WPI is widely recognized for the quality of our undergraduate programs and recently has achieved status as a Doctoral Institution. Furthering strength in the area of graduate education and research is vital to the educational mission of WPI at both the Undergraduate and Graduate levels. This fact is underscored by the recent reports from NSF and NSB (see below) that emphasize the critical need to integrate research and education. Strength in research through graduate education will enhance the educational opportunities available to our undergraduate project students and provide valuable direct exposure to faculty scholarship. Investment in both levels of education will have a synergistic effect on the quality and recognition of our undergraduate and graduate programs. A specific goal for WPI is to raise the national reputation for our undergraduate and graduate programs. This goal can be realized with substantial investment in our graduate programs and research activities beginning now and extending over the next ten years. The National Research Council's peer review of scholarly quality provides an important tool for assessing our progress in this area. This decennial poll will next be conducted in 2005. Investing in our graduate programs starting now will certainly have a significant positive impact on WPI's ranking in this poll. It is our goal to achieve collective and individual rankings in the top fifty in this poll. This goal which is also stated in the Scholarship Initiative can only be realized by addressing those additional aspects which are included here in conjunction with the Scholarship Initiative. Due to the integral nature of research, scholarship and graduate education there exists significant overlap between the PIC Graduate Studies and Research Initiative and the PIC Initiative on Scholarship. Thus dual recommendations from these initiatives are noted by the letter "D".

PIC recommends that the subcommittees on Graduate Studies and Research and Scholarship collaborate in their discussions to provide recommendations and costing for these initiatives.

PIC further recommends that CGSR work to establish a vision for Graduate Education at WPI. This vision should define our goals for growth in quality and numbers for the graduate program. For example is the goal to increase numbers and quality or to maintain our size but only improve on quality?

PIC has assembled the following three point strategy designed to enhance graduate education and research at WPI.

- Improve the Infrastructure at WPI to Support Graduate Studies and Research
- Promote Faculty Development to Encourage Excellence in Graduate Studies and Research
Worcester Polytechnic Institute

- Enhance the Environment to Create a Campus Culture Conducive to Graduate Studies and Research

**Improve the Infrastructure at WPI**
Infrastructures includes both facilities and personnel. Enhancements in each area are required to further efforts in Graduate Studies and Research at WPI.

**Facilities: Develop concerted approaches to bring existing facilities up to date and to create new facilities to support emerging programs. These activities are fundable through Campaign donations, Foundation Requests (Pew, Keck, Howard Hughes Medical Institute to name a few) and the NSF. Some will require matching funds from the institute. At the outset we could provide donors with the challenge to match funds for successful proposals.**

(D) **Endow a Laboratory Renovation Fund**
We recommend the creation through the capital campaign of an endowed renovation fund. This perpetual fund would be distributed on the basis of research and renovation proposals according to the perceived long-term impact on WPI. A key element in any such proposal will be the proposed follow-through by the recipient with regards to projected revenues and potential to attract new external funding. A newly formed Research Development Council (see below) would review and make recommendations for the funding of such proposals.

**Solicit Donor Interest in Supporting Construction Projects**
PIC recommends that donors be solicited for their interest in providing support for new facilities. These are needed to foster improved teaching, undergraduate and graduate research. For example a "Life Sciences" Building which would house Biology, Chemistry, Biochemistry and Biomedical Engineering addresses urgent needs for facilities, impacts on the majority of our undergraduates who do course work in these areas, recognizes emerging programs and leads to greater campus diversity (currently 45% of the female undergraduate population is enrolled in these areas). Every academic program and multidisciplinary effort is a potential candidate in these solicitations. The responses will be invaluable in planning the future growth of our campus well beyond this campaign.

**Establish a Mechanism for Cost Sharing**

- **Establish an Endowed Cost Sharing Fund**
  This fund will support faculty efforts to obtain grants for equipment, facilities and graduate students. Many programs such as those offered by NSF and NIH require cost sharing commitments as a prerequisite for funding.

- **Solicit Donor Participation**
  Solicit donor interest for participation in matching fund programs and 'gifts in-kind' for future initiatives tied to their programmatic interest.

**Establish an Endowed Maintenance Fund**
This will be used to ensure continual upkeep of facilities and replacement of research equipment.

**Personnel: Develop personnel resources which are critical for support of Graduate Studies and Research**

*(D) Endow Undergraduate Research Experience Fellowships*

The early experience of students is of paramount importance to their academic development. Many undergraduates leave WPI without ever having contact with the scholarship of the faculty except indirectly through course content introduced by the faculty. In the interest of expanding the interests and acumen of undergraduate students, we recommend a capital campaign effort to obtain endowed funding for undergraduate research experiences connected to faculty scholarship. These fellowships may either take the form of summer stipend support, or, financial aid linked to assisting specific faculty in their efforts.

*(D) Increase the Number of Endowed Graduate Student Fellowships*

This form of graduate student financial aid is widely recognized as beneficial to both the graduate student and the academic program. High quality graduate students can be attracted to a department by the availability of a fellowship. As a result of their presence, the quality of classroom education, department environment and faculty research are favorably impacted. Where such opportunities arise in the capital campaign, PIC urges development of new endowed graduate fellowships.

**Strengthen Graduate recruiting and retention.**

- Increase number of endowed Graduate Summer Research Fellowships. These funds would be used to supplement academic year support resulting in competitive 12 month stipends.

**Increase support staff**

- Hire staff for the maintenance and operation of equipment and development of programs.
- Expand operation of the Research Administration Office with a "Research Advocate" who would promote linkages with funding agencies, identify and publicize new funding opportunities and facilitate the preparation and submission of proposals.

**Promote Faculty Development**

*(D) Re-Establish the Research Development Council*

We recommend the re-establishment of the Research Development Council (RDC) and making that council a formal sub-committee of CGSR. Members of the RDC would be selected based upon their demonstrated excellence in research. The new RDC would:

1. Administer an internal renovation and seed grant program;
2. Mentor faculty supported by the internal grant program;
3. Encourage interdisciplinary interactions within the context of its grant program and mentorship roles.

4. Engage in on-going dialog with the Provost's Office regarding policies relevant to the execution and promotion of quality scholarship such as appropriate student/faculty ratios, teaching expectations, loading models, growth of the graduate program, rewards and incentives;

5. Engage in on-going dialog with University Relations to identify areas of potential growth that can be assisted with appropriate gifts for equipment and space renovation;

6. Engage in on-going dialog with the Provost's Office and Research Director's Office to present faculty viewpoints on important issues arising in the establishment of flourishing funded research activities. Such issues include: intellectual property policy, RA and TA stipends, cost sharing policy, travel and professional development funds, research incentive funds, etc.

7. Provide input into the budget development process at the level of BDAC.

(D) Endow a Seed Money Fund to Support the RDC
This perpetual fund would be administered by the members of the RDC and would be distributed on the basis of research proposals according to the perceived potential for development of external funding. A key element in any such proposal will be the proposed follow-through by the recipient with regards to acquiring new external funding. After an award, the RDC members would actively participate as mentors in helping the recipient achieve acquisition of external funding.

(D) Establish Rotating Research Chairs for Young Faculty
The first few years comprise the most critical point in a faculty member's career. Without proper assistance towards development of scholarly achievement, both the individual and the institution suffer from a lost opportunity. We strongly recommend the establishment of endowed, rotating research chairs that provide some mix of increased release time, summer salary support of discretionary funds for travel, equipment and supplies that can help launch these careers in a fruitful direction. Industrial sponsorship of these chairs is an appropriate target for the capital campaign effort and beneficial in the sense of creating an immediate network of industrial contacts for the new faculty chair and their advisees.

Establish Endowed Chairs for Senior Faculty
Chairs which recognize achievement in the field would be used to attract high profile scientists and engineers to WPI. One suggestion for funding the endeavor is through our current endowment. A series of five 5 million dollar allotments would be used to endow five chairs. Thus the endowment is not decreased but rather redistributed. Each chair would fund a "star" in a field that dovetails with good work the faculty are already doing here; The net result will be that WPI's reputation is startlingly enhanced in almost no time at all. PIC recommends that a council be established to identify these stars and formulate a mechanism for bringing them in. This activity could fall under the aegis of CGSR or the newly established Research Development Council.

Develop a System of Awards Which Recognizes Faculty Achievement in Graduate Studies and Research.
Work in conjunction with the Provost's office to ensure that our system of rewards and incentives recognizes faculty achievement in graduate studies and research.
Items for consideration include:

- Creation of a new loading model that reflects the time intensive nature of graduate research.
- Research incentive payments
- Improved sabbatical leave program

Establish Travel Fellowships
These would support attendance at meetings and visits to funding agencies for both faculty and students.

Enhance the Environment and Create a Campus Culture Conducive to Research

Establish a commission to assess, review and create an environment and campus culture which is conducive to research

Facilitate Procedures and Policies Regarding External Funding Relationships.
Work with Research Administration to develop more competitive and attractive agreements to entice partnerships with industry, government and professional associations.

Promote New Opportunities for Multi-disciplinary and Practice Oriented Degrees
Review the policies and procedures for establishing degree programs in these areas and make recommendations for facilitation of these efforts.

Improve Graduate Registration Procedures
Review policies and procedures and make recommendations to provide convenient registration and scheduling of classes.

Enhance the Career Development Opportunities Available to Graduate Students
Work with the Career Development Center to identify and implement measures to enhance the Career Development Opportunities for our graduate students.

Appendix of Supporting Data and Recommendations

In their report to the WPI Community CGSR notes that:
"Increased investment in graduate education and research is absolutely vital to the continued success of WPI's educational mission. Graduate studies and research are the keys to establishing a strong reputation for WPI. Indeed, to be recognized as a university, it is necessary to offer students a relevant and meaningful educational experience leading to undergraduate and graduate (Master's and Ph.D.) degrees. While WPI has long been known and respected as an undergraduate institution, in recent years, the graduate and research programs have quietly gained strength sufficient to achieve Doctoral University status. It is vital to the success of WPI that this development continue. The committee believes that substantial investment in our graduate programs and research activities beginning now and extending over the next ten years will result in a significant enhancement in the quality of graduate and undergraduate education at WPI and that this will result in a concomitant enhancement in our nationwide reputation. There are, of course, many indices of reputation but the National Research Council's peer review of scholarly quality is, perhaps, the most important. This decennial poll will next be conducted in 2005. Investing in our graduate programs starting
now will certainly have a significant positive impact on WPI's ranking in this poll. It is our goal to achieve collective and individual rankings in the top fifty in this poll. The reputation of the graduate program ultimately depends on the creativity and scholarly achievements of the faculty members and their students. We equate creative scholarship with the realization of new knowledge and its dissemination to the academic and general communities. The development of research proposals (in itself a creative activity) and the successful solicitation of funding play an important role in enhancing scholarship. It is the role of each faculty member to establish their goals with respect to these scholarly activities and strive to achieve them. It is the responsibility of each faculty member to recognize the central role played by the student in attaining these goals and to involve them in each step of the creative process. By educating these students, who will be the future generation of scholars, the faculty member will ensure the continuity of learning."

The full text of this report can be found at:

https://www.wpi.edu/~cgsr/Reports/enhancing.html

Many of the CGSR recommendations are substantiated in the recent NSB report "The Federal Role in Science and Engineering Graduate and Postdoctoral Education" which was approved at the 347th NSB Meeting. This report is summarized in the following excerpts from the National Science Foundation Release. The full announcement may be found at:

http://www.nsf.gov/cgi-bin/getpub?pr9814

"The National Science Board (NSB) urges a reexamination of the federal/university partnership, and offers several recommendations for improvement, in a policy paper released today titled The Federal Role in Science and Engineering Graduate and Postdoctoral Education."

"The Board paper describes changes such as an increased demand for higher education; and acknowledges many stresses on universities and faculty resulting from those changes, such as rising costs and administrative burdens. In more than a dozen recommendations, the Board emphasizes the integration of research and education, an expansion of the partnership to include a wider range of institutions, broader career options for graduate students outside the research university, and diversity in graduate education."

According to this announcement:

"The National Science Board is composed of 24 members who represent the leadership of U.S. science and engineering. They are appointed by the President to oversee the National Science Foundation and to monitor the health of science in the nation. The paper responds to the board's responsibility in national science policy."

Specific Recommendations of the NSB and GRTF
The full report of the NSB is included here:

The National Science Board

The Federal Role in Science and Engineering Graduate and Postdoctoral Education Approved at the 347th NSB Meeting

RECOMMENDATIONS

The Government/University Partnership in Graduate and Postdoctoral Education: Principles and Practices for the Future

1. Federal Support to the Enterprise
   - The Federal government reward and recognize institutions that initiate model programs for the integration of research and education.
   - Mission agencies funding agency-initiated research in academic institutions recognize the intimate connection between research and graduate education in universities. They should adopt principles and practices exploiting that interconnection and insure that their funding reaps the dual benefits of simultaneously advancing both research and graduate education.
   - The Federal government contribute to promoting closer collaboration between faculty in non-research and research institutions. Such collaboration in research offers opportunities for greater exposure to a variety of career options for graduate students. It can also improve the transition from undergraduate to graduate programs across institutions. The improvement of that transition is especially important for reaching minority undergraduates. Federal investments, particularly in communications infrastructure, can expand the scope of these programs.

2. Breadth vs. Narrowness of Graduate Education
   - University programs and Federal support policies continue to encourage exceptionally talented students to pursue Ph.D. programs and to develop their capacities to advance knowledge in their chosen disciplines;
   - The Federal partner recognize and reward institutions that, in addition to the core Ph.D. education, provide a range of educational and training options to graduate students, options tailored to the career interests of the individual Ph.D. candidate. These might include interdisciplinary emphasis, teamwork, business management skills, and information technologies.

3. Human Resource Policies
   - The Federal and university partners seek more effective ways of promoting diversity and full access to graduate education, guarding against strategies that inadvertently keep
underrepresented groups from the mainstream of research and graduate education. Efforts should emphasize identification of high-ability students earlier in the educational experience, including the precollege level, and encouraging them to consider careers in science and engineering.

The Board recommends the attention of universities to the following areas:

- To assure access for high ability students, examine the current use and possible misuse of assessment tools for entry to, and financial support for, graduate education, e.g. the Graduate Record Examination scores (GREs); and
- Recognize postdoctoral researchers as a significant component of the system of graduate research and education in some areas, and better integrate postdoctoral scholars into the university community.

4. Impact of Federal Regulatory and Funding Practices on the Culture of Institutions

- Support university-initiated efforts to insure in the science and engineering faculty reward systems an appropriate balance between recognition for excellence in research and excellence in teaching, mentoring, and other areas of faculty responsibility;
- Examine how it can prevent unnecessary and unintentional interruptions in academic research programs and in associated support to graduate students that may result from the vagaries of the Federal research funding environment.
- Review conflicting or confusing treatment of graduate students and postdoctoral researchers--as students or employees--in Federal regulations and policies. The review should entail consideration of both consistency across agencies and coherence between the purposes of regulations and administrative requirements and Federal objectives for supporting and integrating research and education in academic institutions.

Issues to be Negotiated Between the Partners

- Strategies to attract and retain talented students from underrepresented groups. These strategies might include consideration, in some cases, of criteria for support on research grants;
- The respective Federal and university responsibilities for reducing the administrative burden on faculty researchers/teachers to increase time available for mentoring and other educational and service activities that enrich the learning environment. This needs to be coupled with the alignment of faculty reward systems, as described in Section 4.
- Improved policy data to assess the effectiveness of current Federal support for graduate education including attention to attrition and time-to-degree, and to identify current and emerging national needs for the science and engineering workforce.

Recommendations from the WPI Strategic Task Force on Graduate Education


Graduate Project Centers for Professional Practice
Project centers for projects and practice would go far to strengthen practice oriented degrees. Incorporation of project activity in degree requirements, analogous to the undergraduate program, would establish a real-world experience for those students studying to improve their professional positions. The WPI network of domestic and global project centers could be utilized as sites for the Graduate Project Centers.

Graduate Internships in U.S. and Overseas
Analogous to medical training, which includes a clinical experience, our practice-oriented degrees could significantly benefit from the inclusion of internships. Such activities not only provide an economic resource to meet costs but also provide essential professional practice experience.

Enhanced Research Facilities
First class, laboratories are essential so that hands-on teaching of state of the art experimental techniques is available to a majority of our graduate students. Such experience is critical to both those students destined for industrial research and development as well as those intending to pursue basic research careers in academic or research laboratories. The added value of such facilities is manifest in attracting faculty, graduate students, and research funding.

Research Chairs for Young Faculty
These chairs would provide a reduced teaching load and provide discretionary funds for untenured faculty. They would foster a rapid engagement of research programs and be attractions for recruitment of outstanding faculty.

Endowed Industrial/Minority/and Part-time Student Fellowship
In the spirit of increasing the number of high quality full and part-time graduate students to WPI, the Graduate Programs Task Force identified specific areas that we believe would benefit from enhanced monetary support. The endowed industrial and minority fellowships are fairly clear in regards to the proposed recipients and how funding such students through increased fellowship opportunities would benefit WPI. Shifting our focus to the part-time student, nominal awards (e.g. one-time awards of $500 based on merit) would be helpful in attracting an increased number of quality part-time applicants to WPI's applicant pool. Even though the dollar amount here is not significant, it is enough to result in positive sentiments towards WPI.

Asynchronous Learning Opportunities
The emergence of communications technology has resulted in the development of asynchronous communications opportunities (teleconferencing, microwave, satellite, courses delivered on the Web, desktop computing, cable TV) that have lowered the barriers to accessing many organizations around the world. With new means and diminishing barriers to communication, opportunities for outreach are enhanced as is the threat of having remotely located competitors reach our students. The world is operating at an increasingly rapid pace. The necessity for convenience, combined with the demand for quality,
dictates that WPI participate in this arena, especially given our technological focus, to compete in the future.

Undergraduate Research Participation
These awards would enable undergraduate students to work in a research laboratory during a summer. They would encourage our best students to pursue graduate studies. Those going to other institutions would help build our reputation while some of these "best and brightest" would likely continue their studies at WPI.

Incubator/Entrepreneurs Collaborative
Funds would be provided to fund, in a venture sense, companies spun-off from WPI research. This extension of the successful undergraduate effort to the graduate level would prime the cycle of conversion of research to product realization.