A. Introduction

The Institute of Technology (IT) is the University’s second largest college with more than 6,800 students (about 4,400 undergraduates and 2,400 graduate students), and approximately 400 faculty members. The college typically produces about 800–900 bachelor’s, 400 master’s and 150–200 doctoral degrees each year. 25% of the University of Minnesota’s prestigious Regents Professors reside in IT. Twenty-seven IT faculty have been elected to the National Academy of Engineering and 12 have been elected to the National Academy of Sciences.

IT’s structure is unique among the country’s major research universities in that it includes engineering, mathematics, and the physical and computational sciences in a single unit. This is an advantageous combination, as the boundaries between pure science and engineering continue to disappear. IT’s 12 departments include seven engineering departments (counting Computer Science and Engineering), four science departments, and mathematics. In addition, there are 24 centers, including a National Science Foundation (NSF) Materials Research Science and Engineering Center, an NSF Science and Technology Center (the Center for Earth-Surface Dynamics), the NSF-funded Institute for Mathematics and Its Applications, and the Army High Performance Computing Research Center.

IT’s mission is to provide a rigorous and stimulating education for its undergraduate and graduate students; to provide programs of instruction in engineering that meet nationally accepted standards for practice of the profession of engineering; and to provide a rigorous and stimulating education for majors in other colleges for whom IT provides instruction in mathematics and physical science. IT’s basic and applied research programs sustain its educational programs, enrich modern culture, improve professional practice, and create the knowledge and know-how that are essential to our increasingly technological society and the maintenance of our desired standard of living. The college’s service and outreach programs provide expertise to the state’s industry and enhance education in science and mathematics in grades K–12. Graduate level courses are provided by University-Industry Television for Education (UNITE) to several companies and University of Minnesota Rochester.

The research productivity of IT’s faculty is high: In 2003-04, 629 grants totaling more than $94 million were awarded to the college. Research expenditures for the same year were approximately $83 million. The corresponding figures for 2002-03 were 540 grants worth $71 million and $77 million in research expenditures.

The Institute of Technology consists of 31 budgeted areas:

- TECHNOLOGY, INSTITUTE OF-ADM
- TECHNOLOGY, INSTITUTE OF-DEV
- TECHNOLOGY, INSTITUTE OF-SSS
- AEROSPACE ENGINEERING & MECHANICS
- ARMY HPC RESEARCH CENTER
- ASTRONOMY
- BABBAGE INST FOR HIST OF INFORMATION PROC
- CHEMICAL ENGINEERING & MATERIALS SCIENCE
- CHEMISTRY
- CIVIL ENGINEERING
- COMPUTER SCIENCE & ENGINEERING
- EDUCATIONAL PROGRAMS, IT CENTER FOR
- ELECTRICAL & COMPUTER ENGINEERING
- GEOLOGICAL SURVEY, MN
- GEOLOGY & GEOPHYSICS
- CHARACTERIZATION FACILITY
- MATH & ITS APP, INSTITUTE FOR
- MATHEMATICS, SCHOOL OF
- MECHANICAL ENGINEERING
- NANOFABRICATION CENTER
- PHYSICS & ASTRONOMY, SCHOOL OF
- SCIENCE & TECHNOLOGY, HISTORY OF
- ST ANTHONY FALLS LAB
- TECH LEADERSHIP, CTR FOR DEV
- THEORETICAL PHYSICS INSTITUTE
- UNITE
- BIOMEDICAL ENGINEERING
- U OF M MAT RSRC SCI/ENG CTR
- INDUSTRIAL PARTNERSHIP FOR RESEARCH
- MN SUPERCOMPUTER INSTITUTE
- DIGITAL TECHNOLOGY CENTER

The compact between the Senior Vice President and Provost and the Dean of the Institute of Technology for 2004–05 includes the following:
B. Update – Major Long-Term Goals/Priorities from Previous Compacts

IT will continue working to fill the open faculty positions that develop normally each year through retirements, resignations, and deaths (the annual faculty turnover rate is typically between 3 and 4%). The goal is to maintain the ranking of chemical engineering while strengthening the other academic programs in the college. This will be accomplished by adding faculty to strategic areas for departmental balance in teaching and research. Several initiatives aimed at meeting this objective are in progress, as follows.

1. The Digital Technology Initiative

The Digital Technology Initiative is a component of the University’s program to renovate Walter Library as a science and engineering library and to create a Digital Technology Center. The purpose of the Digital Technology Center (DTC) is to become a hub of innovation and excellence at the University of Minnesota in the digital technologies serving the industrial, educational, and public needs of the state of Minnesota and the nation. The DTC arose out of a desire to assist in the reestablishment of Minnesota’s commanding position in digital technology as we move into the information era. The DTC integrates research, education, and outreach in computational biology and bioinformatics; distributed robotics; data storage, analysis, and visualization; graphics, visualization, and digital design; networking and security; systems recognition and verification; signal processing, telecommunications, and wireless; and other digital technologies.

The DTC’s mission includes the following objectives:

- To create, promote, and coordinate cooperative interdisciplinary advanced technology initiatives between various University colleges and programs.
- To generate new ideas/learning and educate outstanding graduates who are prepared for the high technology industries of the 21st century.
- To promote communication between the University of Minnesota and industry—as well as other institutions and government—and to serve as a point of entry into research and development partnerships with these various partners.

The center was administered through the Office of the Vice President for Research through June 30, 2003. Beginning in 2003–04, the center was administered through the Institute of Technology.

The DTC has the following general goals:

Faculty recruitment — The Digital Technology Initiative provided funding for eighteen new faculty positions (fourteen with funds provided directly by the State as part of the initiative and four through funds provided by internal reallocations). All of these faculty members are appointed through specific academic departments (e.g., Computer Science and Engineering, Mathematics, or Physics.) Two positions were allocated to the Carlson School of Management. The University of Minnesota Rochester was also allocated one position. The remaining positions were earmarked for the Institute of Technology. As of Spring 2004, eight of the twelve positions within the Institute of Technology have been filled. Active searches are under way for three positions, one of which has been recently filled. The fourth position may not be filled due to budgetary constraints, but the DTC has committed to fund one-half of a database position in CSE in order to strengthen campus expertise in this area, which is vital for the DTC.

In addition to recruiting faculty from outside the University of Minnesota to fill DTC funded positions, the DTC is recruiting existing U of M faculty to join the DTC. The DTC is also an important recruitment tool in filling digital technology-related faculty positions in various departments.

Recruit more members to Affiliates Program — The DTC’s Affiliates Program is a means for companies and other institutions to have a direct association with the DTC. By joining the Affiliates Program, companies can have a representative on the DTC’s Technology Advisory Team, access to annual research reviews, web casts of DTC seminars, reduced fee access to the Usability Lab, and waiver of some DTC/MSI registration fees. The annual membership fee is $10,000. Companies that have donated over $1 million to the DTC are made lifetime affiliates. Currently there are twelve members of the Affiliates Program. These are ADC, Benjamin Moore, EMC, IBM, Intel, LSI Logic, 3M, Nortel, StorageTek, Thomson Legal and Regulatory, Unisys, and Veritas. Additional members will be recruited through direct solicitations and through events such as Open Houses.
For 2004-05, the DTC would like to recruit at least three new members to its Affiliates Program. It would like to increase the total number of members from 12 in 2003–04 to 20 by the end of 2006–07.

*Nurture and expand the DISC and DDC consortia to self-sustaining levels* —
The DTC has developed a Consortium Program to provide focused technology research opportunities to members of the DTC Affiliates Program. These consortia allow industries with synergistic business/technical missions to work as a team with a group of DTC faculty, researchers, and graduate students who have similar technological interests. Currently the DTC has two consortia: Digital Technology Center Intelligent Storage Consortium (DISC) and Digital Design Consortium (DDC)

DISC, which was initially funded through a seed grant by the DTC, currently has three industrial members: StorageTek, Veritas, and LSI Logic. In addition Intel and Cisco have made donations to DISC and Livermore National Laboratory is providing support for one graduate student. DISC faculty and researchers from the Mayo Clinic are also discussing collaborations involving the analysis of clinical data.

The DDC was initially funded by a gift from Ted and Linda Johnson. The DTC has provided space for the consortium and seed funding to launch the industrial affiliates aspect of the program. Currently, the DDC is actively recruiting members. Potential members include paint companies, developers, architecture firms, and construction materials companies. The DDC is also in the process of establishing a relationship with Pine Technical College’s Johnson Center for Virtual Reality. The Johnson Center develops virtual reality training systems. The DDC and Pine Tech are exploring collaborations that build on their collective expertise in virtual reality.

For its consortia, the DTC broadly defines “self-sustaining” as generating sufficient resources through consortia fees, donations, external lab usage fees, and funded research projects to support the research and membership recruitment activities of the consortium. These activities include funding graduate students to work on consortium related research projects, covering the cost of the consortium's technical manager salary and fringes and travel expenses, sponsoring workshops and symposia, as well as other expenses related to operating the consortium.

The self-sustaining level for each consortium will be slightly different depending on the number of students supported, the operating costs of the consortium, and the fee structure of the consortia. For example DISC, with five members right now (ETRI, Engenio, StorageTek, Sun Micro Systems, and Veritas), donations from Cisco and Intel, and funding for a DISC related project through Los Alamos National Laboratory, has achieved the self-sustaining level. Funding from the DTC stopped as of June 30, 2004.

In 2004–05 DISC will support five graduate students, sponsor an annual workshop, and cover the salary and travel costs of its Technical Manager. We anticipate that the DDC, which is in the process of finalizing the recruitment of its first member, will be self-sustaining by 2006. This will entail supporting the DDC’s Technical Manager and at least three graduate students, as well as supporting other consortium related activities.

*Inaugurate additional technology consortia* — There are several opportunities for new industrial consortia. These include distributed robotics and data mining. The DTC is currently in discussions with faculty to determine their interest and to gauge industrial interest.

The success of the Digital Technology Initiative—and the Digital Technology Center—will be also measured by the success of its affiliated faculty and staff in competing for significant sponsored research funding. Since the Fall 2002, DTC affiliated faculty have submitted through the DTC 70 proposals to 8 agencies. The participation of the DTC through its resources, facilities, and researchers, played a key role in the following projects being funded:

- NSF CISE: Collaborative Data Analysis and Visualization
- NSF ITR: Institute for the Theory of Advanced Materials in Information Technology
- NSF ITR: Multi-Robot Emergency Response
- NSF ITR: Collaborative Research in Immersive Design Environments
- NSF-NIH: Bioinformatics Summer Institute

2. *Coping with Enrollment Pressures — Computer Science and Engineering*

From 1993 to 2000 the number of majors in computer science doubled, from about 300 to more than 600. During the same period the faculty size remained essentially constant (at about 27). The demand for computer science courses by non-majors also increased during the same time period. In the University’s 2001 legislative request, 17 new computer science faculty were requested. It was agreed that with these 17 new faculty, the Department of Computer Science and Engineering would increase the number of majors from 600 to 900
students. The result of the 2001 legislative budget was that seven new computer science faculty can be hired at $100,000 salary and fringe benefits per hire. Funding for these new positions will be available from the fiscal year 2002–03 appropriation for that purpose.

In addition to the $700,000 for the new positions funded through the appropriation, the Senior Vice President and Provost also committed $300,000 in fiscal year 2002–03 for three additional computer science positions, bringing the number of authorized new hires to 10. IT agreed to increase the number of computer science majors from 600 to 775 (a linear scaling of the agreement of 17 hires to an agreement of 10 hires).

Seven of the authorized 10 new faculty positions were filled as of the beginning of the 2004-05 academic year; searches for the remaining three positions are in progress.

3. Coping with Enrollment Pressures — Physics

In the 2002–03 compact it was noted that the School of Physics and Astronomy has been affected by burgeoning undergraduate enrollments in the College of Biological Sciences (CBS). The department restructured the introductory physics course most commonly taken by CBS majors (Phys 1201 Introductory Physics for Pre-Medicine and Biology I), and now also provides a spring semester offering of this course. The second course in the sequence (Phys 1202) is also offered in the spring, and last year (Summer 2002) this course was also taught during summer session to provide additional opportunities to students.

It was also stated in the 2002–03 compact that an additional physics faculty member would be hired to help meet the needs of CBS students, and that a search for this individual was in progress. The search was successfully concluded during 2003-04.

4. Nanotechnology Initiative

The Institute of Technology is well positioned in the area of nanoscience and nanotechnology. There are strong faculty in these areas in the departments of Chemical Engineering and Materials Science, Chemistry, Electrical and Computer Engineering, and Physics. Resources serving the areas include the NSF Materials Research Science and Engineering Center (MRSEC), the NanoFabrication Center (NFC) (formerly the Microtechnology Laboratory), and the IT Characterization Facility (CharFac). The NFC and the CharFac are run as ISOs for the benefit of the University and local industrial communities. The college, together with the Office of the Vice President for Research, recently added a $1 million electron beam nanofabrication tool to the NFC. The CharFac has atomic force and magnetic force microscopes, scanning and transmission electron microscopes, a state-of-the-art x-ray facility, and several other instruments needed for nanoscience research.

With a few strategic investments the college can become a national leader in nanoscience and nanotechnology. To this end, we need to add one entry level faculty member in physics, one entry level faculty member in biomedical engineering, and one research staff person in DNA nanoelectronics. As detailed below, the Office of the Senior Vice President and Provost (SVPP) has committed $335,000 in recurring funds to meet these needs.

Expansion in nanophysics — IT has outstanding theorists in the area of nanomaterials. To complete the area, an experimental physicist who specializes in making and characterizing nanomaterials is needed. $110,000 of the $335,000 committed by the SVPP for the Nanotechnology Initiative was committed for hiring such a person. A search was successfully completed during 2003–04 and a new physics faculty member who specializes in studying the dynamical properties of semi-conducting thin film nanostructures joined the School of Physics and Astronomy in fall 2004.

Expansion in biomedical nanotechnology — One of the great challenges in biomedical engineering is the integration of knowledge across varying length scales ranging from the whole body (~1 meter) to organs and tissues (~1 millimeter), cells (~1 micrometer), and molecules (~1 nanometer). Of particular importance in the current post-genomic era is to understand how the molecules identified by the human genome project cooperate to function as cells. To do so requires understanding the physics and chemistry of biological macromolecule complexes and their dynamic behaviors. These complexes are typically 10 to 100 nanometers, and so can be viewed as nanomachines, which perform sophisticated mechanical, electrical, and chemical functions to allow the emergence of biological function at the cellular level. Understanding the principles of operation and control at the nanoscale will enable us to better control cellular behaviors to achieve such goals as promoting nerve regeneration and suppressing cancer, among myriad health problems.

Nanotechnology also offers the promise of computer controlled molecular tools much smaller than a human cell that will enable, for the first time, intervention
in a sophisticated and controlled way at the cellular and molecular level. For example, such nanomachines could more selectively kill cancer cells by having programmed logic for detection of a “cancer profile” upon finding a “suspect cell” and then releasing a computed dose of cytotoxin based on readings from metabolic sensors; a lethal effect could thus be guaranteed. Other examples of cell-based diagnosis and treatment by circulating nanomachines can easily be envisaged, including the replacement of function to damaged subcellular organelles.

The Department of Biomedical Engineering currently has strengths in phenomena occurring at the organ, tissue, and cellular levels. These strengths will be well complemented by addition of a faculty member in the biomedical-nanotechnology area who can connect the nanoscale to the microscale and higher. $115,000 of the $335,000 committed by the SVPP for the Nanotechnology Initiative will be used to hire such a faculty member. A search was successfully completed during 2003–04, and the new faculty member will join the department in fall 2006 after completing an appointment as a postdoctoral research associate at another institution.

Expansion in nanoelectronics — The third addition in nanoscience and nanotechnology is in the area of nanoelectronics. A team led by a faculty member in the Department of Electrical and Computer Engineering recently received a $1 million NSF grant for research in DNA nanoelectronics. To ensure that the project goes forward and realizes its full potential, we plan to hire a research scientist whose responsibility will be to customize and maintain a new two-probe atomic force/scanning tunneling microscope (AFM/STM) used in nanoscale electrical characterization of nanostructures. This instrument and the person to manage it will add greatly to the capabilities and services offered by the Characterization Facility. In addition to serving the NSF grant, this will be useful to other researchers in IT, the Academic Health Center, and the College of Biological Sciences. The remaining $110,000 committed by the SVPP for the Nanotechnology Initiative will be used to hire the research scientist. A search for this individual is in progress.

5 Biotechnology Initiative

Industrial biotechnology is a promising area of economic growth, and biocatalysis is one of the key research areas that will support this growth. The University of Minnesota can, with a modest strategic investment, become a leader in this area. Already in place is the Biotechnology Institute (BTI), which is housed in the College of the Biological Sciences and co-managed by CBS and IT. Faculty members from both CBS and IT form the core personnel of the institute. The current director of BTI, a chemical engineer, has done a good job of managing the institute. However, what is needed now is a world-class researcher who can lead BTI in landing large grants, attracting new young faculty hires in IT and CBS in the area of biocatalysis, and making collaborative connections with biotechnology companies in Minnesota and elsewhere.

The SVPP has committed $215,000 (salary plus fringe benefits) to hire a senior engineering faculty member to become the director of BTI; a search is in progress. The current director has agreed to become the associate director and to take care of routine administrative issues to free the director to pursue research and funding initiatives. CBS and IT are planning to add a few entry-level faculty members to complement the new director and the existing faculty in the area.

6 Investments to Maintain Rankings of Academic Programs

The Institute of Technology has seven Ph.D. programs ranked in the 84th percentile or higher in the most recent (1995) rankings of the National Research Council. In addition to the top-ranked program in chemical engineering, these are: mechanical engineering—8th out of 110 programs, or 93%; mathematics—14/135, or 90%; chemistry—21/168, or 87%; electrical engineering—18/126, or 86%; civil engineering—13/86, or 85%; and physics—22.5/146, or 84%.

Investments are needed to maintain and, where possible, improve these rankings, particularly in view of the most recent round of retrenchments at the University. To this end, the college and the SVPP will jointly invest recurring funds of $0.63 million for seven faculty positions at an average cost of $90,000 per position (salary plus fringe benefits). The seven positions will be deployed as follows:

Mechanical engineering — two positions. The Department of Mechanical Engineering accounts for approximately one-third of all bachelor’s degrees in engineering at the University of Minnesota: an average of approximately 200 mechanical engineering degrees per year have been awarded for the past 11 years. The department has been consistently ranked among the top five or ten mechanical engineering programs in the country for at least the past 40 years, but faces a considerable challenge in trying to improve upon this record, given that other lower ranked programs have recently made substantial investments in...
mechanical engineering. (The University of Illinois at Urbana-Champaign and Georgia Tech are two examples.) The two reallocated faculty positions will maintain the faculty base at its present size (42) and will allow the department to realize its plan to expand its program in industrial engineering.

Mathematics — one position. The School of Mathematics accounts for approximately 25% of the total student credit hours taught in IT. During the past five years, the department has made concerted efforts to improve the quality of instruction in the introductory mathematics courses for all students. The emphasis in these courses is on group and interactive learning, and visualization of concepts using both hand-held calculators (first year) and computers (second year), which requires smaller class and recitation sizes compared with traditional classroom approaches. IT and the SVPP each contributed non-recurring funds of $150,000 in 1999–00 and 2000–01 to assist the department in these efforts, and IT subsequently strengthened the commitment by providing recurring funds of $175,000 for “special teaching needs” and also ensuring that the department’s allocation of supplemental TA funds is sufficient to continue offering comparatively small lecture and recitation sections.

Chemistry — two positions. The Department of Chemistry plays a key role in IT’s efforts in nano/biotechnology. The department has recently retained several of its faculty who were being recruited by other institutions, but stands to lose a position to recent retenchments. The size of the faculty must be maintained at its current level (42) in order to compete with peer institutions and to cope with increased enrollments in introductory courses due to increased numbers of students in CBS and other program requiring basic chemistry.

The planned renovation of chemistry laboratory space in Kolthoff Hall will, in the short term, make it difficult to recruit new faculty to the department. Because of this, the SVPP has agreed to provide $40,000 in 2004–05 and 2005–06 to allow the hiring of temporary teaching faculty to meet student demands for chemistry courses. The department expects to begin recruiting new faculty in 2005–06, with the expectation that the two positions will be filled in 2006–07.

Electrical engineering — two positions. Over the past two decades, the discipline of computer engineering has emerged as an outgrowth of the specialties of digital and computer design within electrical engineering. Over 85% of electrical engineering programs in the U.S., including ours, have changed their names to reflect this fact, and a substantial number (in a few cases the majority) of traditional electrical engineering students now opt for computer engineering degrees. As a joint program of the departments of Electrical and Computer Engineering and Computer Science and Engineering, the University of Minnesota’s Twin Cities Campus established a master’s degree in computer engineering in 1996, and a bachelor’s degree in 1998. The Department of Electrical and Computer Engineering administers both programs. Since 1998, enrollment in the Bachelor of Computer Engineering program has grown from zero to 280, with another 90 students enrolled in the MS program.

Computer engineering considers the interaction between the hardware and software aspects of computer design. While some areas of discipline such as software and compiler design are appropriately covered by computer scientists, many of the core aspects of the field require expertise in electronics and systems, particularly those related to computer architecture and hardware design. The field is growing increasingly interdisciplinary as issues related to device physics and transistor-level design impact architectural design of computers. Therefore, research and instruction in computer engineering requires core electrical engineering capabilities, including knowledge of computer architecture, circuit-level design, and device physics.

The two positions allocated to the Department of Electrical and Computer Engineering will allow the department to keep pace with its peer institutions in computer engineering and will complement the strategic investments that have been made during the past few years in computer science.

One of the two positions has been filled for 2004–05, and the SVPP has agreed to contribute $100,000 (one-time funding) to the setup package for this individual. In addition, the SVPP will transfer a recurring amount of $100,000 to IT for the new hire’s salary and fringe benefits.

Chemical engineering — In addition, IT will provide bridge funding to the Department of Chemical Engineering and Materials Science for three new faculty positions in chemical engineering to replace the next three faculty vacancies in this program. Although only one retirement is currently scheduled (in 2006), at least two others are likely within a few years. These three faculty members are all Regents Professors and members of the National Academy of Engineering so it is urgent that they be replaced. The Department of Chemical Engineering and Materials Science must be allowed the flexibility to begin hiring replacement faculty now to ensure continuity of its research productivity.
7. Strategic Investment in Biomedical Engineering

Biomedical engineering is a rapidly growing program of strategic importance to the University and the State. (On a per capita basis, Minnesota has the largest medical device industry in the country.) Since the Department of Biomedical Engineering was created three years ago, its undergraduate enrollment has soared: the sophomore and junior classes have approximately 65 students each, and 40 bachelor’s degrees will be awarded in 2003–04, compared to six in 2001-02. Within a year or two it is expected that the graduating class will number 75.

In order to meet these demands and help the department achieve its goal of becoming one of the top ten biomedical engineering programs in the country, additional resources are required. To this end, the number of biomedical engineering faculty will be increased by two, to a total of 10, by 2005–06. (The figure of 10 includes the position for the Nanotechnology Initiative, discussed above.) IT will pay for one of the two new positions at an estimated cost of $90,000 (salary plus fringe benefits), and the SVPP will pay for the other, also at $90,000. The SVPP transferred the recurring funds for this commitment to IT in 2003–04, and the position has been filled.

8. Investment in Student Affairs

The college has engaged in several activities during the past five years to recruit and retain undergraduate students and generally improve the undergraduate experience. Specifically, we are now supporting Living and Learning Communities for our students (IT has the largest Living and Learning Community on campus); we have added a “Commitment Event” in spring semester to encourage the best new applicants to attend IT; we are participating in the Gopher Graduate summer program to try to interest inner city students in attending the university; and we have greatly expanded the opportunities in study-abroad programs for our students, with the result that participation in these programs has been steadily increasing.

We plan to build upon these successes by doubling the number of students participating in the IT Living and Learning Community (from 100 to 200) and continuing the expansion of our study-abroad program. In addition, we plan to develop a program to support transfer students (by creating cohorts of new students) in an effort to improve the educational experience for this group of students.

IT and the SVPP jointly committed $75,000 in recurring funds ($37,500 each) in 2003–04 to assist in carrying out these plans. The funds are being used partly for salary and fringe benefits for a new hire in the IT Office of Student Affairs ($60,000), and partly for supporting expenses ($15,000). The new hire will have both administrative and advising responsibilities, and the net effect of the changes will be to extend the breadth and depth of the Office of Student Affairs and to introduce some efficiencies in current operations.

9. The Chemical Biotechnology Initiative

The Chemical Biotechnology Initiative (“CBI”) is designed to stimulate interdisciplinary biomedical/biotechnology research, technological development, and education at the crossroads of chemistry, physics, biology, and engineering at the University of Minnesota. This effort will enhance scholarship in traditional fields such as drug design and will enable the exploration of entirely new concepts at the interface of the subject disciplines. Specific focus areas, or centers, within the CBI are: the Chemical Genetics Center (including bioprobe design, molecular modeling, synthetic chemistry, nucleic acid chemistry, and bioorganic and bioinorganic chemistry); (2) the Biomaterials Engineering Center (biomicroelectronics, tissue engineering, cellular engineering, nanobiotechnology); and (3) the Biotechnology Institute (combinatorial biosynthesis, microbial engineering, and biocatalysis). The latter organization is an existing entity managed jointly by IT and CBS.

The Chemical Biotechnology Initiative involves three colleges—IT, CBS, and Pharmacy—and will be supported for an initial three-year trial period by non-recurring funds of $400,000. Each of the three colleges will contribute $66,666 of this amount and the SVPP will contribute $200,000 ($100,000 in fiscal year 2003-04 and $100,000 in fiscal year 2004-05). The funds will be used for the following purposes: $150,000 for six graduate student fellowships; $180,000 for four postdoctoral fellowships; $20,000 to support a CBI Colloquium; and $50,000 for 50% of an administrative assistant.

The graduate student and postdoctoral fellowships are designed to support new collaborative cross-disciplinary research projects between participating groups. A steering committee composed of faculty representatives from each of the three focus areas will be responsible for evaluating fellowship applicants to ensure that they meet the new collaboration/cross-disciplinary training criteria.

The CBI Colloquium is designed to foster interactions among participants and will involve outside speakers with expertise relevant to the three focus areas, as
well as University of Minnesota faculty. A colloquium featuring an outside speaker will be held about once a month during the academic year, while the summers will be devoted to talks by CBI participants.

The half-time administrative assistant will help coordinate fellowship applications, arrange the CBI Colloquium and other regular meetings of the CBI faculty participants, design and maintain a CBI web site, and assist with preparation and processing of joint proposals submitted to funding agencies.

At the end of the three-year trial period it is anticipated that a number of new collaborative projects will have been initiated that will result in joint publications and joint research proposals to federal agencies. During this period, a plan will be devised for new core research facilities and interdisciplinary research space. The hiring needs for faculty in the three CBI focus areas will also be assessed. The success of the initiative will be judged by the following measures:

1. New collaborations initiated between faculty in different departments and colleges
2. Joint publications between faculty in different departments and colleges
3. Training grant proposals submitted to NIH and NSF
4. New Program Project and Center proposals submitted to NIH and NSF
5. Other collaborative grant proposals submitted (e.g. NIH Interactive Research Project Grants)

10. Relief from 2003–04 Retrenchments for CDTL

The University’s budget plan for 2003–04 had two retrenchments that negatively affect the Center for the Development of Technological Leadership (CDTL). The two recurring retrenchments are: (1) a “prescriptive” reduction of $15,136 related to expenditures on food, travel, and conference attendance during the past three fiscal years, and (2) an “O&M/tuition swap,” which, when calculated according to the process described in the 2003–04 Phase II Budget Instructions, amounts to $125,731. The total of the two retrenchments is $140,967.

During the 2003-04 compact process, the SVPP agreed to provide recurring O&M funds of $40,000 to IT to partially negate these two retrenchments on the basis that CDTL is self-supporting and does not receive a state subsidy. (The students in CDTL’s professional degree programs pay all program costs, including amounts specifically budgeted for food and travel for the

Management of Technology international residency program.) In addition, CDTL’s space in the West Bank Office Building will be considered “supported” space beginning in fiscal year 2004-05, so the unit will no longer be separately billed for utilities.

CDTL will continue to pay the Institutional Revenue Sharing (IRS) assessment on its tuition and on transfers of funds from the University of Minnesota Foundation.

11. Initiative for Renewable Energy and the Environment

As part of its agreement with the State of Minnesota to store waste from its nuclear power plants, Xcel Energy sets money aside each year for alternative energy research. The 2003 Legislature allocated $20 million from this source to the University of Minnesota – a one-time payment of $10 million plus $2 million per year for five years. Faculty from several IT departments (Chemical Engineering and Materials Science, Mechanical Engineering, Electrical and Computer Engineering, and Physics) are currently involved with this Initiative for Renewable Energy and the Environment (IREE).

IT research for IREE is mainly on fuel cells and hydrogen storage technology. Fuel cells can be used to convert wind energy to hydrogen, which will be useful if the storage technology allows economic distribution of the hydrogen. Other IREE-sponsored research in IT concerns energy efficiency of buildings, renewable chemicals, and biodiesel. We anticipate that these activities will promote new collaborative research programs involving additional faculty in IT as well as from other colleges. We hope to leverage IREE funds to initiate major interdisciplinary research programs that will make the University of Minnesota a leader in these areas.

C. New Long-Term Goals/Priorities

Since 1998 the SVPP and IT have jointly supported a highly successful K-12 outreach program called the “Physics Force.” This program is unique in that it is simultaneously educational and entertaining as a team of high school and University faculty members explains basic principles of physics and demonstrates these principles using life-size models and common materials. The goal of the Physics Force is to show that science is fun, interesting, and understandable. During 2003-04, more than 30,000 K–6 students attended performances by the Physics Force team. In recognition of its successful
outreach efforts, the Physics Force was awarded a University of Minnesota Outstanding Community Service Award in 2002–03.

The President’s Initiative Fund will provide funding of $25,000/yr to continue this valuable outreach program for the three-year period 2004–05 through 2006–07; IT will match this contribution with $25,000/yr for the same three-year period.

**D. Diversity Assessment and Planning**

APEXES (Academic Program for Excellence in Engineering and Sciences) provides mentoring and encouragement to enhance retention rates of under-represented minorities in IT’s undergraduate programs. Through APEXES, we also try to find under-represented minority faculty candidates. When suitable candidates are found, we try to hire them in cooperation with the Office of the Associate Vice President for Multicultural Affairs.

The mission of the Institute of Technology’s Program for Women is to encourage, recruit, and retain women faculty and students in the physical sciences, mathematics, and engineering. The program is responsible for the IT Distinguished Women Scientists and Engineers Speakers program, numerous community and networking events including monthly lunches with women graduate students, informal meetings with the women faculty, informational meetings on graduate school and professional options, and support for the recruitment of women graduate students.

IT has initiated discussions with the Minnesota Department of Education and the Minneapolis School District concerning Project Lead The Way (PLTW), a national alliance for pre-engineering programs. Four Minneapolis high schools have recently adopted the pre-engineering curriculum. The expectation is that the University will become an affiliate in the program, in which role it will provide training and professional development opportunities for high school teachers involved in PLTW. The program has the potential to foster an interest in engineering among underrepresented minorities and strengthen links of the college to city schools.

**E. Outreach and Civic Engagement**

The Institute of Technology has several on-going programs that deal with K–12 outreach, as well as outreach to the general public. Examples in the first category include the Physics Force program, and the University of Minnesota Talented Youth Mathematics Program (“UMTYMP”), which is run by the IT Center for Educational Programs (ITCEP). ITCEP also conducts several Summer Enrichment programs that are specifically designed for grade school and high school students.

The IT Public Lecture Series is an example of an outreach activity offered to the public at large. These lectures are typically held several times a year, depending on the availability of speakers.

Finally, it is noted that our award-winning publication *Inventing Tomorrow* is a highly effective vehicle for communicating the activities of IT’s faculty, staff, and students to alumni and friends.

**F. Enrollment Management**

The goal of the college is to hold total undergraduate enrollment at approximately 4,400 to 4,600, or 200 to 300 more than the average levels before the introduction of the undergraduate biomedical engineering program, which has a class capacity of 75. The number of computer science majors has dropped over the past few years, reflecting the weakened position of information technology in the economy, but enrollments are expected to pick up again and eventually reach the target of 775. The long-term need for well-trained computer scientists in modern society has not diminished. Fall 2003 enrollment in IT, at 4,288, includes 250 biomedical engineering majors and 585 computer science majors. With both programs at capacity, total enrollment in the college would approach 4,600.

One- and two-year retention rates for the freshmen and sophomore years are satisfactory and are unlikely to change much. Four-, five-, and six-year graduation rates have improved significantly over the past six or seven years, with some year-to-year reversals, and these are expected to improve further. The recent increase in graduation rates probably reflects the efforts the university has taken to inculcate a sense that the standard period for earning a degree is four years—these efforts include the freshmen convocation, the four-year plan, the 13-credit policy, and increasing the number of freshmen living on campus. Also, the college has developed and refined detailed four-year plans for each major, and these are used extensively in advising. Together, these measures will likely result in further increases in graduation rates over the next few years. We expect the four- and five-year graduation rates to approach 40% and 70%, respectively, by 2005, with the four-year rate eventually reaching 50%.
In providing enrollment projections for the next four years (see the appended table from last year’s compact), we extrapolated based on patterns of intake, retention, and advancement from year to year for the past four years, with allowance made for modest increases in retention and graduation rates over the next few years. Confidence in the projections is not high, even in the short term, and the projection of overall enrollment for fall 2002 exceeded actual enrollment by about 4.5%, largely because the numbers of new freshmen and transfer students were less than anticipated. Historical retention and graduation data indicate that predictions beyond one year are problematical, even if intake levels are strictly controlled.

If the intakes of freshmen and transfer students match targets (freshmen at 775 and transfers at 300), enrollments should stabilize at approximately 4,400 in the next few years.

Demographic trends in Minnesota indicate that there will be smaller increases in the college age population over the next few years than in the recent past, with a growing share of that population coming from typically under-represented groups. With a constant size incoming class of freshmen, the college will be challenged to increase the fraction of under-represented groups to match this demographic shift, because a comparatively small fraction of students from these groups have traditionally chosen to pursue careers in science and engineering.

IT is the major provider of undergraduate education in engineering, physical sciences, and mathematics in Minnesota. In the recent past, IT was responsible for delivering all engineering education in the state. Over the past 20 years, engineering programs have been started at several other institutions, such that today one-third of engineering students in the state are at these other institutions. With even more new engineering majors planned at most of the other institutions, this percentage will grow further. There is room for additional market differentiation and further expansion of engineering education in Minnesota, which ranks 39th in the nation in the number of engineering students per capita, but there will be additional competition for students. Currently, the major competition for students in IT comes from peer public institutions in the Midwest, especially the University of Wisconsin–Madison and Iowa State University.

The quality of freshmen students entering IT (as measured by ACT and SAT scores and high school rank) has remained high (with ACT scores increasing slightly and high school rank declining slightly in recent years), indicating that IT remains successful at recruiting top students in the state and region, despite the competition. Efforts to enhance recruitment are being made by the college in cooperation with the Office of Admissions. These efforts include improving the campus visits of prospective students, inviting top admitted students to a “commitment” event in the college, and holding a “sneak preview” event in the summer for high school students. IT has also agreed to share equally with Admissions the cost of hiring an individual to work exclusively on the recruitment of freshmen for IT, with a focus on women. The college share of this cost is approximately $30,000.

Graduate enrollment is difficult to predict, because the responsibility for recruitment rests with the individual departments and graduate programs. Total enrollment has increased from about 1,700 five years ago to around 2,400 today, largely with an increase in the number of master’s students. Enrollments are expected to stay at this level, provided support for assistantships is not eroded.

Class size and course access problems are greatest in introductory mathematics and science, and are increasing due to the growth in enrollment in other colleges. In particular, the admission of freshmen to the College of Biological Sciences has led to no noticeable decrease in numbers of CLA students enrolling in IT courses, and has added 150 to 200 students to classes in mathematics, physics, and chemistry. Departmental resources are stretched to the limit in trying to accommodate the large freshman classes. Lecture room size, laboratory spaces and hours, and numbers of teaching assistants are the limiting factors; there is no extra capacity.

IT has submitted materials and is working with the Office of the General Counsel to ensure that the college’s admission program meets constitutional standards as set forth by the U.S. Supreme Court.

G. Facilities Issues

IT’s prioritized listing of capital projects is as follows:

1. Teaching and Technology Center — new construction
2. Kolthoff Hall renovation
3. Tate Laboratory of Physics renovation
4. Shepherd Laboratories — renovated for Geology and Geophysics
5. Akerman Hall renovation
6. Vincent Hall renovation  
7. Mechanical Engineering (old portion) renovation  
8. Lind Hall — renovated for Computer Science and Engineering  
9. 1701 University Ave. S.E. — renovated for Computer Science and Engineering  
10. Smith Hall — renovated for Chemistry  
11. St. Anthony Falls Laboratory precinct design

The University’s 2002–04 Capital Request included $3 million in planning funds for a science and technology classroom building. Although this portion of the request was not approved in 2002, it was reinstated in the state’s budget for 2003–05 and planning for the building — now called the Teaching and Technology Center — is underway. It is expected that the building will cost approximately $25 million.

The University’s 2004-06 Capital Request included $16 million for the renovation of Kolthoff Hall, which has an estimated cost of $24 million. This part of the request received support from all parties, but the Legislature unfortunately adjourned without passing a bonding bill so the status of the Kolthoff Hall project is unclear at this point.

The Teaching and Technology Center and Kolthoff Hall projects are IT’s highest priorities. Beyond these two projects, the prioritization is less clear and is strongly dependent on the availability of funding for the University’s one-third share of project costs.

The Teaching and Technology Center will house the Department of Biomedical Engineering and the IT Characterization Facility, units that currently occupy space in Shepherd Laboratories. It will then be possible to use Shepherd Laboratories as “swing space” to allow for renovation of the Tate Laboratory of Physics. Following this, renovation of Shepherd Laboratories will allow the Department of Geology and Geophysics to move to this building, making Pillsbury Hall available for renovation. When this has been completed, the Department of English will move from Lind Hall to Pillsbury Hall, and Lind Hall, when renovated, will become the new home for the Department of Computer Science and Engineering. It is expected that the department will continue to need space for teaching assistants, temporary faculty, and teaching laboratories, and the renovation of leased space in 1701 University Avenue S.E. is intended to serve this purpose.

The other projects on the above list are needed to provide modern facilities for Aerospace Engineering and Mechanics (Akerman Hall), Mathematics (Vincent Hall), Mechanical Engineering, Chemistry (Smith Hall), and Civil Engineering (St. Anthony Falls Laboratory).

H. Other Financial Issues

Tuition — The agreed upon tuition revenue estimate for IT for fiscal year 2004–05 is $54,062,712.

The estimated tuition revenues derive from the following sources:

CDTL (3.1%): $1,658,800  
Software Engineering (Computer Science & Engineering) (1.5%): 825,600  
UNITE (1.5%): 832,000  
Other classes (89.3%): 48,259,427  
Summer Session (4.6%): 2,486,885

Beginning this year, administration of the master’s degree program in Software Engineering moved from CDTL to the Department of Computer Science and Engineering. After deducting the appropriate amounts for historical retrenchments and the institutional revenue sharing (IRS) assessment, the net revenues for CDTL, Software Engineering, and UNITE are treated as “pass-through” funds that are used to support on-going programs in these units.

Tuition revenue provides a substantial portion of the funding required to sustain departmental operations in the college. Gains in revenue due to increases in both tuition rates and enrollment are used for several purposes, viz. funding of portions of the annual compensation plans for faculty, staff, and students; payment of the college’s IRS assessment on O&M funds; and additional funding for supplemental teaching assistants.

ICR — The agreed upon indirect cost recovery (ICR) revenue estimate for IT for fiscal year 2004–05 is $8,711,935 (49.5% of $17,599,869).

Twenty percent of IT’s ICR receipts are returned directly to the departments that generated the funds each year, through “effort” and “formula” distributions. The remaining ICR funds are used to provide setup packages to help departments recruit new faculty, and matches to assist faculty in competing for sponsored research funds. The amount available for these purposes in 2004–05 will be approximately $7 million.
I. Compact Development

This compact was developed through an iterative process involving discussions between the IT Dean’s Office and the Office of the Senior Vice President and Provost. Input from departments was obtained from discussions with the IT Administrative Council (the deans and department heads), and the IT Consultative Committee, an elected body with faculty, P & A, civil service, and student representatives. The dean’s office staff prepared the compact document.

J. Data Profile

For a display of planning data related to the Institute of Technology, refer to a link off the University web site managed by the Office of Institutional Research and Reporting at [http://www.irr.umn.edu](http://www.irr.umn.edu). This site contains standard financial, staffing and student information.

Several performance measures have been adopted to help quantify the success of IT’s programs. These are described below.

1. Retention Rate

Reviewing the data through the 2002–03 academic year, the one-year retention rate of 94% (2002 cohort) and two-year rate of 84% (2001 cohort) are on or above target (the targets corresponding to the best rates of the previous 10 years, consistent with rates in peer institutions). For women, the corresponding rates (92% and 83%) are slightly lower; over the ten-year span, however, the rates for women average 1 to 2% higher than the overall rates. These rates refer to students who began their studies in IT and are still registered within the University, but not necessarily in IT, after one and two years, respectively. The corresponding retention rates for students who remain in IT are 89% (one-year) and 70% (two-year), which are also both on target. For women, the rates are 9 and 12% lower, respectively. (Over the ten-year span, the one- and two-year rates for women average 3% and 7% lower, respectively, than the overall rates.)

2. Graduation Rates

Four-year graduation rates for students starting in and remaining in IT have improved significantly, with some fluctuation, over an eight-year period, with a peak of 29% for the most recent (1999) cohort. Rates for women were 2% lower than the overall rate for the 1999 cohort, but in prior years have been similar to or slightly above the overall rates.

Four-year rates for freshmen who start in IT and graduate elsewhere in the University peaked at 37% overall and 44% for women for the 1999 cohort.

Six-year graduation rates have also improved over the past eight years, with rates within IT at 52% overall (down from a peak of 56% the previous year) and 52% for women for the 1997 cohort. Corresponding rates for IT freshmen graduating elsewhere in the University are 66% and 72% respectively (down from 70% and 77% the previous year). With increased encouragement for students to stay in school and on track, it is anticipated that both four- and six-year rates will continue to rise, with some fluctuation from year to year. Long-term targets of 50% and 75% for four- and six-year graduation rates for IT freshman graduating anywhere within the university college seem attainable, with a closing of the gap between men and women and with a larger fraction of IT freshmen staying in the college to get their degrees.

3. Accreditation of Engineering Programs

In the last cycle of accreditation of the engineering programs by the Accreditation Board for Engineering and Technology (ABET) in fall 2001, all of IT’s programs under review were successfully accredited. The new program in biomedical engineering was reviewed by ABET in fall 2003 and has now also been accredited.

4. Research Expenditures

Research is a crucial component of IT’s mission and is the lifeblood of its graduate programs. The college has historically been very successful in competing with other institutions for sponsored research funding, and aims to maintain its competitive position in the years ahead. As a means of quantifying this goal, we want the total annual research expenditures in the college at least to keep pace with the Consumer Price Index.
### Historical Allocation Summary
FY1999 through 2004 Compact Investments

<table>
<thead>
<tr>
<th>FY99-01</th>
<th>FY2002</th>
<th>FY2003</th>
<th>FY2004</th>
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<tbody>
<tr>
<td>Physical Sciences Courses</td>
<td>$75,000</td>
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<tr>
<td>Freshmen Seminars</td>
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<td>$4,000</td>
<td>$10,000</td>
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<td>Physics Force</td>
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<td>Writing Intensive Courses</td>
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<td>Calculus Initiative</td>
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<tr>
<td>Info. Technology Minor</td>
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<td>Student Affairs</td>
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<td>Digital Tech. Initiative</td>
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<td>Freshmen Seminar Positions</td>
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<td>AFM/STM System</td>
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<td>Advising</td>
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<td>Biomedical Engineering</td>
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<td>CDTL Adjustment</td>
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<td>Diversity Faculty Hires</td>
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<td>Solvent Distillation Equip.</td>
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<td>Research/Grad. School Support</td>
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<td>$4,513,541</td>
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<td><strong>Total</strong></td>
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<td><strong>$438,479</strong></td>
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### Central Allocation Summary – FY2004-05

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<th>FY2005 Amount</th>
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<th>Nonrecurring</th>
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<td>Faculty Positions (7)</td>
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<td>(commitment of $315,000 R total)</td>
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<td>Chemical Biotech. Initiative</td>
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<td>Physics Force</td>
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<td>ADVANCE Proposal</td>
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<td>Freshmen Seminars</td>
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<td>Advising</td>
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<td>Writing Intensive</td>
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<td>Calculus Initiative</td>
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<td>Computer Science Initiative</td>
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<td>(of the $500k reserved)</td>
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<td>VP Research Support *</td>
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<td>Grad. School Support *</td>
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<td><strong>Total FY2004-05</strong></td>
<td><strong>$525,700</strong></td>
<td><strong>$6,364,397</strong></td>
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* As of October, 2004

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K. Report and Allocation Summary

No reports to be submitted prior to next compact development cycle.