# STANDARD FOUR: PROGRAMS AND INSTRUCTION

## Introduction

At the undergraduate level, WPI offers the Bachelor of Science in engineering, the physical and life sciences, mathematical sciences, computer science, management, the humanities and arts, and the social sciences. Detailed rules for majoring or double majoring in these fields, as well as for concentrations within majors, for minors, and for combined bachelor's/master's degrees, may be found in the Undergraduate Catalog.

At the graduate level, WPI offers the master's degree in engineering, the physical and life sciences, mathematical sciences, computer science, and management; and the Doctor of Philosophy in engineering, the physical and life sciences, mathematical sciences, and computer science. WPI also offers master's and doctoral degrees in fire protection engineering. Occasionally, students elect to pursue options available at each of these levels for degrees in an interdisciplinary field.

For-credit certificates are available at the graduate level and may be taken as standalone courses for professional development or eventually applied towards a graduate degree program. WPI's Department of Continuing and Professional Studies offers non-credit certificate programs.

Separate catalogs (*) are issued annually for the undergraduate, graduate and distance learning programs; these include materials on admissions and financial aid; degree requirements; academic advising, policies and procedures; and program and course descriptions. The continuing education program is described in brochures (*) published several times a year. All of these publications are reviewed by the appropriate faculty members and administrators, and published through the Provost's Office.

Planning for curriculum and pedagogy originates with the faculty of the relevant department or program. Most departments have articulated (and published in the Undergraduate Catalog) how their academic mission and associated learning objectives derive from the University's overall mission and goal statements. Faculty propose to create, modify or delete programs, degree requirements or courses according to their professional judgments as teachers and scholars as to what curricular changes are desirable in light of their mission and learning outcomes. Proposals are discussed first within the originating department, typically beginning in a program committee that oversees the currency and consistency of departmental offerings and monitors the progress of majors.

When a department votes on a course or program change, the proposal is sent to the campus-wide undergraduate Committee on Academic Operations (CAO) or Committee on Graduate Studies and Research (CGSR). The relevant committee reviews such issues as resources required, adequacy of course description, adherence to university-wide policy, impact on other departments, and procedural issues in the Projects and Registrar's Office. Once a proposed curricular change is voted out of the appropriate committee, that committee presents the change to the faculty as a whole for a vote at a monthly faculty meeting. The faculty expects that the department advancing the proposal can demonstrate on the faculty floor the merits of the curricular change, can discuss its impact on the programs of other departments, and has identified the resources needed to teach any new courses (including, when appropriate, the authority from the Provost to hire new part- or full-time faculty.)

When the faculty votes to change a program, WPI practice is to make the change binding on the first set of students that enters under the new description as printed in the next catalog. Students currently in the program may opt for either the new or existing procedures. When courses or programs are dropped, every effort is made to assist students by substituting independent studies for the deleted course(s).

The undergraduate Committee on Academic Policy (CAP) and the Committee on Graduate Study and Research (CGSR) address broader issues of academic policy. Both committees consist of elected faculty; the associate provost serves ex officio.

## Undergraduate Degree Programs

The following undergraduate majors are the most common at WPI:

- engineering majors (all accredited by the Engineering Accreditation Commission of ABET) in biomedical, chemical, civil, electrical, industrial, manufacturing and mechanical engineering.

- science majors in biochemistry, biology and biotechnology, chemistry, and physics. Chemistry majors completing a program satisfying the guidelines of the American Chemical Society are certified to that organization as having received an undergraduate professional education in chemistry. The biochemistry degree is accredited by the American Chemical Society.

- mathematical sciences with a separate actuarial mathematics major.

- computer science (accredited by the Computing Accreditation Commission of ABET).

- management, especially with interests in management of technology or management of information systems (WPI currently is a candidate for AACSB professional accreditation in management.)

Less common majors, often combined with a second major, include:

- Humanities and arts, with concentrations available in history, literature, music, philosophy, religion, drama/theatre, writing and rhetoric, art history/architecture, German studies, Hispanic studies, American studies, environmental studies, or science and technology studies.

- Social science and policy studies, with majors in system dynamics; economics and technology; society, technology and policy; and economics.

- Interdisciplinary programs, especially international studies, theatre and technology, and technical, scientific and professional communication.

Significant changes affecting undergraduate majors since the last NEASC visit of 1991 include

- providing undergraduates with options to concentrate within majors and to add a minor to their major.

- altering the admissions requirement to require two years of lab sciences. Physics and chemistry are noted as the usual topics, but a year of each is no longer specifically required.

- establishing procedures for departments to request formal faculty approval for required courses. (As described below, requiring students to take specific courses for a major has not been part of the new WPI undergraduate program, begun in the early 1970s.)

- expanding biomedical engineering from a graduate-only program to the an undergraduate and graduate program and enlarging the faculty in the Biomedical Engineering Department.

- adding a biochemistry major and changing the name of the Chemistry Department to the Chemistry and Biochemistry Department.

- creating an industrial engineering major housed in the Management Department.

- specifying separate majors possible within humanities and arts, as listed above.

- merging the formerly separate biology and biotechnology majors and specifying six separate concentrations within the single new major.

- adding a system dynamics major in the Social Science and Policy Studies Department.

- dropping the nuclear option in mechanical engineering.

- adding electrical and computer engineering as a new major in the Electrical and Computer Engineering Department. The existing major, electrical engineering, will

continue to be available for all students electing it until the last students entering when only that major was available, as stated in the Undergraduate Catalog, have graduated.

Admission to the undergraduate program is uniform for all intended majors at WPI in terms of procedures and required secondary school course of study (which must include four years of English and mathematics, the latter to include trigonometry and analytic geometry, and two years of laboratory sciences.)

In the past, students usually indicated their expected major when they entered and were assigned an advisor accordingly. However, in fall 2001, all entering students will participate in a new first-year extended orientation program, Insight, in which a student's initial advisor is not necessarily in his or her intended major. First-year students will continue to declare their major officially in November of their first year and will be assigned an advisor in that department if a change is needed. A Major Selection Program is available for undecided students.

Since the last NEASC visit in 1991, the WPI undergraduate degree requirements have remained the same, both with respect to the overall number of credit hours of course and project work required (135 credit hours, 126 specified and 9 free electives) and of the distribution between credit hours for the major (54) and for general or liberal education (72). (In these specifications, WPI's system of *units* is presented as conventional credit hours, with one course of 1/3 unit being equivalent to 3 credit hours, one full seven-week term [and unit] of three courses equivalent to 9 credit hours, and one full year of four terms [and four units] to 36 credit hours.)

Departments may specify no more than 54 credit hours of course and project activity within the disciplinary major. Of these 54 credit hours, 45 are devoted to courses (15 in all) and 9 comprise the capstone project (discussed in more detail below). Departments do not stipulate specific course requirements nor can departments, on their own, require students to take specific courses. Generally, students have various options among related courses in acquiring necessary background for projects and advanced study.

Within the 72-credit-hour general or liberal studies component, 36 credit hours may be specified by the disciplinary major department in terms of levels of mathematics and the sciences required to support the major. The other 36 credit hours of general or liberal studies are distributed as follows for all students:

- a 9-credit-hour Interactive Qualifying Project (or IQP) capstone project relating science/technology and societal structures or values, described in greater detail below.
- an 18-hour program of study in the humanities or arts (5 courses and a capstone project, described in more detail below.)
- A 6-credit-hour requirement (2 courses) in the social sciences.
- A 3-credit-hour requirement (4 courses) in physical education.

In summary, the 126 credit hours specified for graduation are comprised of 54 credit hours in the major and 72 in general or liberal studies, 36 of which link to the major and 36 of which link to humanities/arts, social science, and interdisciplinary studies.

# Distribution of Degree Requirements: 135 Credit Hours

<table>
<tr><td rowspan="5">126 Specified Credit Hours</td><td rowspan="3">72 General or Liberal Education Studies Credit Hours</td><td colspan="2">36 Disciplinary Major Specified Credit Hours in Mathematics and Science</td></tr>
<tr><td rowspan="2">36 Other General or Liberal Education Studies Credit Hours, as specified to the right</td><td>9 IQP Credit Hours<br><br>18 Humanities and Arts Credit Hours (15 course Credit Hours plus 3 Credit Hours for Capstone Project)<br><br>6 Social Studies Credit Hours<br><br>3 Physical Education Credit Hours</td></tr>
<tr></tr>
<tr><td rowspan="2">54 Disciplinary Major Credit Hours</td><td colspan="2">45 Course Credit Hours in Major</td></tr>
<tr><td colspan="2">9 MQP Credit Hours</td></tr>
<tr><td>9 Unspecified Credit Hours</td><td colspan="3">Free Electives</td></tr>
</table>

*Indicates that text to right is further breakdown of requirements noted to left. Chart reads left to right*

## Capstone Projects

Since the 1970s, the hallmark of WPI's undergraduate program has been an emphasis on capstone projects in three areas: humanities/arts, interdisciplinary studies, and the major field. Each of these projects, called, respectively at WPI, the *Sufficiency*, the *Interactive Qualifying Project (IQP)* and the *Major Qualifying Project (MQP,* aims to measure learning outcomes—what students *can do* rather than what *courses they passed*. Each of these capstone projects is described below, along with the course work relating to it.

**Humanities/Arts (the Sufficiency Requirement):** To demonstrate a grasp of how creativity is exercised and judged in the humanities and/or arts, students, most often in their sophomore year, write (or compose, perform, act in or direct, as the case may be) an independent study project for three-credit hours that builds upon five previously taken courses in a thematic area of interest. The courses may be elected from WPI or from Colleges of Worcester Consortium offerings in these fields. Disciplines offered in depth at WPI are literature (including theater), history (including history of science and technology), philosophy and religion (including ethics in the professions), music (including electronic music), German, Spanish, and global studies. The students must select the courses, identify the theme, and persuade a member of the Humanities and Arts department to advise their capstone project by justifying its cohesiveness

**Interdisciplinary Studies (the Interactive Qualifying Project or IQP):** To provide them with opportunities to reflect on how methods they are learning for solving problems in their scientific, engineering or managerial disciplines may also be applied to addressing and solving problems in social domains, all WPI students must complete a nine-hour-project (usually in their junior year) called the Interactive Qualifying Project or IQP. As described in the Undergraduate Catalog (p. 20):

> An IQP shall address a topic relating science and/or technology to society. In this context both "society" and "technology" should be construed as broadly as possible. Technology refers to the application of rational and efficient principles to a body of knowledge or to the control of space, matter and/or human beings. Thus, the IQP encompasses not only techniques of production embodied in tools and machines, but also advances in methods of social and economic organization, in managerial techniques, and in methods of analysis in science, mathematics and engineering. Society refers not only to a grouping of individuals but also to the culture, values, law, customs, and institutions shared by these individuals.

Very few IQPs demonstrate outcomes in all these domains, but every IQP must demonstrate that the students have considered one or more relationships between technological and societal systems. Students are encouraged to use the two-course social science requirement to explore areas of interest on the societal side for the IQP and to acquire some background in useful methodologies. To illustrate the full range of IQPs completed in a single year, *Interactions 18: Undergraduate Projects Linking Science, Technology and Society,* with abstracts of completed projects, is included as Appendix 4.

In recent years, more than half of all IQPs have been completed at off-campus sites where students and faculty in residence work on a project full time for a local sponsor. In academic year 2000-01, more than half of WPI's junior class participated in residential IQP programs in Bangkok, Boston, Copenhagen, Hong Kong, London, Melbourne (Australia.), San Jose (Costa Rica), San Juan (Puerto Rico), Venice, Washington, D.C., and Zurich. WPI now graduates substantially more engineering students with a global experience than any other American college or university**.** According to the most recent Institute of International Education data, WPI ranks second only to Dartmouth among doctoral-granting universities in the percent of undergraduates who study abroad.

**The Disciplinary Major (the Major Qualifying Project or MQP):** To provide students with the opportunity to show that they can apply all the appropriate facts, theories, methodologies and analytic skills acquired throughout their course work to framing and solving a problem at a level expected of an entry-level professional, students must complete a nine-credit-hour project in their major. The project topic may be theoretical, experimental or design, as appropriate to the discipline and student interests. The MQP is the culmination of the student's work in the major (consisting of at least 15 disciplinary courses) and occupies at least one-quarter of the final year. The MQP also provides an opportunity for in-depth study of current professional practice in a student's area of specialization. Students present the results of their MQPs in formal colloquia, organized by their departments, on Project Presentation Day in the spring. The colloquia booklet, which provides the schedule of project presentations, is included as Appendix 5.

All three projects must be documented in writing (or in other forms as appropriate, such as a videotape, with commentary of a performance). In addition, most faculty require one or more oral presentations of the projects, often at various stages of development. WPI encourages but does not require students to work in teams for both the large-scale projects, the integrative (IQP) and the disciplinary (MQP). WPI also encourages but does not require students to select topics offered by off-campus sponsors for both the IQP and the MQP. Over the last quarter century, WPI has developed networks of external liaisons such that more than half of both these projects are externally sponsored.

To support the new program with its de-emphasize on courses and greater emphasis on projects, WPI faculty developed new operational procedures. The calendar, the grading system, and the method of publicly recording undergraduate student achievement were all changed.

- To encourage students to experiment with different classes and to work on teams without being concerned solely with their own grades, the faculty adopted a non-punitive grading system in which the only grades assigned are the traditional "A," "B" and "C." If for any reason (illness or lack of interest, ability or need) a student does not complete the requisite course work, the "grade" given is "No Record" (no public record is made of the student's enrollment in the course).

- To overcome the complaint frequently voiced by students in the semester system that juggling five or more topics over four months resulted in too much diffusion of attention, WPI adopted an undergraduate calendar of seven-week terms (two in the fall and two in the spring). Students normally take three courses (or project equivalents) per term, earning in WPI nomenclature a full unit of credit per term if all the work is completed.

- To try to reduce undue competition among students for grades and thus to foster teamwork—both in major projects required for graduation as well as in the increasing number of team projects required in courses—the faculty voted to eliminate any official calculation of individual student Quality (or Grade) Point Averages. Consequently, "class rank" was abolished.

- To encourage greater student investment in planning their program of study, formal course prerequisites were abolished. When WPI students sign up for courses, they cannot be denied access to a course because of any established prerequisites. Faculty publish advice to students in the Undergraduate Catalog about the background they typically will need to succeed in specific courses, but it is up to the student to interpret and follow this advice.

## Outcomes Assessment

Because of the importance of the three degree-requirement projects, WPI in the mid-1980s began to institute annual summer faculty assessments of completed projects, first of IQPs and then of humanities/arts Sufficiencies and MQPs. The intent was two-fold: to assess how well students were succeeding in accomplishing the outcomes anticipated for the project (as defined by the above passages from the Catalog) and to assist faculty in enhancing their skills as advisors. Faculty members working on such outcomes assessments begin by looking at the published goal statement for the program and at the measurable learning objectives derived from it (such as communication skills and appropriate use of disciplinary and foundational course materials). The resulting reviews are distributed and discussed to determine how course and project pedagogy can be improved to close those gaps that inevitably occur between mission and learning goals and the work actually presented in the written reports. Increasingly, faculty members are recognizing the limitations of assessing outcomes from only the written report, and are experimenting with additional assessment data gathered from student oral presentations and from the advisor, who can often document learning outcomes implicit in the learning process but not explicit in the written reports. (Copies of the most recent reviews for the IQP, the humanities/arts Sufficiency, and MQPs in electrical and computer engineering are included as Appendix 6.)

The campus-wide effort to implement outcomes assessment has been supported by the Student Outcomes Assessment Steering Committee (SOASC), established by and reporting to the president to coordinate outcomes assessment activities on campus, specifically for major reaccredidation visits in 2001 (regional and AACSB) and 2002 (ABET). With support from SOASC, all eight ABET-accreditable programs, along with most other departments and programs, have made major strides in developing departmental outcomes assessment plans. The ABET programs have aligned their MQP review procedures so as to collect similar types of data across all programs; and several have advanced to the point of specifying and measuring learning outcomes for individual courses that are mapped to departmental learning outcomes. SOASC's support has included organizing and hosting information sharing events for the ABET programs, disseminating "best practices" documents, and developing a protocol by which any program that reviews project reports (IQPs or MQPs) can make statistically valid decisions about sampling.

In spring 2000 and again in 2001, WPI administered the Education Benchmarking (EBI) survey to undergraduates about to receive their first degrees in engineering. The 2000 results (*) showed

WPI students comparing their academic programs quite favorably to students at other institutions in the comparison group.

## Appraisal

At WPI, the degree requirements that fall outside the major field constitute 72 credit hours out of 126 that are specified in general terms. These 72 credit hours fall into five categories:

1. 36 in the mathematics and science required in most departments as the foundation for the major
2. 18 in humanities/arts
3. 9 for the IQP
4. 6 from social science
5. 3 from physical education

With respect to the intended learning outcomes of this general education requirement, until recently the faculty has not discussed thoroughly the coherence and substance of the five separate categories at WPI that constitute a "general education requirement…[that] embodies the institution's definition of an educated person" (Standard 4.15). In spring 2001, the Committee on Academic Policy began discussing WPI's general education. The following statement is from the minutes of the CAP meeting of April 6, 2001:

> "The self-study draft [for Standard 4] indicates that the balance of the credit hours needed for general education are fulfilled by the completion of mathematics and science coursework specified as part of the distribution requirements for majors. The approach suggests that for most students, mathematics and science coursework serves the needs of the major and contributes to WPI's definition of a well-educated person. This model may work for most majors, but it does not fit the requirements for all programs. CAP members agree with the appraisal that "...faculty have not discussed thoroughly the coherence and substance of the five separate categories at WPI that constitute a 'general education requirement.'" It was noted that the proposed outline of WPI's requirements for general education tends to segregate the knowledge into disciplinary bins, which is counter to the notion of educating technological humanists."

Other current concerns about WPI's curriculum include a) the relevance of the two social science courses to the IQP, b) breadth versus depth in the Sufficiency, c) amount of time available for study in the major, d) flexibility and coherence in the first year, and e) the merits of physical education as a degree requirement.

ABET's adoption in the mid-1990s of outcomes assessment as the primary vehicle for institutional self-study, along with WPI's internal assessments of the student project reports for the three degree requirements, gave the University a comparatively early start in assessing student learning outcomes. Consequently, WPI has had significant experience in at least some areas of the undergraduate curriculum in using such assessment data to try to improve pedagogy and enhance learning.

However, non-engineering departments at WPI—which are not subject to ABET accreditation—generally have had less experience with using outcomes assessments to improve learning opportunities**.** Also, the procedures for reporting back to the faculty about the findings of outcomes assessment studies have been inconsistent through time and among the different projects assessed. For example, some departments have formal meetings to review MQP assessment findings, while others do not. WPI has not been consistent in providing faculty advisors of projects with copies of written comments on projects they have advised, and at least some faculty question the authority of colleagues to conduct such individual project reviews.

To attempt to obtain comparative data on program outcomes from students graduating from WPI's closest peer institutions, in January 2000 WPI took the lead within the 16-member Association of Independent Technological Universities (AITU) to adapt the new National Survey of Student Engagement (NSSE) for assessing those outcomes of specific interest to technological institutions. WPI intends to share the outcomes data within the group in an effort to move beyond anecdotes reflective of the unique strengths of each member to comparative data that may show successes and failures as perceived by the common pool of undergraduates. These data will be available in late summer/early fall 2001.

WPI is proud that a large proportion of its students participate in project-based global programs. Not only do more than half of all juniors complete their IQPs abroad, but increasingly, students are pursuing other degree requirements off campus. In 2000-01, a program for students to complete their Spanish Sufficiency was established in Madrid, and for the German Sufficiency in Darmstadt. Since the 1990s, students have completed humanities and arts projects (both the Sufficiency and MQP in humanities and arts) in London in art history, drama, theatre, literature, music, and philosophy and religion**.** Residential sites for students to complete MQPs now exist in Greenbelt, Maryland (NASA's Goddard Space Flight Center), Limerick, Ireland, and Silicon Valley, with a new program opening in fall 2001 on Wall Street.

WPI's comparatively long experience in outcomes assessment of undergraduate education has brought some important national recognition. As mentioned earlier, in 1996, WPI was selected as one of only two institutions to undergo the new ABET outcomes-based engineering program accreditation process. In 2001, the Association of American Colleges & Universities selected WPI as one of only 16 institutions invited to join its Greater Expectations Consortium on Quality Education.

## Projection

Several departments are working on systems to obtain information about student educational outcomes as demonstrated in courses that have been structured specifically to capture such assessment data.

An alumni survey designed in-house was administered in 2000-01 to establish an ongoing program of assessing learning outcomes and their results after graduation. The return rate was disappointing—about 15 percent. Data have been obtained and analyzed. The process of gathering and interpreting the data was resource-intensive; more efficient "off-the shelf" surveys may ultimately be more effective, but at the cost of not getting some data of specific interest to

WPI. As of summer 2001, the intention is to revise the survey for greater clarity and use it again, with a principal goal being a greater return rate. How best to use the data to formulate proposals to improve pedagogy is being discussed in summer 2001.

Steps are being taken to improve those programs rated most unfavorably by students in the EBI survey. Specifically, graduating students rated their experience four years earlier with the introductory mathematics sequence less favorably than students at comparable institutions. Since introductory mathematics was the only topic in the survey for which WPI programs were ranked less favorably than those at comparable universities, the Provost's Office and the Mathematical Sciences Department have mapped out a response. The department surveyed students in the current introductory sequences to try to isolate specific problems, especially with the MAPLE software program. The use of software for mathematical calculations in mathematics and in engineering and science has been discussed at a department heads meeting, and the assistant provost has been charged with developing an ongoing taskforce to address problems students and faculty identify with the introductory sequence. The larger question, what are the learning outcomes expected by faculty whose course and project work requires students to use advanced mathematics, is being addressed in summer 2001.

Broad curricular issues were discussed in the Committee on Academic Policy in 2000-01. In February 2001, for example, CAP brought to the faculty a motion to consider establishing specific university-wide learning outcomes. The faculty voted to accept the recommendation to create a taskforce to draft university-wide educational outcomes that could articulate measurable learning achievements embodied in the WPI mission and goal statements—including the "general education requirements." The taskforce held several open meetings in spring 2001 and will continue its work into the fall semester.

In 1999-2000, an administrative team reviewed the current system for obtaining, processing and using student course and project evaluations. In spring 2001, faculty governance began reviewing the recommendations of the team and the report they commissioned from external consultants, and assigned several faculty and administrators to develop specific proposed revisions for faculty action in 2001-02.

With respect to reviewing WPI's general education program, on April 13, 2001, CAP voted to "initiate a discussion of WPI's general education requirements starting in Term A, 2001."

## Undergraduate Admissions and Retention

WPI recruits and seeks to enroll the appropriate number (between 660 and 675) of well-qualified undergraduate students each year. As well as recruiting students for our academic departments, specific outreach is performed for women, multicultural students, international students, high-ability students, and transfers. The undergraduate Admissions Office directs a comprehensive campaign of direct mail, electronic mail, staff travel, on-campus programming and alumni activity toward students who have expressed an interest in WPI. The faculty and the Department of Physical Education and Athletics provide additional support for Admissions Office efforts.

The University offers four options for first-year students: Early Entrance, Early Decision, Early Action and Regular Decision. The Early Entrance option is for students who wish to enroll after

their junior year in high school. This option is exercised by students who have exhausted the curriculum offered by their high school and know that WPI is the institution they want to attend. They must have a recommendation from their high school principal. Typically, one or two students will apply under this option each year.

The Early Decision (ED) option may be exercised by students in the first portion of their senior year in high school. This option is for students who know that if admitted, they will attend WPI. ED is considered a "binding" plan, and students withdraw any applications submitted to other institutions. A separate timeline for application, notification and confirmation exists for ED applicants. Approximately one-quarter of the first-year class of 2005 is made up of Early Decision candidates. The Regular Decision option is the most often selected method of applying to the University.

Early Action (EA) offers students a "non-binding" alternative to the Early Decision program. The application and selection process are the same for EA as for ED. However, students need not withdraw applications submitted to other colleges, and no confirmation is required until May 1. This option will be offered for the first time to students entering in the fall of 2002.

WPI is well known by high school counselors in the Northeast, who tend to refer well-prepared and qualified students. In addition, each year more than 100 high school guidance counselors visit the campus. Much of our activity in the last several years has been focused on recruiting students from farther afield. Travel by admissions staff is focused in areas outside of our traditional primary market of New England, including international markets. Particular attention and time are spent on visiting schools where the University may not be well known, but that produce significant numbers of highly qualified students. One admissions staff member is also the coordinator of multicultural recruitment. His efforts are focused on recruiting activities and on areas from which we intend to draw Black and Hispanic students. This position works closely with the Office of Minority Affairs and Outreach Programs and the Office of Diversity and Women's Programs.

Professional members of the admissions staff review applications each winter. During the selection process, the Admissions Office pays close attention to course selection, trends in grades on the high school transcript, overall grade point average, rank in class, courses taken and grades earned in the senior year of high school, recommendations from counselors and high school faculty, and a required personal statement by the applicant.

For the class entering in August 2001, more than 3,200 applications for admissions were reviewed. Emphasis was placed on the overall quality of the high school transcript, with special attention paid to mathematics and sciences courses. Students are required to have a sequence of mathematics courses that includes pre-calculus. Two laboratory science courses are required, usually physics and chemistry. The Scholastic Aptitude Test (SAT) I and three SAT II Subject Tests are required: Writing, Mathematics IC or IIC and a science test of the student's choice. Students may substitute the American College Test (ACT) in place of the SAT I and SAT II test. The Admissions Office will use the best verbal and math scores a student submits for the SAT. If a student submits both the SAT and ACT, the office will use whichever scores are higher.

Transfer credit is awarded to students who have earned grades of C or higher at any accredited institution, with the exception of mathematical sciences, for which a grade of B or higher from a community college is required. In addition to standardized testing and high school and college transcripts, transfer candidates must furnish an autobiographical statement and a recommendation from a mathematics or science teacher. At the time of application, transfer candidates must have completed a course in calculus or be enrolled in one. In 2000-01, WPI enrolled 95 transfer students (89 full time and six part time.) The undergraduate Admissions Office and the Academic Advising Office provide students with unofficial estimates of transfer credit and estimates of how long the course of study will take at WPI.

Formal transfer credit will be reviewed and granted as soon as a final transcript is received. Because WPI degree programs are not constituted of specific required courses, credit plays a somewhat lesser role at WPI than it does at other institutions. The WPI faculty makes final decisions as to which courses will be accepted for transfer credit. In all cases, the transferring course must be the academic equivalent of a WPI course. Generally, all college level chemistry, calculus, and calculus-based physics and engineering science courses will transfer. Examples of courses that will not transfer are pre-calculus, non-calculus-based physics or engineering science, or computer courses in BASIC. Virtually all humanities and social science courses will transfer. However, while a grade of C is usually acceptable for transfer credit for a course, applicants must have an overall GPA significantly higher than a C in order to gain admission to WPI.

Advanced Placement (AP) credit is awarded to undergraduate students who score 4 or 5 on an AP exam. The policies are clearly stated in the Undergraduate Catalog and available on the Web. These polices, the result of faculty actions taken in 1983, took effect for the classes entering in 1984 and thereafter. This action specifically addressed biology, chemistry, mathematics, physics and computer science. International Baccalaureate (IB) Higher Level Exams results of 5, 6 or 7 also receive advanced standing. Credit may be granted for national examinations or certificates of education, depending on the type of exam certificate, type of subjects, and the marks achieved.

Among those recognized are these:

- British General Certificate of Secondary Education (GCSE)
- “A” Level Examination
- Danish Studenter Eksamen
- French Baccalaureate II Exam
- German Abitur Exam

Guidelines for the determination of satisfactory academic progress, academic warning, academic probation, academic suspension and readmission are clearly stated in the Undergraduate Catalog. Undergraduate degree requirements are also extensively stated in the catalog, which is mailed to every applicant and all current students. In addition, the catalog is available on the University Web site.

The WPI Office of Academic Advising (OAA) provides support to undergraduate students and their advisors. OAA has three full-time professional staff to deal with any issues—including learning disabilities—that prevent students from making satisfactory academic progress. Through OAA, students may seek individual counseling on academic issues; OAA also supports a variety of student peer-tutorial activities. Information on OAA, including the Advisor's Handbook, is available at http://www.wpi.edu/Admin/OAA/. Further information on academic advising at WPI, including procedures to verify completion of degree requirements for majors, is available in the document (*) *The WPI Academic Advising Process*.

The WPI Academic Resources Center (ARC), which administratively is part of OAA, accommodates the needs of enrolled students who have disclosed individual needs or learning differences. Among the services provided by ARC are untimed testing, quiet testing space, ensuring that rooms are accessible, referring students for evaluations, peer tutoring, and individualized academic success plans. The Career Development Center offers a Major Selection Program.

Beginning with a five-day orientation program, WPI students are exposed to a wide array of programming. Through the Student Affairs Division—primarily Student Life, Student Activities and Residential Services—specifically recruited populations are fully integrated into the larger student body to the extent that each student chooses to be.

## Appraisal

Gains have been made in diversifying the undergraduate student body. Women make up about 23 percent of the Class of 2004, compared to 19 percent of the Class of 1997. The number of minority students has increased, but most of this increase has been is in Asian students and Pacific Islanders. Recruiting Black and Hispanic students to WPI is a challenge, in part because of the intense competition for such students among technological universities. Preliminary data indicate that the total number of students matriculating in the Class of 2005 will be above the budget target of 660, with 700 as a best guess. However, the number of women in the incoming class appears to be lower than in several previous years.

## Projection

Coordinated marketing of the University is key to expanding WPI's base of interest. Recent efforts to clarify an image for the University will provide some guidance in the best way to articulate what is outstanding and distinctive about the institution and how it relates to student interests. Ensuring that the resources are available to market all portions of the University is essential. Equally important is developing the discipline to follow the recommendations and critically assess activities and results.

The happy economic state of the late 1990s has dimmed. Increasingly, it appears that the economy—especially the high-tech sector—is in trouble. Thus, WPI needs to work diligently to broaden its base of inquiries and applications. Specializing in science and engineering is a great strength for the University; however, if interest in these areas declines, WPI's position will be

precarious. Recruiting international applications will continue to be a priority. Finding the best way to increase the number and quality of minority students is also a continuing challenge.

Close attention needs to be paid to the mix of applicants and enrolling students. The growth of interest in computer science—more than 25 percent of the Class of 2005 expressed an interest in this discipline—is a major concern, given the imbalances of resources and needs that result. Currently, WPI admits students to the University in general, and not to a particular major. If this policy is to change, the impact of restricting enrollment in computer science for first year students will need to be carefully examined.

Merit scholarships are currently effective recruiting tools for the University. The effectiveness of these scholarships needs to be periodically reexamined. Effectively marketing these opportunities to prospective students and their families will be a priority for the next several enrollment cycles.

In 2000-01, several fairly minor inconsistencies in transfer course credit policy for the social sciences were noted; these will be addressed in 2001-02. The status of the International Baccalaureate for admission to WPI must be defined.

## Graduate Degree Programs

At the graduate level, WPI offers a master of science in biology, biotechnology, biomedical engineering, chemical engineering, chemistry, biochemistry, civil engineering, construction engineering, environmental engineering, computer science, electrical engineering, computer science or electrical engineering with a specialization in computer and communications networks, fire protection engineering, manufacturing engineering, marketing and technical innovation, operations and information technology, materials science and engineering, applied mathematics, applied statistics, mechanical engineering, and physics. A master of engineering is offered in biomedical engineering, clinical engineering, environmental engineering, and master builder.

A doctor of philosophy is offered in biomedical engineering, biotechnology, chemical engineering, chemistry, civil and environmental engineering, computer science, electrical engineering, fire protection engineering, manufacturing engineering, materials science and engineering, mathematical sciences, mechanical engineering, and physics. An interdisciplinary Ph.D. program is also available.

WPI also offers the MBA, a master of mathematics for educators, professional master of science degrees in financial mathematics and industrial mathematics, and graduate certificates and advanced graduate certificates.

The master of engineering programs and some master of science programs allow a student to complete a degree without a thesis. Degree requirements vary by program within departments. The chart below presents the most recent requirements.

**REQUIREMENTS FOR THE MASTER OF SCIENCE AND MASTER OF ENGINEERING AT WPI**

| Department | Requirements |
|---|---|
| Biology and Biotechnology | M.S. (thesis): 30 hours; minimum of 6 hours thesis |
| Biomedical Engineering | M.S. (thesis): 30 hours, minimum of 6 hours thesis<br>M.E.: 33 hours; may substitute 3-6 hours of directed research for BME and electtives |
| Chemical Engineering | M.S. (thesis); 30 hours; at least 12 hours thesis<br>M.S. (non.); 3-hours; at least 24 hours in courses; 6 hours in independent study |
| Chemistry and Biochemistry | M.S. (thesis): at least 6 hours thesis |
| Civil and Environmental Engineering | M.S. (thesis/project): 30 hours; 6 hours research or project<br>M.S. (non.): 33 hours<br>M.E.: 30 hours |
| Computer Science | M.S. (thesis): 33 hours; minimum of 9 hours thesis<br>M.S. (coursework option): 33 hours; coursework |
| Electrical and Computer Engineering | M.S. (thesis): 30 hours; at least 21 hours in thesis or courses<br>M.S. (non.): 33 hours; at least 21 hours in research or courses |
| Fire Protection Engineering | M.S. (thesis): 30 hours; thesis or project<br>M.S. (course option): 30 hours |
| Management | M.S.: 30 hours; all courses |
| Manufacturing Engineering | M.S. (thesis): 30 hours; 6-12 hours thesis<br>M.S. (non.): 30 hours; 0-9 hours in research |
| Materials Science and Engineering | M.S.: 30 hours; 6 hours thesis |
| Mathematical Sciences | M.S.: 36 hours; 6 hours thesis<br>Master of Mathematics for Educators: 30 hours; 6 hours project |
| Mechanical Engineering | M.S. (thesis): 30 hours; 12 hours thesis<br>M.S. (non.): 30 hours; 0-9 hours in research |
| Physics | M.S.: 30 hours; 6 hours or more in thesis or research |

Master of engineering programs generally require 10 three-credit courses within a plan of study developed in consultation with a faculty advisor. These programs are designed to enhance professional skills and to develop a mastery of the subject so that the concepts of the thesis are intimately related to practical professional applications.

Degree requirements in the M.S. programs generally include a core set of courses, as determined by the department, elective courses within the department and in related areas, and either a thesis or a project. Students are required to establish a plan of study with their faculty advisor early in their program. All master's-level programs require at least one project-based course with a current and professional application. Most course-related projects, either at a campus site or through the Advance Distance Learning Network (ADLN), are based on teams, as they are in the professional world.

Part-time and full-time enrollments vary each year and seem to parallel the roller coaster of the local and national economy. Since 1991, cumulative full-time enrollments have dropped slightly, with a significant decline in electrical engineering. Part-time and non-degree enrollments have shown an increase, with a significant rise in numbers in computer science. Management enrollments showed a steady climb through fall 2000, with the introduction of the MBA for part-time students. In the fall 2000 semester, WPI enrolled 429 full-time, 346 part-time and 282 non-degree graduate students, for a total of 1,057 students.

Graduate certificate and advanced graduate certificate programs were introduced in 1996. The non-thesis master of engineering has become available to part-time students in mechanical engineering, civil and environmental engineering, biomedical engineering, and manufacturing engineering. In 1998, the natural science degree program for educators was dropped, largely because of changes in state regulations for high school teachers.

At the graduate level, WPI offers courses for complete degree and certificate programs on campus and at two off-campus locations (in Waltham and Southborough, Mass.). The off-campus locations were selected because of their proximity to many corporations seeking continued professional development for their employees in areas where WPI has strong programs.

The Worcester campus provides graduate students with full access to all laboratories, faculty, administrative offices, and library and student services. Most students taking classes in Worcester are full-time; the small part-time population, for the most part, is pursuing certificates or degrees in computer science, electrical and computer engineering and, management, or the Master of Mathematics for Educators.

The Waltham campus is located in the heart of the commonwealth's high technology sector. Courses offered at this site lead to a graduate certificate or the MBA through the Management Department, the M.S. in computer science, and the M.S. in electrical and computer engineering. In addition, several five-course certificates are available, including a popular computer and communications networks certificate offered through the departments of Computer Science and Electrical and Computer Engineering.

The Southborough campus, which sits two miles from the Interstate 495 interchange on Route 9, is situated in a region that is becoming known for its dense concentration of corporations focused on Information Age technologies. Here, students may pursue degrees and certificates in computer science and electrical and computer engineering, along with five-course graduate certificates.

Nearly all of the graduate students taking courses in Southborough and Waltham are fully employed, so courses at these locations are offered in the evening. At the Worcester campus, which attracts a blend of full- and part-time students, most classes begin between 3 p.m. and 6 p.m.; a few classes are offered in the morning.

Courses at all three locations are taught by a combination of Worcester-based full-time WPI faculty and adjunct professors. Most engineering, computer science and management graduate students may choose from a thesis or non-thesis master's degree program. Since academic standards for instruction are consistent among all sites, students may elect individual courses at any of the three graduate program locations. Faculty at all three locations are hired with the same selectivity and report to the academic department head responsible for the instruction in their field.

All graduate students in Southborough, Waltham and Worcester receive computer accounts and e-mail addresses at the start of each semester, providing computing assistance, library access and campus e-mail. Student IDs are provided each semester in Waltham and Worcester. Graduate faculty and students are assisted by two full-time graduate admissions staff members in Waltham. Business hours for one staff person have been adjusted so that person may be available in the early evenings when classes are in session.

Given the emphasis on research in the undergraduate projects, many WPI faculty strive to structure undergraduate, graduate and, sometimes, post-doctoral research into a vertically-integrated program with students tackling those parts of a large-scale problem appropriate to their background and interests. Roughly 100 undergraduate and graduate students work together in both 4000-level undergraduate classes and graduate classes. Approximately 25 students annually pursue a combined B.S./Masters program in which a maximum of four courses can be counted towards both degrees.

## Appraisal

Graduate program staff are represented intermittently at the Southborough campus. Staff from Worcester or from Continuing Education provide daily service.

Admission to all graduate certificate and degree programs is centralized in the Graduate Admissions Office, with the exception of programs within the Department of Management, which has its own admissions staff and process. Published admissions guidelines have been accepted by the faculty.

Efforts must continue to ensure that all course work and programs of study offered in Worcester, Southborough and Waltham, and through the Advanced Distance Learning Network (ADLN), offer the same professional and scholarly content. WPI is building larger and more complex

structures to accommodate the needs of an environment that demands a highly trained and educated workforce. According to the Mass High Tech collaborative, based on 1998 statistics, the percentage of persons with a bachelor's degree in the state of Massachusetts is 11 percent higher than the national average. These economic and demographic figures have enabled WPI to grow its part-time graduate programs and fill more classes. Given the current economy, WPI must be vigilant to maintain the quality of instruction as the number of students grows, along with the difficulties of finding staff.

The quality of graduate student life is in need of evaluation and assessment. The Graduate Student Organization is responsible for orientation programs and social events that may be of interest to the graduate student population. These events generally are attended by a core group of graduate students, many of whom are international. All graduate students live off-campus and many spend a great deal of time working in labs. Attention needs to be given to this group in terms of access to services and facilities during the undergraduate vacation breaks.

Differences in undergraduate (seven-week terms) and graduate (14 or more week semesters) provide ongoing logistical challenges for both faculty and students teaching or learning in both systems.

In spring 2001, the Student Outcomes Assessment Steering Committee began addressing how WPI assesses the outcomes of its graduate programs in terms of the stated goal for graduate instruction: "to convey the arts of scholarship to new generations" (Undergraduate Catalog, page 4). Preliminary study indicates that this goal is being achieved, whether the graduate program concludes with a thesis or with advanced course work.

Preparation for this self study indicated that the Graduate Catalog lacks some of the material presented in its undergraduate counterpart, such as WPI's Mission and Goal Statements and non-discrimination statements. Future catalogs will address these concerns.

Some graduate-level courses are offered in a given semester only at the Southborough or the Waltham sites because of faculty availability. Full-time students at the Worcester campus desiring to take such courses must commute to the other site on a bus provided by WPI. The graduate program is working hard to reduce and eventually eliminate this inconvenient scheduling situation.

At the previous NEASC review in 1991, WPI indicated its intent to review two graduate programs in a formal process every year. Only two programs were in fact ever reviewed.

## Projection

As new programs move into the Southborough campus, additional space for faculty offices and graduate staff representation will be important. Additional lease space provided in 2000-01 includes faculty and staff offices. As part of the recent buildouts in Waltham and Southborough, a dedicated faculty office is available at each of the two branch campuses and a shared office is available at each campus for visiting administrative staff.

WPI needs to create a direct link between off-campus and distance students, and the services provided by the Career Development Center, before a long downturn occurs. Addressing this issue began in 2000-01.

The strengths of non-thesis master's programs must be monitored to insure that this program of study is more than a series of courses. The Committee on Graduate Studies and Research, which provides faculty governance for graduate studies, should conduct this assessment in association with the Provost's Office**.** CGSR should design a review of all graduate programs on a rotating basis. If programs within three academic departments were reviewed each year, a complete review of all programs could be conducted every five years.

The graduate program should begin considering how to frame and measure specific learning outcomes, for both thesis-based and course-based master's degrees.

## Advanced Distance Learning Network (ADLN)/Graduate Programs

The Advanced Distance Learning Network currently offers the following graduate level certificates and degrees:

- Management—MBA; Certificate, Advanced Certificate
- Fire Protection Engineering—Master of Science in Fire Protection Engineering; Certificate, Advanced Certificate
- Civil and Environmental Engineering—Master of Science in Environmental Engineering, Certificate, Advanced Certificate.

In the academic year 2000-01, 1,091 credit hours were delivered through 24 courses via ADLN. FY00 survey data reveals that approximately 70 percent of ADLN students are over the age of 30, with 73 percent being male. Over 60 percent are enrolled in one course per semester, which reflects the demanding professional and personal schedules of distance students. Seventy percent of ADLN students indicated that they would not be enrolled at WPI if they could not take their course work via the distance network.

All academic responsibilities for the ADLN program remain with the Division of Academic Affairs, especially with the Associate Provost; the Director of the Center for Educational Development, Technology and Assessment; the Director of Graduate Admissions, and the participating academic department heads. ADLN staff report to the IT division of the University, assuring that technological delivery mechanisms are state of the art and are performing at optimum level. The ADLN staff also works closely with the staff of the Instructional Media Center (shared positions, office space, technological resources, etc.) to ensure that the development of distance programs is aligned with WPI goals for technology mediated learning support of campus-based programs.

Distance learning at WPI is regarded as a delivery mechanism and not a separate program; therefore, students are not admitted into a distance program. Currently, ADLN delivers only graduate level courses and programs. A student admitted into a course of graduate study (certificate or degree) may take a sampling of graduate courses as a non-matriculated student.

Depending upon their geographic location and professional or personal schedule, students may take either on-campus or distance courses. The purpose of ADLN is to extend quality educational opportunities to the continuous learners of the world so they may pursue educational opportunities while maintaining their professional and personal lives.

ADLN course sections are designed to present the same content as the on-campus sections of the courses, but they differ in the mode of delivery. The manager of faculty support services works closely with each ADLN faculty member and his or her department to ensure the effective and optimal use of available teaching technologies. Services include course redesign assistance, Web development and design, audio and video digital conversion, document scanning and conversion, content production, and just-in-time training and consultations. Funds are available to compensate faculty for their time when converting a course to ADLN is particularly demanding.

Student assessment for ADLN courses is also as similar as possible to that for on-campus courses. At the graduate level, assessment normally consists of cases, projects and essays that reflect the knowledge of each specific student. Any issues of academic dishonesty are handled in the same manner for distance and on-campus students.

Several technologies are utilized for WPI's distance delivery: videotaping of class lectures in a state-of-the-art TV studio; ISDN and IP videoconferencing; and complete delivery via the Web. These are described below.

**Videotape Delivery:** Most ADLN courses are videotaped in real time as they are taught in a classroom at WPI's Worcester campus. Videotapes and accompanying classroom materials are express mailed to students' homes or offices. On a case-by-case basis, arrangements may be made to ship tapes to students who are traveling. Students are expected to view the instructional materials within one week of receipt. Instructors of videotaped courses use the Internet to distribute additional course information and to facilitate communication among professors and classmates. Faculty typically employ the Blackboard course management system to manage class communications, make announcements and deliver additional content.

**Videoconferencing Delivery:** With sufficient enrollment, ADLN courses may be received in a fully interactive mode with two-way audio and video. Sites must have videoconferencing equipment (room-based or desktop) that is H.320 compatible.

**Web-based Delivery:** An increasing number of ADLN courses are available entirely over the Internet. In most cases, faculty employ the course management features of myWPI (described below) to manage class communications, make announcements and deliver content over the Internet. Synchronous communication tools, including real-time chat and a shared whiteboard, are also available for faculty and student use.

A combination of these mechanisms is frequently used to distribute content and foster interaction among students and faculty. Also from time to time, students are sent CDs or paper content, depending upon the needs of the course. Students and faculty maintain contact through myWPI, e-mail and telephone. The use of e-mail and other collaboration tools, such as threaded discussion boards and virtual chat, is stressed to create an environment that promotes the formation of a faculty-student relationship.

WPI strives to offer ADLN students informational services comparable to those available to on-campus students. Alterations are made only when necessary due to geographical constraints. ADLN students are served through the appropriate administrative office on campus or through the ADLN office, which is readily available via e-mail or telephone. Most students use e-mail as their method of conversing with the office. Their e-mails are reviewed several times per day. An informational catalog (*) and comprehensive Web site (www.wpi.edu/+ADLN.) (@) are also available to ADLN students.

The following is a list of readily available services for the distance student:

- **myWPI:** This is an online information and learning portal, powered by Blackboard, that provides a customized interface to course content, campus organizations and WPI's web of information. The myWPI portal is widely used by faculty and on-campus and distance students for academic and nonacademic purposes, providing a seamless transition to WPI for the distance learner.

- **Computing Services:** A UNIX account from WPI's Computing and Communications Center provides students with access to a wide variety of information resources. Students taking courses through ADLN may obtain a free account by applying online. The WPI Help Desk, reachable by phone or e-mail, assists students with all software and hardware questions.

- **Library:** Students have access to a variety of services and resources comparable to those available at WPI's Worcester campus. ADLN students may register for a library card and request books and journal articles from the Gordon Library or from other libraries via e-mail, mail and fax, or by filling out online forms. Items may be renewed via the same avenues. The Gordon Library Web site (http://www.wpi.edu/+library) offers all students access to the online catalog, tutorials on using the various electronic resources, and a collection of librarian-selected Web sites.

- **Books:** To order books, students may call the campus bookstore with a toll-free number. Textbooks and materials in stock are shipped within 24 hours.

- **Career Development Center:** Nearly all students who use ADLN for their course work are working professionals. They usually do not require the services of the Career Development Center, but the center's career assistance services are accessible by telephone and via the Web. Students also consult with the faculty in their respective departments on career-related issues.

- **Academic Advising:** Part-time graduate students are assigned a faculty advisor at the time of their admission to degree-seeking status. ADLN students communicate with their advisor regularly via e-mail and telephone.

- **Registration:** Students may register for classes online or by mailing a registration form that can be obtained from the WPI Web site or by contacting the Projects and Registrar's Office. Academic course listings are available online.

- **Applying for Admission:** Applications may be completed online at the WPI Graduate Admissions Web site (http://www.wpi.edu/+GAO); paper applications may be obtained by contacting the ADLN program office.

## Appraisal

WPI has been engaged in distance learning for over 20 years. Yet on campus, knowledge about distance learning is limited. Questions are often raised about the similarities and differences between distance and on-site teaching—and student reaction to those differences and similarities. To help them design a quality distance learning experience, faculty members have available to them professional instructional designers, content developers and technical staff to provide advice on the best relationships between delivery mechanism and content.

Technology for course delivery is rapidly changing and this fluid environment demands a constant reevaluation of delivery mechanisms and course structures. Converting a course to ADLN requires ongoing fine-tuning and potentially major changes from time to time. Resources for and recognition of this process will be necessary.

Students usually register for ADLN courses out of necessity, not desire. As the number of distance learning courses and familiarity with the Web increase, students are becoming more comfortable with and knowledgeable about obtaining an education through this delivery mechanism.

ADLN students may contact the ADLN office for administrative matters; the ADLN staff then resolves those matters by contacting the appropriate office on campus. Efforts should be made to raise the level of service in WPI administrative offices to the point where they can easily process ADLN students and resolve any issues that are unique to distance learning.

The offering of an ADLN course usually coincides with the offering of its campus-based equivalent. The ADLN section does not count as a separate section for purposes of faculty course load. The increasing demand for ADLN classes will result in the need for additional instructional resources to assist with large enrollments; otherwise, students will be regularly closed out of classes. Any additional burdens on faculty resulting from delivering courses simultaneously to campus and distance students must be addressed.

In addition, faculty compensation for distance students will need to be reassessed as the program grows. Currently, there is a transfer of funds equivalent to 25 percent of ADLN student tuition from the ADLN department to the sponsoring academic department. The department chairperson decides how to use those funds, including compensation dispensed to the individual who taught the course. The use of these funds is at the discretion of individual department heads and can range from faculty compensation, to faculty travel, to student assistance. While this process gives heads the flexibility to address departmental needs as they see fit, it does potentially create an inequitable use of funds.

## Projection

A five-year plan for ADLN is updated annually. In FY02, the ADLN office projects a 36 percent increase in the number of sections offered, yielding a 48 percent increase in credit hour delivery. The bulk of this increase will come from the Management Department. In FY03, ADLN projects a 33 percent increase in sections and a 46 percent increase in credit hour delivery. From FY04 onward the projected increases are more modest.

ADLN anticipates adding one to two additional programs per year to the distance delivery network. The revenue projected from these additions will be channeled into the services required to support quality technology-mediated learning environments in general. The areas being considered for future ADLN offerings are graduate certificates in the Computer Science and Electrical and Computer Engineering departments, the Massachusetts Academy for Mathematics and Science (a public high school on campus, briefly described below) for dual enrollment courses, and Continuing Education for noncredit offerings.

Additional staff requests for the next few years include an assessment professional, a system administrator, course content editors, student support service coordinator and secretarial support. Funding of these positions will depend upon credit hour delivery. Constant monitoring of services are required to assure adequate delivery. An assessment of the academic strengths of the curriculum and of overall student satisfaction will be done within the next year.

Competition within the distance delivery arena is projected to increase dramatically during this decade. WPI will need to assess its marketing, delivery and tuition rates to offer a competitive program.

Data indicate a growing dissatisfaction among corporate employers with the inability of graduate education to meet their needs. Companies are providing their own professional training or contracting with outside providers to create individualized training. If this trend continues, it could negatively impact demand for ADLN graduate courses. WPI will need to be cognizant of corporate training needs and meet these needs with programs for the working professional.

## Continuing and Professional Education

WPI's Department of Continuing and Professional Education offers a wide range of non-credit professional development programs for technical and management professionals desiring to enhance their skills or redirect their careers. More than 60,000 men and women have participated in these programs since the department was founded in 1977. In FY00, nearly 6,000 individuals participated in WPI continuing education programs, which range from one- and two-day open enrollment seminars to six-month certificate programs. Programs meet at the Worcester campus and at the branch campuses in Southborough and Waltham, Mass. Many programs are also delivered at corporate sites. The branch campuses are open more than 70 hours per week to meet the diverse scheduling needs of adult learners. These campuses are fully staffed with professional and support staff and feature start-of-the-art computer labs with Internet access via T-1 lines connecting to the Worcester campus.

Most of WPI's continuing education programs are open enrollment, with promotional materials (*) and the department Web site clearly stating appropriate prerequisites. The prerequisites are also referenced on confirmation letters mailed to individuals after they register. The information technology certificate programs have more rigorous prerequisites that include the submission of an application form(*) and resume, and an interview with the program manager.

Students earn continuing education units (CEUs) in recognition of program completion. The number of CEUs awarded is based on the duration of the course and follows national standards. (*) At the conclusion of a program, participants receive certificates of completion (*) that include the CEUs awarded. Many of the participants use CEUs to meet professional training requirements or for resume enhancement. WPI maintains a permanent record of all CEU awards dating back to the start of the program.

WPI continually evaluates the success of its continuing education programs based on the criteria listed above and based on market demand. The program managers, directors and dean have extensive expertise working with adult learners. They meet regularly with industry leaders and are well versed in new and emerging training needs. They periodically conduct focus groups with industry leaders, instructors and students to review existing and proposed curricula.

Each student completes a program evaluation (*) for every program–whether it lasts one day, one week or six months. These evaluations are first reviewed by the appropriate program manager(s). They are then sent to the instructor within one week following program delivery. For corporate training programs, evaluations are also sent to the corporate contact.

WPI also maintains an outplacement record (*) for all students enrolled in daytime information technology certificate programs. This data is reported annually to the Corporation for Business Work and Learning, which manages the federally funded program. Over the past six years, WPI has consistently reported a placement rate of over 90 percent.

The instructors for WPI's continuing education programs are typically industry practitioners who have extensive subject knowledge, excellent communication skills, and prior experience teaching adult learners. Prospective instructors are interviewed by the appropriate program manager(s), the dean and a WPI faculty member who works in the same or similar field. The interview includes a "stand up" presentation by the candidate to the above-mentioned audience.

Students enrolled in WPI's information technology certificate programs complete quizzes at the end of each module (typically 40 hours of classroom instruction) to help them and the instructors evaluate their progress and undertake any appropriate remedial action. The students also must complete a "master lab," a team-based project that integrates the technology concepts. Each team is required to present its findings to the class, the instructor and the program manager during the last week of the program. This team-based experience is a major differentiator between WPI's IT certificate programs and those of many other organizations.

Corporate training programs are appraised by the program staff and the corporate contact. Following the delivery of a corporate training program, the program manager reviews the student evaluations with the assigned on-site seminar administrator, the corporate contact, and the instructor. If future programs are scheduled, this feedback is used to help with the planning

process. A similar process is used for open enrollment seminars. WPI continually seeks feedback from program attendees, instructors and the corporations it serves. Over 70 percent of the corporate training programs delivered in FY00 included companies that had previously contracted with WPI for training.

## Appraisal

Following the recession of the early 1990s, continuing education at WPI began to enjoy significant interest from adult learners and from corporations. This renewed emphasis on training has provided WPI with extensive opportunities to serve these markets. As long as the economy stays relatively strong and unemployment remains low, WPI will continue to be challenged to retain sufficient numbers of qualified instructors and staff to meet the increased demands for its continuing education programs. The department's contributions to the operating budget have increased significantly during the past 10 years. In FY95, the department contributed approximately $250,000 to the operating budget. By FY00, that number had grown to $1.6 million.

In recognition of the growing importance to WPI and to the communities it serves, in 1999-2000 the continuing education program was made a separate administrative unit led by the dean of continuing studies. The dean reports directly to the associate provost and sits on the 14-member President's Cabinet.

## Projection

The Continuing and Professional Education Department is projected to continue growing during the next five years through the addition of new programs and instructors. WPI has extended the lease at its Waltham Campus through August 2006. The lease at the MetroWest (Southborough) Campus runs through June 2004.

To ensure the academic quality of WPI programs, the department intends to formalize the processes by which it evaluates instructors and curriculum. Currently, instructors meet with program staff on an annual basis to review curricula and instructional materials, share best practices, and identify new programs and instructional materials. With limited resources, it remains a constant challenge to keep up with the strong demand for cutting-edge training programs in business practices and information technology that fit WPI's mission—especially in efforts to hire, train and mentor top-quality continuing education staff members and instructors who combine industry experience with experience working with adult learners in academic settings. Since a majority of WPI's continuing education instructors also teach or consult for other organizations, it is crucial that the University develops and institutionalizes a program to orient the instructors to WPI and provide ongoing experiences to develop their knowledge and understanding of the WPI culture.

The department is in the process of establishing an alumni network to help serve the career and networking needs of students who complete the IT certificate programs. Since 1994, more than 3,000 men and women have earned certificates of completion through these advanced technical training programs.

# School of Industrial Management

WPI's School of Industrial Management (SIM) was established more than 50 years ago to help regional industry provide:

- education in the human element in any organization.
- group study in developing skills in manpower management.
- broadening experiences needed for supervisory and middle-management personnel.

SIM offers two major programs: the traditional SIM program and a certificate/degree preparation program.

## Traditional SIM program

The traditional SIM program provides a four-year curriculum of related study to supplement the work experience of eligible managerial employees of firms in the Worcester area. It includes eight-semester courses of study, organized around a core objective--the development of management skills essential to executive action. Classes meet one night each week during the regular school year and continue through four years. WPI provides instruction, staff, equipment and an atmosphere conducive to the attainment of this objective. The four-year curriculum was designed by representatives of industry, students, faculty and administrators of WPI to meet the practical needs of employees assuming increasing responsibility. Each subject continues through one semester, and the curriculum is so arranged that every student may begin to participate at any level.

Because management is essentially a group process, the emphasis is on group participation and the development of group spirit. Membership in each year's class is limited. To be eligible to participate, a person must

- be a mature individual who has at least five years of industrial experience and who has shown marked ability for management.
- show an earnest desire to profit by this program of self-development.
- be nominated and financially supported by his or her employer.
- show a likelihood of completing the full four-year program.

Students receive a written evaluation from each professor at the end of each semester. Students also evaluate their professors at the end of each semester. WPI awards certificates to those who successfully complete the eight courses of study.

## Graduate Certificate/Degree Preparation Program

SIM also offers an additional Graduate Certificate/degree preparation program. These programs are interdisciplinary and allow the student to combine such programs as management and power systems engineering or management and manufacturing operations. The students are individually chosen, sponsored and supported by their respective companies. Classes are taught by WPI

faculty in the same manner as in the regular graduate program, in that similar examinations are administered and the contact hours are identical to the normal graduate programs of the University. Letter grades are given. In general, classes meet every three weekends in an executive education format throughout the day on Fridays and Saturdays. The students take all of their prescribed classes together as a cadre.

To date, two corporations have sponsored or are sponsoring 35 students, each for approximately 18 credit hours of study. One corporation is on its second two-semester, one-year iteration; the other is about to begin a second-semester, first iteration, and a first-semester, second iteration.

## Appraisal

Evaluations of both faculty and courses are obtained at the end of each semester's study for the traditional SIM certificate program. SIM intends to adopt the evaluation system used in WPI's regular graduate offerings as the basis for course evaluation for the SIM Graduate Certificate Program.

Registration for both programs is now in the process of being converted to the Banner information management system used at WPI. Registration, accounting, documentation and scheduling will be accomplished through the use of Banner by the end of the 2001 calendar year.

## Instruction

Full- and part-time faculty, of whom 97 percent hold the doctorate in their fields, provide classroom and project leadership for WPI undergraduate and graduate programs of learning. WPI restricts graduate teaching assistants to supporting roles such as lab and section support, grading materials, and the like. Continuing education courses, as noted above, are taught primarily by industry practitioners whose teaching ability and expertise are reviewed by Continuing and Professional Education Department professionals and by a WPI faculty member from the relevant disciplinary department.

The most common format for undergraduate classes at WPI are four 50-minute meetings a week for a seven-week term; common variants on this are three or more 50-minute sessions with a longer lab, or two 100-minute sessions meeting weekly. Graduate classes usually meet in the more conventional 14- or 15-week semester. Continuing education class formats vary greatly to accommodate the schedules of full-time working professionals.

WPI attempts, wherever possible, to vertically integrate faculty research with graduate and undergraduate learning. Faculty members are encouraged to bring their research into the classroom at all levels. Given the emphasis on projects, most class sections at WPI are small: 83 percent have 29 students or fewer. Virtually all class meetings are facilitated by regularly appointed faculty members; graduate students normally lead classes only as emergency substitutes.

Since the last NEASC visit, WPI has focused much effort on providing opportunities in undergraduate classes, especially in the first two years, for students to learn to solve open-ended

problems while working in teams. With initial financial support from the Davis Educational Foundation, 11 large introductory courses in seven disciplines were restructured in a problem-based cooperative learning program, with small student groups facilitated by undergraduate Peer Learning Assistants (PLAs). PLAs have performed well previously in the classes they support, are selected for excellent interpersonal skills, and are trained and paid to facilitate team learning in individual cooperative learning groups in a large class format. Because this peer-assisted cooperative learning model has proven to be successful both in terms of student learning and resource allocation, WPI has absorbed the small additional cost of hiring PLAs, and some additional courses have begun to use them.

During each of their last two years at WPI, undergraduates generally commit at least a quarter of their learning activity to carrying out one of WPI's two nine-credit-hour projects. The interactive project (IQP) is usually done in the junior year, and the project in the major discipline (MQP) in the senior year. The faculty does not require that either of these projects be conducted in teams, or that students focus on open-ended problems posed by external professional organizations, but most students seek out such projects because of the greater learning opportunities they offer. Students in each of the last two years of the WPI program thus become significantly involved in a demanding and rewarding project advised by one (and sometimes more) WPI faculty members, often with strong additional mentorship from a practitioner in the field. These experiences provide rich opportunities for learning about the *process* of problem solving as well as the *content* needed to address the problem.

Given the technological bent of its curriculum, WPI encourages students and faculty to use up-to-date information technology. Since 1999, WPI has spent more than $1 million annually on improvements to the campus computing infrastructure, primarily to increase the speed of the network in the residence halls to 100 megabits per second switched Ethernet and to build wireless links to fraternity and sorority houses. In 2000, WPI was in the second year of a three-year, $4.5 million networking upgrade for academic and administrative buildings. Currently, over 50 percent of WPI's classrooms are equipped with permanent projection and networked computer capabilities; the remainder will be outfitted over the next five years.

On the application side of technology, WPI enjoys wide cultural acceptance. E-mail and voice mail are used by over 95 percent of faculty, students and staff. Over 93 percent of WPI students in the residence halls have computers and are connected to the residential network. A 10-megabit connection is the standard for all rooms; 100-megabit switched Ethernet is available to all students for an additional service fee. More than 400 public lab seats are available and 80 laptop computers are maintained by the Instructional Media Center to support the presentation and project needs of faculty and students. In September 1999, WPI implemented a course management tool, CourseInfo ™ by Blackboard; today more than 150 faculty members use this Web-based system to communicate with and deliver content to their students. Wireless connectivity is offered in the Campus Center, Gordon Library, parts of Higgins Laboratories and Fuller Laboratories, and in an outdoor plaza that connects these buildings.

On campus, faculty members in every disciplines use technology in their classes. The physiology sequence uses ADAM™ software as a student resource, while the experimental biology sequence makes heavy use of CATGEN™ software to aid in the teaching of genetic principles. Maple™, a computer algebra application, and MatLab™, a high-level scientific computing and

visualization language, are core parts of the curriculum taught by the Mathematical Sciences Department. Students are taught how to construct multidimensional images using high-end 3D animation software. Many engineering faculty use notebook computers in the classroom to teach the use of sophisticated computational tools. Others have developed multimedia-teaching tools and, more importantly, examined the learning benefits and cost effectiveness of teaching with that technology.

The technical disciplines are not the only ones where educational technology is used at WPI. The Humanities and Arts Department boasts a variety of innovative technology applications. Multimedia curricula and computer-based translation programs are used to teach German and Spanish. The Spanish culture curriculum is greatly enhanced by students developing Web-based content and by using the Web to connect with people and resources around the world. One faculty member has developed the Virtual Orchestra–though there are no instruments, computer-generated music responds to the beat of a conductor's baton. Dramatic productions are set virtually before they are physically constructed so that the cast and crew may "tour the set" early in the production preparation. Students learn about architectural history and its aesthetic effects by exploring architecture through the use of multimedia technology.

In addition to many technology mediated learning environments found routinely throughout WPI's day-to-day curriculum, faculty and students have discovered innovation applications outside of the classroom: "virtual advising" of students at off-campus locations using various communication technologies; faculty use of technology to provide on-campus students access to experts from all around the world; professional meetings broadcast via the Web to a global audience.

Support for faculty development in all aspects of teaching is provided through the Center for Educational Development, Technology and Assessment (CEDTA), which is directed by a professor of biology with additional support from professional staff. Increasingly, CEDTA is working closely with the Instructional Media Center, since many of their interests overlap in using new technologies to enhance learning. CEDTA provides workshops, lunchtime discussions, a film series, a resource library, group training of teaching assistants, a new faculty mentoring program, and individual consultation aimed at assisting established and new faculty to work effectively in an outcomes-based educational system. Beginning July 1, 2000, CEDTA assumed expanded responsibilities and resources for promoting effective use of educational technology and providing expertise and services for educational assessment.

By vote of the WPI faculty, students in all courses have the opportunity to evaluate their courses using a written form distributed in the classroom at the end of the term. Aggregated numerical responses from students are available over the campus Web site as a guide to help other students in selecting courses. The course evaluation process and the use of its data for faculty development are described in greater detail in Standard 5.

The Director of Academic Advising assigns WPI faculty members, normally in a student's major area, as advisors to undergraduates for their second semester. First-semester advising is now handled by the Insight program described below. The Academic Advising Office also handles requests from either students or faculty for changes in advising relationships. The WPI Faculty Constitution defines academic advising as teaching (not service), and thus advising loads and

performance are part of faculty teaching responsibilities. The Committee on Advising and Student Life (CASL), composed of faculty, students and staff, meets regularly during the academic year to review performance of the advising system and to plan annual programs for new and experienced advisors. For example, in 1999-2000, CASL designed a new "Excellence in Advising Program," which provides special training, recognition and a modest honorarium to faculty with heavy or special advising obligations who wish to participate in this program.

## Appraisal

In a more recent effort supported by the Davis Educational Foundation, three interventions are being pilot tested, with the ultimate goal of delivering a first-year experience in which students perceive more connections among themselves, their peers, their teachers, their academic work, their careers and the world outside the college campus. These initiatives also have the more pragmatic goal of improving WPI's already quite good freshman to sophomore retention rate (91 percent for the Class of 2003).

1. The *Insight* program was pilot tested during the 1999-2000 and 2000-01 academic years and will be implemented for all members of the Class of 2005 entering this fall. Insight is a residence-life-based program in which students go through new student orientation with their residence hall group. Especially chosen Insight faculty advisors, assigned to the Insight groups, interact with the students on a regular basis in their residence halls during the fall semester. Special programming is provided in the residence halls on such topics as time management, healthy life styles and relationships.

2. The *Bridge* program grows out of prior work funded by an NSF Institution-Wide Reform grant, and constitutes an attempt, through faculty collaboration on course planning and delivery, to help students see the relationships between the content of their courses (for example, physics and calculus, or biology and chemistry). During the 2000-01 academic year, bridging was confined to introductory physics and calculus during the fall semester; in the upcoming academic year, bridging will be extended to common three-course "clusters" for which freshmen typically register.

3. Finally, the *Tutorial* program is an attempt to adapt the British tutorial model to the modern university. In academic year 2000-01, 21 students and three faculty members (one each from physics, mathematics and humanities) spent all of their academic time together for one term and parts of their time in two other terms, in an integrated consideration of the relationships among physics, calculus and the history of science (termed "Humathics"). In academic year 2001-02, the tutorial will be offered full-time for the fall semester.

An extensive assessment of all three interventions is under way in an attempt to identify which combination of components is most effective at improving student learning and retention, and also the most cost effective.

WPI's capital investments in the infrastructure, coupled with annual investments over $1 million in desktop computers and University servers, have made (and will continue to make) WPI one of the most technologically sophisticated universities in the country. In 2000, *Yahoo! Internet Life* named WPI the 23rd "most wired" campus in America. In 1999, WPI was chosen to be part of an

elite group of institutions that will design and test the next generation Internet–the Internet2 project.

Faculty acceptance of new teaching technologies has been encouraging—especially the large number of faculty (over 150 in spring 2001) who have used myWPI for online classroom communications. Nonetheless, WPI acknowledges that the faculty requires support in adapting new technologies efficiently. Thus, in February 2001 the provost and the vice president for information technology announced the Teaching Technology Fellowship Program. (*) that will annually support, with stipends and hardware, eight faculty members who commit to assessing the pedagogical implications of new technologies and redesigning one of their courses accordingly.

Given that roughly half of WPI's graduate students are international, assuring the English language and classroom-management skills of international TAs is a challenge that has been addressed by creating a special ESL program for international TAs. The program includes a comprehensive evaluation of all international TA candidates in August and instruction in ESL and classroom management and communications skills. TAs in ESL classes are given assignments in their first semester that do not involve direct contact with undergraduate students. The ESL director also assists academic departments in assessing the language skills of TA applicants.

Class length and scheduling are of concern in some areas. The format of two-hour classes, twice a week, for first-year students has been reviewed to assure that such a format serves the students' pedagogical needs. Similarly, four-hour, once-a- week graduate courses may not serve student learning well.

WPI, like many other universities, struggles to provide recognition and loading credit commensurate with the contributions that many faculty members make to learning by serving as academic advisors.

The first-year program remains fairly conventional when compared to the emphasis on projects for upperclass students. The strategic plan initiative to make the whole of the WPI undergraduate experience like that of honors students at other institutions has not yet fully impacted the first-year experience for most WPI undergraduates.

## Projection

In 1999-2000, the ESL program added training sessions for TAs on classroom management skills. WPI continues to monitor quality of TA preparation in terms of language and classroom management skills, and provides programs to assist TAs needing assistance in these areas.

As part of the current strategic plan initiatives, several faculty and administrative groups continue to discuss how to make the first year at WPI more congruent with the emphasis on teamwork, problem solving, and multidisciplinary and interdisciplinary learning that occurs in the upperclass years.

Faculty governance committees will continue discussion of issues of class format and scheduling times beginning in fall 2001.

## Other Educational Services to the Community

In addition to the undergraduate, graduate and continuing education programs described above, WPI provides community support for education, especially K-12 education, in several significant ways. Since 1992-93, WPI has been an institutional partner with the state Department of Education to support, on campus, the Massachusetts Academy of Mathematics and Science, a public high school for gifted $11^{th}$ and $12^{th}$ grade students (*). The academy has graduated more than 400 students and was accredited by the New England Commission on Public Secondary Schools in 1999-2000. WPI also supports K-12 education by providing numerous students for volunteer and for-credit (typically IQP) activities, by offering middle and high school teacher certification in mathematics and science as an option, and by offering the Master of Mathematics for Educators degree program. The Worcester Community Project Center contributes to the local Engineering Pipeline Collaborative K-12, and to statewide efforts to implement the new engineering frameworks in public K-12 education.

## Scholarship And Research

All faculty members are expected to pursue creative scholarship, which is one of the two most important requirements for tenure and for promotion. Evidence of scholarship includes publications in respected research or scholarly journals, non-routine presentations at meetings of professional or scholarly societies or at seminars at other colleges, and authorship of well-regarded textbooks or monographs. In addition, faculty members may demonstrate creative scholarship by applying knowledge as a consultant or inventor, and through artistic publications, exhibitions or productions.

Scholarship is closely integrated with course and project teaching. Faculty members are encouraged to pursue scholarly experimentation concerning both the content and technique of their teaching, and to present and publish results of this work. Faculty members bring research results to both classroom and project advising. Many faculty members integrate their teaching, project advising and graduate research activities by using a thematic team approach to their combined scholarship and research activities. WPI publishes a bibliography, *Educational Publications of the WPI Faculty*, which is being updated in summer 2001 (*).

Most faculty members maintain active research programs. For many, especially those in engineering and the sciences, external funding is essential for the support of graduate students, laboratory equipment and summer salaries. WPI invests heavily in laboratory infrastructure, start-up funding, cost sharing, facilities maintenance, computing infrastructure, machine and electronic shops, and technicians as shown in the table below.

## FY ’01 Expenses in Support of Scholarship and Research

| | |
|---|---|
| Cost Sharing on Research Grants | $620,600 |
| Research Incentives | $142,310 |
| Research Facilities Improvement | $2,613,125 |
| Faculty Start-Up Funds | $540,000 |
| Faculty Travel | $252,463 |
| Research Initiation | $10,300 |
| Equipment | $626,882 |
| Maintenance | $1,037,206 |
| Computing Infrastructure | $1,864,554 |
| Machinists and Technician Support | $1,059,939 |
| Research Development Council | $100,000 |
| Fellowships for Graduate Student Research | $308,066 |
| Undergraduate Summer Research Stipends | $24,000 |

Extramural support is sought for undergraduate research projects, graduate research, faculty research, research centers, facilities improvements and additions, and laboratory equipment. To support these efforts of the faculty, WPI operates offices for research administration, research accounting, and corporate and foundation relations. New faculty members typically receive summer salary allocations in addition to laboratory and equipment allocations to ensure rapid establishment of research programs. In addition, WPI budgets significant funds for cost sharing on grants, graduate tuition waiving, indirect cost recovery distribution, facilities improvement, travel, research initiation, equipment and maintenance.

Internal and external support is also secured to support students in conjunction with faculty research programs. Opportunities for graduate student support include teaching assistantships, research assistantships, graduate assistantships, internships and fellowships. More than 200 graduate students are supported through these mechanisms. Undergraduate students also receive support through summer research opportunities, project support and work study assignments.

WPI maintains and updates as needed policies regarding research, including conflict of interest, human subjects, animal care, honesty/ethics and intellectual property. Faculty members play an active role in the creation, revision and promulgation of these and other policies through the committee structure and the appointment of ad hoc advisory policies committees. These policies are included in the faculty handbook or are available on the Web. New faculty members are briefed on these policies during their orientation activities. All policies will soon be available at a single Web location (http://www.wpi.edu/Pubs/Policies/).

Scholarship and research receive substantial support and encouragement. Faculty members are expected to participate in appropriate professional forums. Travel funding is provided through the academic departments. The faculty culture and practice at WPI make scholarship and research important ingredients in tenure, promotion and salary reviews.

As part of the new strategic plan, WPI has identified six interdisciplinary research initiatives toward which most new resources are directed. More than 100 faculty members are participating in one or more of these six interdisciplinary research "thrust" areas:

Life Sciences and Bioengineering
Aerospace
Computer and Information Technology
Materials
Environmental Studies
Computer Modeling

Decisions regarding resource allocation are strongly weighted towards augmentation of teaching and research in these areas. Principal among these have been internal research funds, endowed fellowships, institute fellowships, and undergraduate research stipends. The effectiveness of the thrust area strategy has been realized through increased interdisciplinary collaboration and increased research funding. The Materials area has shown remarkable growth, especially through the Metal Processing Institute, which now has multi-million-dollar support through corporate memberships and extramural funding. The Life Sciences and Bioengineering area has resulted in a major initiative to form a Bioengineering Institute. The institute will include several centers and will be focused on product realization.

The WPI Office of Research Administration (ORA) supports WPI faculty with applications for external support by providing the following services: assistance with proposal preparation, identification of funding sources, and approval of proposals for submission. In addition, ORA negotiates contracts and awards, maintains the electronic submission process, authorizes cost sharing, and maintains appropriate records. It is also responsible for briefing new faculty and staff, hosting workshops, and arranging seminars for funding agency representatives. ORA transfers responsibility for grants and contracts to Research Accounting when the award is received.

The Director of Research Administration also provides leadership for the Research Development Council, oversees research integrity issues, and oversees human subject and animal care issues.

Faculty and students are accorded the academic freedom to pursue scholarship and research. Policies are clearly presented in the faculty handbook. The Committee on Tenure and Academic Freedom hears complaints associated with these issues.

## Appraisal

ORA oversees the submission of approximately 200 proposals and the receipt of approximately 100 awards each year. The value of these awards is approximately $7.5 million annually. This number is less than the total amount WPI secures annually to support research because some categories of gifts as well as support for some major research centers are not included. WPI is working to improve its financial recording system to ensure that all of these forms of external support for research will be included in published reports in the future.

For many years, ORA was a one-person shop. However, recent increases in the number of faculty successes in proposal activity, along with increasing federal requirements, have necessitated the addition of a second professional person in that office. Concerns regarding post-award management and intellectual property management have resulted in a request for a third professional.

ORA provides professional service to faculty and staff submitting proposals. That service has been excellent and demand is increasing. Physical space is becoming a problem and the physical separation from Research Accounting is already a limitation.

## Projection

ORA will continue to experience increasing demand for its services. Additional faculty, a desired 50 percent increase in full-time graduate students, and increasing regulatory requirements will all result in increasing staff and office space needs.