development and application of performability (performance and reliability) measures to material handling system design. Her work in the area of supply chain systems has focused on establishing relationships between supply chain performance and design for the purposes of improving supply chain evaluation, comparison, and improvement methodologies. Professor Beamon's current work extends her supply chain research to the domain of humanitarian logistics. The unpredictability of global emergencies (e.g., volcanic eruptions, war, earthquakes, floods) and the stakes associated with adequate and timely delivery dominate the uniqueness and challenge of managing the material flow of the relief chain, with the ultimate objective of quick-response delivery of people and supplies. Professor Beamon's work in humanitarian logistics focuses on establishing effective performance evaluation and management of humanitarian relief chains. This inter-disciplinary research project involves University of Washington colleagues from Technical Communication (Engineering) and Public Affairs (the Evans School). Her research work has been supported by the University of Washington's Innovation Fund, The Fritz Institute, The Boeing Company, Flow International Corporation, LensCrafters, Pierre Foods, Medtronic Physio-Control, and the National Science Foundation

Professor Beamon is the Faculty Advisor for the University of Washington chapter of the Institute of Industrial Engineers (the Industrial Engineering professional society) and Alpha Pi Mu (the Industrial Engineering Honor Society). She has also served as the Industrial Engineering coordinator for the College of Engineering Open House and the Industrial Engineering representative for pre-engineering and WISE (Women in Science and Engineering) student activities. On the national level, Professor Beamon has served on a National Science Foundation review panel, served as the Faculty Advisor for the College Industry Council on Material Handling Education's National Material Handling Student team that received Honorable Mention in 2001, and is currently an Associate Editor for the International Journal of Modelling and Simulation.

Professor Beamon received her PhD in Industrial and Systems Engineering from the Georgia Institute of Technology, her MS in Operations Research and Industrial Engineering from Cornell University, and her BS in Industrial Engineering from Northwestern University.

Professor **Tom Furness** is a pioneer in the development of interfaces between humans and complex machines. He has been a crusader for the past 24 years for building aircraft cockpits which take into account the perceptual organization of the human. Most of his work has centered on the concept of virtual interface technologies which prove a circumambience of three dimensional spatial information to the human using the visual, auditory and tactile sensory modalities. His current research involves the comprehensive development of affordable virtual interface technologies for industry and consumers with applications in medical imaging, virtual prototyping, prostheses for the handicapped, virtual classrooms and televirtuality. Prior to joining the University of Washington, Professor Furness served as the Chief of the Visual Display Systems Branch, Human Engineering Division of the Armstrong Aerospace Medical Research Laboratory (USAF), Wright-Patterson AFB, OH. While in this position, he developed and evaluated visually-coupled systems and virtual interface concepts to improve the communication of information and control functions with the pilot and in 1986 he organized the Super Cockpit program for the Air Force and served as the program director until leaving for the UW.

Professor Furness has lectured widely and written numerous technical articles associated with human interaction with complex machines and the use of virtual interfaces. He has made a number of television appearances including NOVA and CBS, BBC, CNN, ABC, NBC science programs. He is a member of the Human Factors Society, Association of Computing Machinery, Institute of Electrical and Electronic Engineers and the Society for Information Display. Professor Furness is co-editor with Prof. Thomas Sheridan at MIT of PRESENCE: The Journal of Teleoperators and Virtual Environments. He received his Ph.D in Engineering and Applied Science from the University of Southampton, England.

Professor **Kailash (Kal) C. Kapur's** research focuses on customer centered approach for quality and reliability engineering; system design, control and optimization; and integrated quality management system (IQMS), which also includes all the elements of six sigma. As a leader in the field of reliability, he is working to extend the area to include multi-state network reliability, as well as, applying these new principles to the evaluation of supply chain networks. In the area of six sigma implementation, he is focusing on the application of these principles to homeland security. His research in six sigma has also addressed optimization and modeling strategies for design for six sigma. He has done extensive consulting in reliability design and management, quality engineering, including Taguchi Methods and design of experiments, statistical process control and total quality management.

Professor Kapur has co-authored the book *Reliability in Engineering Design*, John Wiley & Sons. He has written chapters on reliability and quality engineering for several handbooks such as *Industrial Engineering* and *Mechanical Design*. He has published over sixty papers in technical, professional, and research journals and has recently given keynote addresses at international conferences. He is a member of the Institute for Operations Research and Management Science (INFORMS), the Institute of Industrial Engineers (IIE), the American Society for Quality (ASQ), and the American Society for Engineering Education (ASEE). Professor Kapur has received funding from NSF, the US Army, and companies such as General Motors and Ford. Professor Kapur received The Allan Chop Technical Advancement Award from the Reliability Division and The Craig Award from the Automotive Division of ASQ. He was elected a Fellow of ASQ and IIE. He received his Ph.D. in Industrial Engineering from the University of California, Berkeley.

Professor **Christina Mastrangelo**'s research is in the area of quality engineering concentrating on multivariate modeling methods for dynamic systems, where she has established herself as a leader in the research of correlated data streams. This research area is at the cutting edge of current work in quality control. It reflects the nature of newer manufacturing processes, characterized by short runs and the need for rapid detection of small shifts in processes. While there is general applicability of these techniques, the industry which has the greatest immediate need of further development and application of these research results is the semi-conductor manufacturing industry. Professor Mastrangelo has developed ties with major companies in this industry, including those with ties to the Northwest such as Intel. Her research has been funded by NSF, including a Career Award, as well as numerous companies such as Capital One and Boeing.

Professor Mastrangelo is an editorial board member for the *Journal of Quality Technology* and *IIE Transactions on Quality and Reliability*. She is a leader in the American Society of Quality Control/American Statistical Association and the Institute of Industrial Engineers. Her society memberships include the American Society for Engineering Education (ASEE), American Society for Quality (ASQ), American Statistical Association (ASA), Institute of Industrial Engineers (IIE), Institute for Operations Research and Management Sciences, International Council on System Engineering, and Women in Engineering Program Advocates Network. She received her Ph.D. in Industrial Engineering from Arizona State University.

Professor **Richard Storch** is a leading researcher in productivity improvement as applied to shipbuilding. His work involves a variety of topics including dimensional quality control, work organization, lean implementation and system design, and design for production. Large assembly industries such shipbuilding face challenges in adapting and implementing modern manufacturing approaches. Professor Storch's major on-going research has involved the definition and adaptation of group technology and mass customization for shipbuilding. The principles of group technology applied to the manufacturing and assembly operations, and mass customization applied to design, are critical to moving away from one-of-a-kind or custom production. Professor Storch's recent work has focused on a new definition of the design process, which allows for rational decision-making in choosing the proper stage at which to employ mass customization while still satisfying customer requirements for the end product. His other on-going work has involved the definition of lean principles for shipyards including flow, visual controls, quality and dimensional control, work station design, and material management.

Professor Storch is the lead author of the text *Ship Production* and publishes frequently in the *Journal of Ship Production* and *Production Planning and Control*. He also commonly presents his research findings at the Ship Production Symposium and the International Conference on Computer Applications in Shipbuilding. He is a member of the Ship Production Committee, the Society of Naval Architects and Marine Engineers (SNAME), International Federation of Information Processing (IFIP) Work Group 5.7, Institute of Industrial Engineers (IIE), and American Society of Naval Engineers (ASNE), and serves as the editor of the *Journal of Ship Production* and on the editorial board of the *Journal of Marine Science and Technology*. He received his Ph.D. in Mechanical Engineering from the University of Washington.

Professor **Zelda Zabinsky**'s research in global optimization is internationally recognized. Her recent book, titled *Stochastic Adaptive Search in Global Optimization*, present state of the art research on theory and algorithms to the optimal design of stiffened composite panels with manufacturing constraints. This research has led to a design tool in use by Boeing engineers for the design of large composite structures (e.g. composite fuselage or wing). Providing engineering with the capability to optimally design cost-effective composite structures will increase the

competitiveness of US-based industries including the aerospace industry, the naval industry (e.g. design of composite engine hoods or body panels). Professor Zabinsky is also extending optimization methodologies to address uncertainty within a complex system. One of her current projects is to apply optimization to the management of air traffic flow under stochastic weather conditions to reduce airline delay. She has also worked on applications of Operations research in manufacturing, production, transportation, health care, and forestry.

Professor Zabinsky has published numerous papers in the areas of global optimization, algorithm complexity, and optimal design of composite structures. Her work has appeared in *Mathematical Programming*, *Journal of Global Optimization* and the international journal *Composite Structures*. Her research has been funded by Boeing Commercial Airplane Company, NASA, FAA, and NSF. She is a member of the Institute of Industrial Engineers (IIE), the Institute for Operations Research and Management Science (INFORMS) and the Mathematical Programming Society (MPS). She received her Ph.D. in Industrial and Operations Engineering from the University of Michigan.

The IE Strategic Plan was approved in December 2004 by the Industrial Engineering faculty: Cynthia J. Atman, Benita M. Beamon, Thomas A. Furness III, Kailash C. Kapur, Christina M. Mastrangelo, Richard L. Storch, Tony C. Woo, and Zelda B. Zabinsky.

The Updated IE Strategic Plan was approved in September 2005 by the Industrial Engineering faculty: Cynthia J. Atman, Benita M. Beamon, Thomas A. Furness III, Kailash C. Kapur, Christina M. Mastrangelo, Richard L. Storch, and Zelda B. Zabinsky.

Appendix I – Research Focus Areas

Bio-Industrial Systems Research Focus Area

The Industrial Engineering Program at the University of Washington seeks to strengthen, enhance and expand a research focus in bio-industrial systems. The goal is to become a focal point for collaborative research in this area, applying Industrial Engineering principles in combination with a wide variety of other specialties. This area of research includes:

- health systems design and improvement,
- simulation and modeling of biological processes,
- manufacturing of biological products,
- environmental protection and improvement in health care systems and biological product manufacturing,
- quality and reliability systems in health care systems and biological product manufacturing,
- the virtual human model development,
- visualization and representation of biological processes,
- human factors in health care, and
- computational methods in biological processes

The Industrial Engineering Program at the University of Washington will build on the current strengths and research activities of the faculty and the synergy offered by collaboration with other researchers in the College of Engineering, and the Medical School and the School of Public Health and Community Medicine. Additionally, the Pacific Northwest is a major center for research and development in medical equipment, pharmaceutical research, and health care advancement. These resources and collaborative opportunities will also be expanded and enhanced.

Integrated Logistics Systems Research Focus Area

The Industrial Engineering Program at the University of Washington seeks to strengthen, enhance and expand a research focus in integrated logistics systems. The goal is to become a focal point for collaborative research in this area, applying Industrial Engineering principles in combination with a wide variety of other specialties. This area of research includes:

- quality, reliability and maintainability in logistics systems,
- risk analysis,
- life cycle costs and economic analysis,
- environmentally-conscious manufacturing,
- supply chain management,
- globalization and international policy issues,
- production systems, including inventory management,
- operations engineering,
- network optimization,
- transportation and distribution,
- air traffic management,
- natural resources,
- electric power distribution,
- robust/survivable systems,
- human systems in logistics, and
- security hardware and software

The Industrial Engineering Program at the University of Washington will build on the current strengths and research activities of the faculty and the synergy offered by collaboration other researchers in the College of Engineering, the Business School, the Evans School of Public Affairs, the College of Architecture and Urban Planning, and the Jackson School of International Studies. Additionally, the Pacific Northwest is a major center for trade, especially involving the Pacific Rim, and has a significant industrial base involved in international trade. These resources and collaborative opportunities will also be expanded and enhanced.