

*Information Sciences
and Technology*

*Report of the
Strategic Planning
Group*

*The Pennsylvania State University
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Preface

Information Sciences and Technology encompasses a wide range of academic fields, and is multidisciplinary by its very nature. The IST Strategic Planning Group established the following working definition:

Information Sciences and Technology (IST) integrates a wide spectrum of knowledge and skills ranging from the design of hardware and software systems to considerations of the impact of information technology on society. IST draws on expertise in such diverse areas as network architecture, systems administration, multimedia programming, telecommunications and information policy, enterprise systems, computer consulting, data management and retrieval, electronic documentation and publication, and training. Information technologies are rapidly evolving, and students should not focus on narrow skills or single applications currently in demand; rather, they should learn the general principles that govern the creation, organization, and structure of information, as well as the implications of IST in law, ethics, and social policy. IST recognizes the importance of both theory and application.

In September 1997, Executive Vice President and Provost John Brighton appointed the IST Strategic Planning Group. We were asked to consider the feasibility of a new academic unit in Information Sciences and Technology at Penn State. How should we structure such a unit? What would be the nature of its degree programs, both at the undergraduate and the graduate levels, and its relationship to existing departments at Penn State? How could strong faculty collaborations be forged? The IST Strategic Planning Group was asked to identify the characteristics of a well-educated student who graduates with an IST degree, and to develop the broad outlines of a curriculum to accomplish that goal. Finally, the Provost's charge stressed the need to work with industry to identify key issues, needs, and possible areas of collaboration, and to benchmark against other universities regarded as leaders in IST education.

Executive Summary and Key Recommendations

In his 1997 State-of-the-University Address, University President Graham Spanier asked if Penn State was organized in the most effective way to prepare our students for the Information Age. Were we doing enough, he asked, to help meet the enormous needs of today's workforce--and to help government, industry, and society deal with the daunting challenges of tomorrow? After carefully studying what Penn State is currently doing and considering the extraordinary opportunities available to us, the IST Strategic Planning Group recommends a set of changes in how information technology is integrated into our undergraduate and graduate programs at all locations. Indeed, only through a bold new approach can we position the University as a national leader in the curricular integration of information sciences and technology.

Our primary recommendation is that Penn State create a School of Information Sciences and Technology. The School will be the focal point for developing, offering, and coordinating University-wide activities in Information Sciences and Technology (IST) both at the undergraduate and graduate levels. Although its administrative hub will be at University Park, the School will work closely with faculty and programs throughout Penn State. Through the World Campus, the School will work directly with post-baccalaureate students who cannot come to campus but who need additional knowledge and specialized skills. There are enormous research and development opportunities in the area of IST, and this new School should be attractive to many constituencies--students, parents, employers, funding agencies, and foundations.

Penn State already has a formidable array of IST-related programs in traditional disciplinary fields that produce nearly a thousand graduates a year. The establishment of a School of Information Sciences and Technology will complement and build upon these existing activities. The new School's programs will be focused on IST education, research, and outreach, and represent a unique

opportunity for students to pursue more advanced studies in IST major and minor programs, or in related functional areas.

The School will be highly interdisciplinary, and its programs will foster collaboration among existing programs at all locations. The School will be a seedbed for curricular development and innovation, and will help Penn State fulfill its new general education requirements in "information literacy." Undergraduate and graduate degrees in IST will be established, as well as a new IST minor that will be available to students majoring in other academic disciplines at the University. The proposed new IST undergraduate degree will feature a common core of courses and several curricular tracks that will allow students to pursue particular areas of academic interest. That is, students will learn not only about information technology--the creation, management, and interpretation of information--they will learn about it within the context of other academic areas. Such topics as telecommunications, operations research, computer science, hyper-media communications, cognitive science, intelligent and learning systems, electronic commerce, computational science, Web-based and network computing, scientific visualization, and digital libraries--all of these areas offer wonderful opportunities for our students, but all of these areas require cross-disciplinary faculty expertise. Students will learn to apply information technology within the intellectual framework of established disciplines. But they will also learn the skills that industry experts have repeatedly found missing in new employees: excellent communication, project management, and teamwork.

The School of Information Sciences and Technology will not only have strong curricular partnerships within Penn State, it will forge strong partnerships with industry and government. Partnerships are vital to the success of the School, both for keeping the curricula relevant to workforce issues and for providing students with a chance to learn from professionals who are using information technology to solve real problems in industry and government. Such partnerships will spur research opportunities for faculty and students. An external advisory

board will be created, along with an internal coordinating council, to draw upon a wide range of expertise. The goal is to ensure that the new School is responsive to the changing needs and opportunities of contemporary society. Penn State alone cannot solve the crisis in the IST workforce, but it can set a sterling example of how to institute major changes to address the issues. We are confident that the creation of a new School of Information Sciences and Technology is the first step towards transforming Penn State for the century to come.

Recommendation:

A School of Information Sciences and Technology as the Focus of a University-Wide Initiative

The Strategic Planning Group unanimously recommends that Penn State establish a School of Information Sciences and Technology. This new School will serve as a focal point for offering and coordinating University-wide information sciences and technology activities. It will strengthen programs and collaborative efforts in existing University academic units, with the result that information sciences and technology will be infused throughout the University.

The Mission of the School of Information Sciences and Technology

The School of Information Sciences and Technology (IST) will facilitate the development of IST programs at all locations and educational levels in the University. At the broadest level, this initiative should include undergraduate degree programs, graduate programs, minors, outreach programs (professional degrees and certificates), research programs, and general University-wide competencies that are consistent with the new directions in general education to be implemented in 1999. More specifically, there are five aspects to the mission of the School of Information Sciences and Technology; these aspects are closely coupled to Penn State's long-standing mission of teaching, research, and outreach.

Partnerships Across the University

Penn State currently offers a wide variety of IST-related programs across the Commonwealth, and the School of Information Sciences and Technology should complement and build upon these strengths. These existing academic resources include associate, baccalaureate, and graduate degrees and numerous research programs at one or more academic colleges represented at Penn State's 23 campus locations and the Pennsylvania College of Technology. In addition, the University has a long history of delivering high quality educational programs through distance education, including the recently-launched World Campus. An impressive technological infrastructure including hardware, software, connectivity, and training for faculty, staff, and students supports this existing IST-related enterprise at Penn State.

There is a strong commitment throughout the University to strengthening IST-related activities. In addition to the formal degree programs within the School, we envision a core of undergraduate service courses and an IST minor that will broadly develop the skills associated with information sciences and technology. This diffusion within other disciplines would be facilitated by joint

appointments with other discipline-based units, and will require a variety of partnerships across the University between the School and other Penn State colleges, the University Libraries, and the Office of Computer and Information Systems (see Appendix A for a map of Penn State campus locations and the Pennsylvania College of Technology).

Teaching Mission

Strong information technology skills are necessary for all graduates of Penn State, regardless of discipline. Thus, undergraduate and graduate degree programs, minors, and general education offerings are critical elements of the initiative. Technology education is increasingly important for members of the existing workforce: a strong instructional outreach component offered through Outreach and Cooperative Extension and the World Campus will satisfy a clear industry need and represents an opportunity for Penn State.

Students need a multidisciplinary understanding of the role of information technology in our society. There are increasingly unmet demands for technologically literate graduates at all levels and in all disciplines. Since the technologies driving these changes are extremely fluid and are changing at an almost exponential rate, Penn State must develop programs that can change along with them. Our programs must use a dynamic systems model rather than the traditional academic approaches.

A clear understanding of current and future research and industry needs is crucial when developing successful academic programs. Programs that incorporate elements of such fields as management information systems, information engineering, information retrieval, and new media can offer students a broad understanding of the uses of technology. Such areas as telecommunications, operations research, computer science, hyper-media communications, cognitive science, intelligent and learning systems,

computational science, scientific visualization, electronic commerce, Web-based and network computing, and digital libraries offer wonderful opportunities for our graduates, but all require cross-disciplinary teaching strategies. Understanding the dynamic nature of these areas and building a curriculum that supports them will position Penn State and our graduates well for the future.

Graduate programs should focus on innovative uses of technology, exploring in greater depth those areas of knowledge and practice central to the information sciences. Both professional and research-oriented graduate programs should be established. Professional programs can offer new competencies to graduates already well established in their careers. Professional master's degrees should provide a broad applied approach to IST and related fields, and keep IST students apprised of changing paradigms in the industry and of practical uses of IST technologies. Doctoral programs should offer more in-depth study of specialized areas and provide research opportunities on the cutting edge of discovery in IST and related fields.

Research Mission

Participation in an information-based society should be universal, transparent, and affordable. The research mission of the School of Information Sciences and Technology is to contribute knowledge to meet this goal. The School should promote an understanding of the principles behind and uses of advanced computing, communications, and information systems in industry, government, and society. This research mission by its very nature is cross-disciplinary. Current National Science Foundation (NSF) research themes such as knowledge and distributed intelligence, new computational challenges, electronic commerce, cognitive science, and the next generation internet would be excellent areas of concentration for the School's research agenda. In addition, the increasingly important questions concerning the access of different populations to information and public policy regarding the ownership, use, and distribution of information form important research agendas. To undertake such research at

Penn State, collaboration crossing traditional disciplinary lines is required, along with external partnerships with corporations and foundations willing to sponsor university research. A vital research core will contribute greatly to the teaching and outreach missions of the School.

Outreach Mission

The outreach mission of the School is an area of opportunity. Professional degree and certificate programs should be vehicles to meet corporate needs for state-of-the-art education and training in technology. These programs themselves should be developed and delivered using the latest teaching and learning technologies, including Penn State's World Campus. Internship and cooperative work programs should be developed to introduce ideas into host corporations or other organizations and to bring back ideas for curricular and technological changes to the University. The School should be a valuable source of expertise to Pennsylvania corporations. Professional associations, workshops, corporate advisory committees, and technology transfer activities should also provide mechanisms for the dissemination of information on new technologies.

Partnerships with Industry and Government

Strong ties to IST industries are extremely important. Industry and government partnerships demonstrate the University's commitment to change the role of education to meet the needs of industry. These partnerships are also a way of better identifying the critical issues facing education and industry. Undergraduate and graduate internship programs should be encouraged that offer students opportunities to develop relationships with Penn State's technology partners, relationships that often pave the way for future employment.

Programs should be developed that include industry-University exchanges in which researchers and teachers "switch locations." This switch could be virtual

or physical, for short or extended periods of time. Joint research with industry should be encouraged and promoted within the School, building partnerships through Penn State research centers and institutes, both within and affiliated with the School.

Organization of the School of Information Sciences and Technology

Guiding Principles

- The School of Information Sciences and Technology (IST) should be the unique focal unit for academic programs in information sciences and technology, with high visibility and stature among Penn State's academic colleges and schools
- The School should have a substantial base of tenure track faculty with active research agendas, supplemented by highly qualified IST practitioners from industry and government
- A large number of Penn State students must be served through IST programs
- IST program articulation and collaboration should be encouraged, even expected, across Penn State's colleges and campuses
- Close collaboration with industry and government is essential to a successful IST program

Recommendations

The Strategic Planning Group recommends that the School of Information Sciences and Technology be established at University Park as a free-standing academic unit of the University, with the authority to offer baccalaureate, master's, and doctoral degrees and a minor that can be taken by students in other colleges (Figure 1). The School should be led by an academic dean who reports to the University Executive Vice President and Provost. The dean's responsibilities will include academic and development leadership of the unit, encompassing strategic planning, budgeting, efforts to secure external resources

for the School, and University-wide coordination of IST initiatives. The School should include, at the end of a five-year period, a minimum of 30 tenure track faculty whose tenure home is in the School. An additional 25 new IST faculty should be hired at other Penn State campuses over this same time period.

The School should play a strong role in coordinating and promoting IST programs across all Penn State colleges and campuses. In addition to its 30 core faculty, the School should have a highly selective cadre of 15 jointly appointed faculty (preferably tenured professors and associate professors) who are committed to a wider vision of information sciences and technology across the University. The faculty of the University Libraries also represent a significant resource for instructional and research activities. Co-funding of information sciences and technology faculty appointments in IST-related units of other colleges should be a high priority.

The hiring and retention of faculty in the School and in related units will represent a significant challenge to the University. In a tight labor market characterized by high salaries and intense competition, considerable creativity in regular faculty appointments may be necessary, with a significant reliance on part-time instructors. Initial investments in faculty should focus on academic leaders who will set the directions of the new School. Some of these faculty leaders may, in fact, come from existing academic units across the University.

What is needed in the new School of Information Sciences and Technology is a fresh approach to the curriculum--one that is broader than existing programs such as management information systems or computer science and engineering, and which integrates communications and teamwork skills with professional leadership. This approach entails a core curriculum that would serve as a platform for students to specialize in a wide range of information-related sciences (e.g., computer science, management science, library science, etc.). A merger of existing faculty and instructional programs to form the School was considered, given the breadth of Penn State's current IST-related activities (refer

to Appendices B and C for listings). However, we believe that such a merger would not lead to the new type of curriculum and program orientation that is required. Indeed, what ultimately will make the School successful is its unique instructional core and its ability to forge curricular partnerships with existing programs throughout the University. These partnerships must reach across college, departmental, and campus boundaries in creative ways.

An IST Coordinating Council should be created in order to facilitate collaboration and coordination of IST curricular offerings throughout Penn State. It should be chaired by the dean of the School of Information Sciences and Technology (Figure 2). This Council should consist of a representative group of appropriate academic administrators who will ensure collaboration and coordination of IST curricular offerings throughout the University (Figure 3). The School and the IST Coordinating Council will allow representatives from Penn State campuses and colleges to collaborate on degree programs that are not identical (they may be tailored to area needs) but that will have certain common core elements. In particular, existing programs in computer science and engineering, management information systems, and communications should collaborate with and be highly supportive of the educational and research programs in the new School.

At University Park, the School should confer a Bachelor of Science degree in Information Sciences and Technology, a professional Master's of Information Sciences and Technology degree, and a Ph.D. degree in Information Sciences and Technology. At other Penn State campuses, colleges should confer associate and/or baccalaureate degrees as appropriate to their faculty and resource capabilities. Graduate degrees should be offered by the University Park, Harrisburg, Great Valley, and Erie campuses, where the capability for delivering high quality resident graduate education currently exists. IST minors at both the undergraduate and graduate levels should be established.

The B.S. degree in Information Sciences and Technology offered by the School should serve as the model for degrees offered at other Penn State locations. We strongly recommend that these degrees be identical or very similar in curriculum and degree requirements. Although some flexibility is desirable, so is considerable commonality. This commonality will promote a smooth transition from associate to baccalaureate degrees, and from one campus to another.

In order for IST programs to serve a significant number of students, team teaching and delivery to multiple campuses should be facilitated by additional investment in intercampus telecommunications linkages. Core courses that will serve large numbers of students across the University should be available in both traditional and on-line versions. Based upon the capabilities of the Penn State telecommunications infrastructure, courses in resident instruction may be delivered at multiple campuses and other sites using current technologies such as PicTel or other, newer technologies that are emerging from breakthroughs in bandwidth capacity. The Penn State World Campus provides an outstanding opportunity to deliver numerous courses as part of the IST degree programs, as stand-alone IST course offerings, and as certificate and other IST programs that contribute to continuing workforce development.

The Pennsylvania College of Technology (Penn College), which is affiliated with Penn State, has been highly successful in producing graduates with the information technology skills in demand by industry. Aspects of Penn College's programs could be effectively delivered at multiple Penn State campuses across the Commonwealth, thereby contributing significantly to economic growth through workforce development.

The School of Information Sciences and Technology should have active research centers to explore issues at the frontiers of information sciences and technology. Existing centers and institutes conducting research in information sciences and technology, which will continue to operate within Penn State's

various colleges, should be encouraged to establish collaborations or joint affiliations with the School as appropriate.

There should be a strong bond between the School, industry, and government, reflected in an active industry advisory board organized by the dean of the School. The School must build linkages with industry for shared faculty and other resources, and must have a broad base of industry and government representatives who reflect the many constituencies of the IST programs at Penn State.

The Information Sciences and Technology Curriculum

Guiding Principles

- IST must be infused broadly into all appropriate Penn State degree and certificate programs
- IST must draw upon and have strong cooperation from numerous fields such as management, computer engineering, instructional systems and design, education, communications, library science, information and telecommunications policy, and other related fields
- All levels of IST education (associate, baccalaureate, graduate, minor, and certificate/outreach programs) are critical components of a Penn State initiative
- IST degree programs should have a strong commitment to general education and global perspectives, and provide a foundation for the creation, understanding, organization, and human processing of information
- All programs should focus on building strong and adaptable analytical, critical thinking, team-building, and oral and written communication skills
- Students must understand the importance of the social and institutional milieu of IST
- Curricular innovation and rapid and responsive program changes are essential to high quality IST programs

Recommendations

New baccalaureate and graduate degree programs in Information Sciences and Technology should include an information technology component, an applications integration component, and a third component focused on information, society, and public policy (Figure 4). IST majors, both undergraduate and graduate, should be strongly encouraged to pursue a minor(s) in a related discipline, such as management science, computer science and engineering, media studies, telecommunications, communications, geography, and other fields that would provide an appropriate context and functional field of expertise for IST applications. Students enrolled in existing disciplinary majors should likewise be strongly encouraged to complete a minor in the School of Information Sciences and Technology. Double majors should also be encouraged.

Associate, baccalaureate, and graduate programs should have strong elements of communication skills building, practical applications, and critical thinking. Programs should emphasize teamwork approaches to learning. The School should strive to foster curricular integration and to develop students' skills in applying technology to solve practical problems and, in the case of academic graduate degree programs, to advance the frontiers of knowledge. Some basic components and thrusts of various IST programs are presented below; specific task forces should be appointed to make detailed formal proposals for IST curriculum development appropriate to the degrees offered.

Bachelor's Degree

We recommend that the bachelor of science degree in IST require a minimum of 30 credits in the major. All majors should complete an IST core, which may consist of the five courses identified in this report (or an equivalent coverage of core material). All five courses in the IST core could be available as "on-line courses," meaning that the courses can be offered at any Penn State location. Some locations may also choose to offer all or some of the courses as

traditional classroom instruction. International experiences and foreign language study are strongly encouraged for all IST majors, given the increasing globalization of information sciences and technology.

An appropriate IST core curriculum should include the following, to provide a base and context for more advanced IST applications (Figure 4):

- | | |
|---------|--|
| IST 110 | Introduction to Information Systems and Applications |
| | Prerequisite: None |
| | Introduction to information systems and applications, project planning and project management, technology management, and organizational behavior |
| IST 210 | Language, Logic, and Discrete Math |
| | Prerequisite: IST 110 |
| | Introduction to graph structures, syllogisms, recursive structures, data types, proof by induction, and counting argument |
| IST 220 | Systems Architecture and Telecommunications |
| | Prerequisite: IST 110 |
| | Introduction to systems architecture, network architecture, and telecommunications issues, including emerging technologies and public policy issues |
| IST 230 | Organization of Information |
| | Prerequisite: IST 110 |
| | Introduction to the storage, retrieval, manipulation, analysis and display of information; attention will be given to both emerging technologies and to public policy issues |

IST 240 Introduction to Computer Languages

Prerequisite: IST 110

Introduction to the many kinds of computer languages, including scripting languages, programming languages, abstractions, and issues that affect the design of new computer languages and software engineering

The IST core curriculum could be offered as a mix of traditional coursework and instructional modules developed in common and available at multiple Penn State locations.

Upper-division courses should include a mixture of new courses and courses that are currently offered by various departments and units across the University. Existing courses should be cross-listed, where appropriate, as IST courses. We envision three initial upper-division tracks or options in the bachelor's degree program:

- software and computer systems
- information systems applications
- information, society, and public policy

Students should also have the opportunity to create individualized tracks such as multimedia.

The upper-division course track for the IST major should include at least one course that emphasizes the development of writing, speaking, and problem-solving skills as they relate to the information sciences and technology. In addition, students should be required to complete an internship (or its equivalent) and a capstone course that requires the integration of project management, technology, and the communication/analytical skills developed earlier. This upper-division experience should include, where possible, exposure to cutting-edge technology and applications that define current trends in industry.

Minors

We recommend that an IST minor be created within the School to support the academic programs of students majoring in other fields. An IST minor consisting of a minimum of 18 credits should be built upon a combination of key elements of the core curriculum and other advanced courses in the School, including some that are cross-listed and offered by units in other academic colleges. The IST minor represents an attractive opportunity for a wide range of undergraduate students both at University Park and other Penn State locations to build an IST component into their major programs. IST minors should be widely developed across all Penn State locations. The provision of a broadly based minor that meets the service needs of other colleges would also allow the Smeal College of Business Administration to reposition its management information systems program to focus primarily on students within the business majors.

An IST graduate minor should be developed for students in master's and doctoral programs. Here again, the opportunity for students at the graduate level to incorporate an IST dimension into their studies is vitally important.

Undoubtedly several of the IST core courses (e.g., IST 110) would be available to students throughout Penn State to fulfill the quantitative general education requirements, while at the same time helping to build students' "skills in quantitative analysis, information literacy, and collaborative interaction" (from Final Report and Recommendations of the Special Committee on General Education, Fall 1997). Additional courses that could count toward the general education requirements, and which should be developed by the new School, may include courses in multimedia and hyper-media communications, computer ethics, telecommunications, and IST public policy, among others.

Associate Degrees

Associate degrees at Penn State campuses should be tailored to labor market situations specific to particular regions of the Commonwealth. The associate degree in IST should incorporate major elements of the core curriculum for the baccalaureate degree identified above. Associate degrees should articulate readily into baccalaureate programs for those students who wish to pursue a bachelor's degree at one of the Penn State locations where they are offered. The Pennsylvania College of Technology's applied associate degrees in information technology, which serve special purpose missions, should also be made available across the Commonwealth in cooperation with various Penn State locations.

Graduate Degree Programs

We strongly recommend that the School of Information Sciences and Technology establish master's and doctoral programs at the University Park campus. A doctoral program is essential to further the research program of the School and to assist in attracting high quality tenure track faculty. Doctoral students also represent an important resource for the instructional program, particularly as teaching assistants in core curriculum courses, for which there will be strong demand from IST majors, from students outside the School pursuing IST minors, and from other students who will likely be taking an IST core curriculum course as general education. Doctoral education, by its very nature, will reflect the scholarly interests and expertise of the faculty within the School as well as that of jointly appointed IST graduate faculty members who have responsibilities in other academic colleges.

We recommend that a professional Master's degree in Information Sciences and Technology be established at University Park in the School of Information Sciences and Technology. This program should be modeled after the successful graduate professional programs offered by Penn State Great Valley's

School of Graduate Professional Studies and the Capital College at Penn State Harrisburg. Master's programs in IST at all Penn State locations where this degree is offered should respond to the needs of professionals who wish to further their education while maintaining current employment. The master's program should include options in which students may pursue different IST topical themes in a manner similar to those available to undergraduate majors. The specific nature of these graduate IST options will depend upon faculty expertise, industry needs, and student interest.

Certificate Programs

Certificate programs offer students the opportunity to participate in on-site education in either credit or non-credit formats. Some programs can be customized to integrate specific industry or company needs, and credits earned in Penn State certificate programs can often be applied to degree programs. Certificate programs are extremely flexible, and can be rapidly adapted to changing industry needs.

Certificate programs represent an area of growing importance as businesses and other organizations seek to upgrade the skill levels of their workforces. These certificate programs typically represent 9-15 credit hours of focused coursework. We recommend that a concerted effort be made to address the burgeoning need for certificate programs, both through the new School and existing college units, in collaboration with the World Campus and other Outreach and Cooperative Extension programs and technologies.

Resources to Support the Information Sciences and Technology Initiative

Guiding Principles

- Major investment is required to expand IST academic, research, and outreach programs University-wide; this investment will support the development of a new School as a focal point for offering and coordinating IST activities and will simultaneously strengthen existing programs and collaborative activities
- Resources to support IST initiatives (in terms of people, facilities, program development, faculty development, and operations) will exceed those available through the simple reallocation of existing University resources; they will need to be drawn from a combination of University, industry, and government sources
- Since the IST initiative will directly impact economic development throughout the Commonwealth and the nation, and will help to address IST workforce shortages, opportunities to acquire state and federal funding to help support the School should be pursued
- Industry participation is a key to the success of IST initiatives in the form of funding, equipment and software, advice from executives, and an exchange of highly qualified practitioners and opportunities for cooperative work programs; furthermore, providing opportunities for industry-based internships for students and for shared industry-University teaching and research for faculty is essential to both instruction and research
- Continuing University resource reallocations, implementation of tuition differentials for IST majors and minors, and attraction of new students are required to provide funds to support IST initiatives

- The University should expect to commit to continuous faculty development programs to develop pedagogical skills that incorporate interactive, team-based, and service learning as an important part of the classroom experience

Recommendations

We recommend that the University build the IST faculty over a five-year period as follows:

- 30 core faculty appointed in the new School
- 15 additional School of Information Sciences and Technology faculty (preferably tenured) shared through co-funded positions with existing University Park academic colleges to support cross-college collaborations
- 25 new IST faculty at other Penn State locations

The School should open in Fall Semester 1999 with a complement of at least ten faculty, adding about five additional faculty per year over the following four years. Some faculty from existing Penn State colleges may wish to move their tenure track and budgetary lines to the new School; these shifts should be welcomed provided their teaching and research interests are appropriate to the mission of the new School.

To better infuse information sciences and technology throughout the University, and to strengthen existing programs and collaborative efforts, joint appointments of faculty at University Park should be encouraged and supported with the necessary funding. In addition to formal joint appointments, a number of affiliate appointments are also desirable to provide further support for the educational and outreach mission of the School.

A faculty of the size recommended for the School of Information Sciences and Technology (including additional fixed-term and part-time faculty) could serve approximately 800 undergraduate majors at University Park and 200 graduate students. In addition, the number of students choosing to take the IST

minor is likely to reach several hundred within five years after the School is established. The addition of 15 co-funded faculty jointly appointed in other University Park academic colleges should permit existing IST-related programs to significantly boost the number of students they serve in information-related minors (e.g., management information systems, computer science and engineering, and geographic information systems). At its other locations, Penn State should be able to serve 1000 additional associate and baccalaureate degree students in existing or prospective IST programs and, where qualified graduate faculty resources are available, an increased number of master's degree students. General education courses will infuse IST-related competencies throughout the Penn State undergraduate curriculum. IST certificates (and, at some future date, degree programs) made available through Outreach and Cooperative Extension and the new World Campus will add to this IST outreach impact. Thus, the program has the potential to reach several thousand students in five years from the establishment of the School.

Curriculum and program development funds will be required for the School's curriculum, for the new programs at other Penn State locations, and to strengthen existing programs. These funds are estimated to grow from \$250,000 to more than \$750,000 over three years, and then decrease to about \$250,000 per year, representing the need for continuous renewal of the IST curriculum. Because some courses will be delivered on-line, there will be additional development costs similar to those of the World Campus; these costs should be quickly recovered as the courses are offered to a large number of students.

For the School of Information Sciences and Technology at University Park:

- Permanent general funds required annually are anticipated to grow to approximately \$7 million in five years, assuming a complement of faculty, staff, and graduate assistants appropriate for a school of 30 core faculty and an additional 15 half-time joint appointments. Implementation of the

new School will require a commitment of permanent funds of approximately \$2 million during the first year (1999-2000), assuming the program is launched with ten faculty; additional permanent budgetary increases of \$1-1.25 million per year over the remainder of the five-year ramp-up period will be required

- Additional permanent funds of approximately \$750,000 will be required by University Park colleges to hire replacements for those faculty who will be shared with the new School of Information Sciences and Technology
- Laboratory facilities and equipment will require continuous investment to keep up with the constantly changing technology inherent in this dynamic field

At other Penn State locations:

- Enhancement funds should be allocated initially for curricular development in information sciences and technology
- Consistent with the college budget models, the tuition and fees from increased student enrollments should fund the permanent operating costs after the second year
- Both space and funding to support equipment and facilities will vary by campus or college; therefore, these requirements will need to be identified for each location engaged in an IST initiative

All students in IST majors and minors must have a personal computer of certain minimum capabilities. In addition, initial and continuing IST infrastructure investments are critical to current delivery and future progress. Significant and continuing investments in library collections are also needed.

We believe the overall magnitude of the proposed resources requirements are realistic. These estimates are based upon Penn State academic units of similar size and professional orientation. Start-up costs will include a large number of one-time expenses, and we expect that a significant tuition differential will help to meet a portion of the budget needs at University Park. At other Penn State campuses, the IST programs will grow as rapidly as student demand and additional tuition warrant resources. Without knowing more about possible space for the School, we have not provided any estimates for this important element.

A New Information Sciences and Technology Building

In the short run, space on campus will need to be allocated to the School to meet its immediate needs. In the long run, it is recommended that a centrally located, state-of-the-art building be constructed to house the School's faculty and administration. This building should be a showcase for the range of interests and expertise of the faculty and students, including information technology, information resources, and laboratory facilities. It should provide a place where IST academics and professionals from across Penn State's campuses and the University's industry partners could gather to share ideas and collaborate on projects of mutual interest.

This building should provide a number of state-of-the-art classrooms as well as experimental labs and classrooms. As faculty and students experiment with immersive environments and high-end simulation, they will need a building that enables such work. Thus, the new building would be both functional and symbolic of the School's vision. We recommend that consideration be given to housing some closely related academic departments (e.g., the Department of Computer Science and Engineering) in this new building. The construction of this building should be a high priority for the University, and put on a fast track.

Industry Partnerships' Support

To adequately fund a School of Information Sciences and Technology at Penn State, **we will need** revenues from a number of sources, including the government, student tuition and fees, and philanthropy from corporations, foundations and individual alumni and friends. **To explore this issue, we sought the** input and recommendations of various industry and government representatives. Two **half-day** meetings were held on campus with representatives of Fortune 500 companies, Pennsylvania companies, and state government officials (see pages 38-41 for a more detailed report of the industry conferences).

Industry participation and partnerships are a key to the success of a School of Information Sciences and Technology. **We need not** only advice from executives, exchange of qualified practitioners, **and** teaching and research collaborations, but also **gifts** of hardware, software and, perhaps most importantly, current and pledged monetary contributions. As stated elsewhere, funding in the range of \$6-8 million annually will be required to make this School a reality. Critical to meeting permanent funding needs is the development of various endowment funds, which will provide annual revenues in perpetuity. We recommend that Penn State seek to build endowments for various needs, including **chaired professorships, career development professorships, undergraduate scholarships and graduate fellowships (see Appendix D).**

To attract such contributions from industry, support must be viewed as an "investment" **by** our industry partners. There must be a "value return" to the corporation in exchange for the funds and equipment resources that we desire and need.

Special programs and opportunities should be created for our closest philanthropic partners. These include invitations to serve on advisory committees, the early identification of potential permanent hires from among our graduates, **preferential** opportunities for student cooperative work and internship

programs, access to research activity and findings, faculty consulting, personnel exchanges, customized training programs, continuing and distance educational opportunities, and so on. Furthermore, the University must be creative in finding new opportunities to return significant value to individual corporations, helping to offset other incurred costs and thus freeing resources that could then be made available to Penn State.

Implementation Timetable for the School of Information Sciences and Technology

We recommend an aggressive timetable for the establishment of the School of Information Sciences and Technology (Figure 5). Considerable groundwork must be accomplished to secure appropriate faculty consultation, Faculty Senate review, University Board of Trustees approval, and industry feedback. To achieve the goal of welcoming the first class of students in Fall Semester 1999 will require a well-organized and fast track effort through the 1998-1999 year to recruit the School's leadership and the initial cohort of faculty, and to complete the processes of developing the detailed proposals required for the new degrees and the specific courses to be included in the IST curriculum.

Background to the Information Sciences and Technology Recommendations

IST Strategic Planning Group's Approach

The Strategic Planning Group formed four small task forces to examine several key issues related to the Provost's charge. One task force gathered information on programs currently offered or in the process of development at Penn State, relying upon published information and a survey of Penn State academic colleges. A second task force used the Internet and other sources to identify innovative and relevant IST-related programs at other colleges and universities. A third task force read industry reports and trade publications to learn the extent of IST worker shortages and to pinpoint the particular types of workers who are in greatest demand. A fourth task force explored the possibilities for various IST futures scenarios.

The work of each of these task forces is reflected in the additional background information; it formed the context for our recommendation of a new School of Information Sciences and Technology. The perspectives of industry were of particular importance in formulating our curricular plans and in establishing the need for a large-scale, cross-university, multidisciplinary approach. IST graduates must be ready to contribute both in the near term and over the long run in rapidly changing technological and business environments.

The Demand for Professionals in IST

Both statistical and anecdotal evidence indicate a severe shortage of qualified IST workers in the Commonwealth and in the nation. The new economy is information-based, and U.S. universities and colleges, including Penn State, are failing to keep up with the growing need for IST professionals. In a Fall 1997

report, the U.S. Department of Commerce labeled this shortage "America's New Deficit: The Shortage of Information Technology Workers."

A survey by the Information Technology Association of America (ITAA) of some 2000 large- and mid-sized U.S. companies reported in 1997 that there were 190,000 unfilled information technology jobs in the nation; the worldwide shortage was more than double this figure, fueled by the increasing use of electronic commerce, the Year 2000 conversion problem, the moves toward a European single currency, and Japanese financial deregulation. In the Commonwealth, Kevin Harter, chairman of the Technology Council of Central Pennsylvania, estimates the vacancy rate of information technology (IT) jobs in the central region to be at least 11 percent, slightly above the national average.

ITAA warns that if the current growth rate in fields that are consumers of information technology continues, more than a million new computer scientists, systems designers, and programmers alone will be needed by the year 2005. In a separate study, the U.S. Office of Employment Projections, Bureau of Labor Statistics, concluded that the fastest growing occupations between 1996-2006 will be in information technology areas--database administrators, computer support specialists, computer scientists and engineers, and systems analysts. The Bureau of Labor Statistics projects that 1.3 million new IST workers will be needed between 1996 and 2006. A January 12, 1998, Executive Briefing on Information Technology Workforce Shortages reported on the collaborative research conducted by Virginia Tech and ITAA: "... responses suggested that 346,000 IT positions are currently vacant in the three core information technology occupational clusters--129,000 in 5,874 IT companies and 217,000 in 97,733 non-IT corporations with more than 100 employees."

How accurate are these numbers? The U.S. General Accounting Office issued a report in March 1998 challenging the high projections of the ITAA and Bureau of Labor Statistics. Yet, every corporation dealing with information technology has been struggling with the problem, and the crisis has prompted

several national forums, including the Closing the Gap National Forum sponsored by the University Continuing Education Association in Washington, DC. At the National Information Technology Workforce Convocation sponsored by ITAA, University President Graham Spanier, who chairs the NASULGC (National Association for State Universities and Land-Grant Colleges) Commission on Information Technologies, concluded that "Colleges and universities must do a lot more to help ease the growing nationwide shortage of qualified information technology workers." Indeed, anecdotal evidence combined with even the most conservative statistics provide overwhelming evidence that universities must do things differently, better, and soon if they are to fulfill their educational mission in this area.

It is estimated that fewer than 25,000 U.S. students graduate in computer science per year, although there are openings each year for 95,000. Fewer young people have selected computer science as a major over the past decade--there has been a 42 percent decline from 1986-1994. Of those who do major in computer science, a growing number--18 percent--are foreign nationals. In addition to concerns about declining enrollment in this field, there is growing evidence that traditional computer science training does not fill the needs of an information-rich array of developing industries.

In two Penn State-hosted events, information technology executives from large national corporations, Commonwealth-based companies, and government conveyed their needs for a more broadly based education for IST managers, analysts, and policy experts in technology-intensive companies (see pages 38-41 for a more detailed report of the industry conferences). The concerns of these companies reflect a recent survey which reported that almost 20 percent of top U.S. executives identified the lack of skilled IST personnel as the most serious constraint on the growth of their businesses.

Corporations are willing to pay high salaries to new graduates--averaging nearly \$37,000 for entry-level programmers and almost double this amount in

some urban areas--according to the ITAA report. The shortage has raised salaries in the field an average of 13 percent annually in recent years. Many corporations are offering substantial sign-on bonuses and "finders' fees" for those who recruit a colleague from another company--a cross-corporate raiding nightmare that adds to the frustration caused by an inadequate supply of IST professionals. To compound the problem, few entry level hires arrive "job ready," and corporations must pour additional money into training and retraining employees. This demand has created a fast-growing proprietary IST training industry, with revenues expected to increase from \$16.4 billion in 1996 to \$27.9 billion in 2000. IST executives from large companies who attended the Penn State event estimated that their companies spent \$50,000-60,000 in additional training costs per new IST hire.

Clearly, the traditional university curriculum is failing to adapt to the complex educational needs of a rapidly evolving information industry. Penn State is presented with an opportunity and a challenge to provide new academic programs at all levels--graduate, four-year, two-year, and certificate--to satisfy the range of IST opportunities available to its graduates. Corporations have expressed interest in helping to create a new School of Information Sciences and Technology, a school that can move beyond traditional models and shape a responsive, creative new set of educational programs to help meet the rising demand for IST professionals.

Penn State's Existing and Proposed IST-Related Programs

As the Information Age has unfolded, Penn State has increasingly incorporated information science and technology-related elements into the curricula of existing undergraduate and graduate majors. This change has taken place across many colleges, campuses, and degrees. Several IST-related options or tracks have been created to explicitly incorporate information capabilities into traditional discipline-based degree programs. These changes represent responses both to the development of new technologies (with the enhanced analytical

capabilities that they add) and the increasing demands of employers. A list of IST-related discipline-based programs is provided in Appendix B; there are likely to be other degree programs or options that could be construed as information-related of which the Strategic Planning Group is not aware.

A precise count of students enrolled in these programs is not possible, since students are not separately identified by option in many of the traditional discipline-based majors. However, based on a 1996-97 survey of programs conducted by the Office of Undergraduate Education and some additional updating, it appears that about 2500 undergraduate and graduate students are currently enrolled across Penn State's campuses in these 39 majors, minors, or options that were identified (Appendix B). Data on degrees awarded suggest that more than 800 students, both undergraduate and graduate, received degrees during 1996-97 in these IST-related discipline-based majors, minors, or options.

Further evidence of the response of traditional disciplines to IST may be found in the new degree majors and minors currently in the proposal stage. A list of proposed new programs is provided in Appendix C. This list is based on survey responses to the Strategic Planning Group's request for information about prospective curricular changes, and represents proposals already submitted to the Faculty Senate or in earlier stages of development. Several University Park colleges are represented in these proposals, some in joint collaborative approaches; several other Penn State locations are particularly active in developing plans for new baccalaureate degrees in keeping with the strategic objectives of the former Commonwealth Educational System campuses.

The Pennsylvania College of Technology offers baccalaureate and applied associate degrees in computer information systems, technology management, and office technology. These programs have been very successful at responding to immediate workforce needs. Indeed, such programs may well fit into several of the IST certificate programs described in this report.

The innovations of the many college and campus IST-related majors, minors, and options provide an especially rich environment in which a new School of Information Sciences and Technology at Penn State can thrive. The inventory of programs suggests that potential faculty and program linkages abound, and that students of the new School will have a wide variety of opportunities to study in IST-related disciplinary majors, minors, and related courses. These disciplinary ties are critically important to the broader educational objectives of students in the information sciences, and will help to provide the context for IST applications that will subsequently be made in industry and other employment.

University Benchmarking

We engaged in a major benchmarking effort to learn as much as possible from other universities. This effort involved gathering secondary data and information about IST programs, as well as surveying relevant administrators to acquire detailed comments on their organization and operations. We sought to identify "best practice" programs whose features were relevant to our vision.

Based on the knowledge of the Strategic Planning Group and suggestions from industry executives, a number of institutions were targeted for benchmarking (Figure 6). Background information on the programs' definition of information technology, curricular and pedagogical approaches, modes of instructional delivery, organizational structures, and relationships with business and industry was obtained from the Internet home pages of these institutions. More in-depth discussions with representatives of selected colleges and universities allowed us to verify the information and to ask additional questions about the process of program development, the skills and attributes expected of graduates, program size, barriers to implementation, the availability of minor programs, areas of faculty research interest, and the existence of advisory boards.

We found that a range of academic degrees was available at other institutions and decided to focus on baccalaureate programs as a baseline for making decisions about the structure and curriculum for our proposed new School. The following points summarize our major findings:

- ***Definition of Information Technology.*** Most of the benchmark institutions define information technology in relation to the use of information in solving organizational problems, the need for communication, and the application of technology. Interdisciplinarity is a key element as well. Some programs go further, to include a focus on the role of information in society as a whole. There are also conceptual approaches that include the specific processes involved in the creation, collection, organization, storage, identification, access, distribution, presentation, interpretation, and use of information.
- ***Process of Program Development.*** Many of the programs included in the benchmarking project are built upon existing program areas of strength rather than launched as completely new programs, but highly successful programs often develop wholly new initiatives. Relationships with business and industry are stressed. Cross-disciplinary teams contribute to the development of effective programs. A barrier to implementation across most programs is the difficulty of attracting faculty.
- ***Curricular Approaches.*** Courses are generally required across college curricula, commonly from computer science, business/management, and information systems. Mathematics and statistics are usually stressed, as are communication skills and exposure to the social sciences. Many programs allow customization to meet student needs. Cooperative programs, projects, and minor programs are encouraged. A number of programs refer to the development of team skills, the importance of communication skills, and leadership development. Those associated with Master of Business Administration programs include emphases on a variety of business processes.

- ***Skills and Attributes Expected of Graduates.*** Students are expected to develop a broad range of skills and attributes and to be educated in the management and communication of information. One program's goal is to prepare students to "embrace lifelong learning and to contribute to their community." A representative of another program stated, "We are not building computer jocks; we stress how information science can be used in business." Cross-disciplinary experiences and understanding are seen to strengthen the development of broadly based conceptual and technical skills.
- ***Modes of Instructional Delivery.*** Many programs include some form of distance education. The sophistication varies across institutions, from programs with a one-credit computer course to programs entirely on-line.
- ***Program Size.*** The number of majors reported to be enrolled ranges widely, from less than 20 to more than 1000 students.
- ***Pedagogical Approaches.*** In the program descriptions, references related to pedagogy focus on the significance of experiential learning. Internships, cooperative work programs, and capstone projects play a significant role in virtually every program. The second pedagogical theme is related to the importance of a broadly based rather than a narrowly defined technical education.
- ***Relationships with Other Campus Units.*** Joint appointments within institutions are common, as are cross-disciplinary research projects. Research centers facilitate relationships across campuses. Multi-campus approaches are rare.
- ***Organizational Structures.*** Information technology programs at other institutions are typically located in liberal arts colleges, computer science programs, or business colleges. Those housed in colleges of business are often offered in conjunction with Master of Business Administration programs.

- ***Areas of Faculty Research Interest.*** As might be expected, faculty research interests vary widely. Information systems is the area most frequently identified. Examples of other areas of interest include artificial intelligence, multimedia systems, knowledge management, industry-specific applications of technology, software development and engineering, curriculum development, and distance education.
- ***Funding Sources and Relationships with Business and Industry.*** Information related to sources of funding is not easily accessible, but funding generally seems to take the form of corporate scholarships, sponsored research, and the availability of cooperative work programs for students. Relationships with business and industry tend to be clearly focused on meeting the technology needs of organizations with extensive reliance on corporate representation on advisory boards. The significance of industry-university collaboration in maintaining up-to-date curricula is mentioned in most program descriptions.

Consistent and recurring themes discovered as a result of benchmarking other university programs include: cross-disciplinary approaches; broadly based information sciences and technology education; and close working relationships with business and industry, including the use of advisory boards and cooperative programs for students at the undergraduate level.

Industry Perspective on a School of Information Sciences and Technology

The Strategic Planning Group hosted two events, one with representatives from Fortune 500 companies (January 28) and one with representatives of Pennsylvania companies and state government (February 26) (participants are listed in Appendix E). Because we asked a common set of ten questions to both groups, it was possible to easily identify common concerns, issues, and recommendations. The purpose of the meetings was to discuss workforce needs, curricular opportunities, and the feasibility of new kinds of partnerships between Penn State, industry, and government. In particular, we sought to do a "reality-

check" on some of the issues that have been raised in the popular media about workforce demands, the Year 2000 problem, and the needs for increasingly specialized and ever-changing technology skills among current employees.

Our discussion focused on the following ten questions, but roamed quite freely as executives shared experiences from their own companies' current situation:

- From your perspective, what basic, fundamental knowledge of the IST world should all college graduates have whom you hire? What specific expertise and technical skills are most valuable in your new IST hires?
- What categories of IST employees are you finding it hardest to recruit and retain now, and how do you see this changing in the future?
- What do IST executives see from your perspective as the appropriate balance between a general or liberal education on the one hand, and specific and rapidly changing technical skills that are current today (e.g., C++ programming language) on the other?
- Your companies currently have very large workforces in place with massive expenditures on continuing skills development. Which of these could better and perhaps more efficiently be provided by universities? How should Penn State seek to balance its activities between degree programs, certificate programs, and continuing professional education?
- What colleges and universities do you regard as having the best programs right now for meeting the needs of IST-suppliers or user companies? at the associate? baccalaureate? graduate levels?

- What do you find least satisfactory about the knowledge, skills, and attitudes of your new employees coming out of Penn State and similar institutions? What changes in curriculum would you make if you were in academia?
- From your perspective, how might Penn State best organize its efforts in educating for the IST professions, e.g., one large mega-IST school or college, a school with a core IST faculty and programs strongly linked to IST-related functional areas in existing schools, or simply adding more faculty to existing colleges and disciplines?
- How could Penn State best allocate its limited resources among traditional campus-based, off-campus sites (e.g., at companies), or on-line programming?
- How would the IST professionals envision a new type of partnership between Penn State and their companies? What would they bring to the table? What would they expect Penn State to bring? Would they be willing to share some key employees for stints as short-term faculty? Would they provide hardware and software for instructional and research purposes? How could they adapt their internship and cooperative work programs to best help IST students?
- Where should Penn State be pushing its IST-related research programs to best contribute to the future success of IST-suppliers and user companies?

Both groups of executives agreed that the workforce crisis is real and will become worse in the next few years because higher education is not producing graduates with the right skills and in sufficient numbers to meet current needs. When executives of large, multinational companies and medium- or small-sized Pennsylvania companies are saying much the same thing, we can be confident that both groups have a real problem and that they see Penn State as part of the solution.

Executives stressed the need for all graduates to have much better technology skills than they currently have. Indeed, one of the major problems is that recent graduates need a significant amount of training before they can become valuable employees. (We note that Penn State's recent changes in general education requirements may help in this regard.) For IST graduates, the most critical qualities are not just technical skills: IST graduates need to have much stronger analytical capabilities.

Again and again, executives stressed that the need is not just for more programmers; it is for persons who understand project management, who have good communication skills, who can function effectively in teams, and who are adaptable to changing corporate needs. As one executive stated:

"The problem is broad and not narrow. We all agree that there is a huge shortfall, but the studies do not get to the real issue. In 1997, of the 8200 people we hired, 700 were programmers; 953 were project managers; 2000 were consultants; and the rest were architects. We hired a very small number out of a computer science curriculum; but we hired a whole cadre of people who apply it; this is a big shift in the marketplace."

In other words, the answer to the workforce problem is not to increase the size of the computer science department or the management information systems program: it is to create a different kind of graduate with a richer set of skills.

Which skills are most needed? Graduates need to have a global perspective. They need to be broadly educated and to understand how large organizations function. They cannot work in isolation from the larger issues and problems with which their employers deal. Lots of graduates have good technology skills, but they do not know how to apply them to real-life problems and needs. Graduates need to be flexible and self-motivated in learning new skills and in making transitions both in technology and in organizational structures. As

another executive put it, "the needs are greatest in the area of data modeling, database management, hands-on database manipulation, and project management. Programming skills are fine--it is the management of information where recent graduates are weakest."

An IST graduate must have learned to integrate and apply skills that span disciplinary boundaries in our current curricula. One computer industry executive summarized quite succinctly what other executives said in both meetings: "Three elements are needed: 1) core technical skills, 2) knowledge of process integration, or how functions work together, and 3) people with the ability to continue to learn and collaborate." All executives agreed that there would be an enormous need for continuing education for the current workforce, and they further agreed that wherever possible the education should be delivered on site and perhaps to the employee's desktop. The possibility of on-line learning was very warmly received, especially if the learning is not necessarily limited to traditional degrees. Modules of instruction and certificate programs were regarded very positively. The most important first step for Penn State would be to create a school that was truly interdisciplinary.

The IST graduate programs at Penn State Great Valley and Capital College were singled out for praise as were the undergraduate programs at the Pennsylvania College of Technology. All three programs stress the application of technology to business problems and processes.

All executives believed that their companies would welcome a more vigorous program of internship and cooperative work programs. They would welcome the chance for their executives to teach in an affiliate role in IST programs, but few thought that they could afford to lose key executives for long periods of time.

When we asked about the direction that Penn State should take, the executives unanimously said that for a new school to succeed, it must make a bold

break with current programs. Simply increasing the size of a current program would not attract much attention or corporate support. They encouraged Penn State to avoid incremental changes and to redesign instead a fresh way to integrate associate degree programs, baccalaureate programs, graduate programs, and certificate programs. In doing this, Penn State could be the first major school to integrate on a large scale this major curricular reform. One executive who summed up the situation, said, "To be attractive for corporate support, Penn State has to demonstrate this is a fundamental change, not incremental. Corporations won't support incremental change." Another echoed this statement, indicating that, "The IST proposal must be sufficiently different in order to be noticed."

In summary, the IST executives stressed that a School of Information Sciences and Technology should have a healthy mix of core technologies, integrative experiences, and soft skills, coupled with a strong general or liberal education component. Such a school should have a considerable degree of integration with related fields, offering both majors and minors in IST, but also encouraging IST students to enroll in minors offered by allied functional fields elsewhere in the University. Executives stressed the need for a bold approach to IST education covering a broad spectrum from associate to graduate degrees, with a continuously and rapidly evolving curriculum and a series of multiple internship experiences in order for students to better understand industry settings and corporate expectations. There was unanimous agreement that on-line and off-site delivery capabilities would become increasingly important as industry seeks to better train its incumbent workforce in IST skills, recognizing the magnitude of the training needs and the difficulty of accessing traditional university or college classroom environments for many workers.

Appendix A

Map of Penn State Campus Locations and The Pennsylvania College of Technology

Appendix B

Inventory of Current Penn State Information Sciences and Technology-Related Programs

<u>Program</u>	<u>College/Campus</u>
Graduate Degree Majors and Minors	
Media Studies	Communications
Telecommunications Studies	Communications
Computer Science and Engineering	Engineering
Electrical Engineering (Communications emphasis)	Engineering
Industrial Engineering (Operations Research emphasis)	Engineering
Mechanical Engineering (Robotics emphasis)	Engineering
Geography (Geographic Information Science emphasis)	Earth & Mineral Sci.
Instructional Systems	Education
Statistics	Science
Information Science	Great Valley
Information Systems	Capital College
Mass Communications	Communications
High Performance Computing (Minor Only)	Engineering
Baccalaureate Degree Majors	
Agricultural Systems Management	Agricultural Sciences
Management Science and Information Systems	Business
Administration	
Media Studies	Communications
Telecommunications	Communications
Computer Engineering	Engineering
Computer Science	Engineering
Electrical Engineering	Engineering
Industrial Engineering	Engineering
Geography (Geographic Information Science Option)	Earth & Mineral Sci.
Astronomy (Computer Science Option)	Science
Mathematics (Computational Math Option)	Science
Statistics (Statistical and Computational Option)	Science
Computer Science	Capital College
Information Systems	Capital College
Management Information Systems	Behrend College
Communication and Media Studies	Behrend College
Mathematics (Computer Science Option)	Behrend College
Baccalaureate Degree Minors	
Management Information Systems	BusinessAdministration
Information Systems and Statistical Analysis	Liberal Arts
Statistics	Science
Management Information Systems	Behrend College
Associate Degree Majors	
Computer Science	Engineering
Computer Science	Multiple Campuses
Telecommunications Technology	Multiple Campuses
Electrical Engineering Technology	Multiple Campuses

Appendix C

Proposed Penn State Information Sciences and Technology-Related Programs

(submitted for Faculty Senate approval or in development)

<u>Program</u>	<u>College</u>
Baccalaureate Degree Majors	
Computer Engineering	Behrend College
Information Technology	Berks-Lehigh Valley College
Information Technology	Commonwealth College (multiple campuses)
Technology Management	Altoona College
Baccalaureate Degree Minors	
Health Planning Administration (IST Intensive)	Health & Human Development
Management Information Systems (changes)	Business Administration
Media and Information Systems	Earth and Mineral Sciences
New Media	Arts and Architecture Communications Earth and Mineral Sciences Engineering
Technology Integration	Education
Master's Degree Major	
Information and Communications Technology Management	Communications & Engineering (joint proposal)

Appendix D

Philanthropic Opportunities for the School of Information Sciences and Technology

- Initial basic endowment of \$50 million, growing to \$100 million
- Naming opportunity for School of \$25 million (individual)
- Building naming opportunity of \$15 million or more
- Endowed faculty chairs: 10 @ \$1.5 million each
- Endowed faculty professorships: 10 @ \$500,000 each
- Endowed career development professorships: 10 @ \$250,000 each
- Endowed graduate fellowships: 25 @ \$100,000 each
- Endowed Practitioner's Lecture Series: 2 @ \$100,000 each
- Naming opportunities within new building: \$100,000 to \$5 million
- Hardware equipment/software donations: numerous
- Current undergraduate scholarships: numerous
- Current graduate fellowships: numerous
- Current student internship and cooperative work program opportunities: numerous

Appendix E

Penn State Information Sciences and Technology Meeting Participants from Industry and Government

Fortune 500 and Other Corporate Executives (1/28/98):

Marshall Banker, Executive VP, Management & Data Systems, Lockheed Martin
Harry Bosco, President, Network Systems Data Networking Unit, Lucent
Bruce Claflin, Sr. VP and Group Executive, Digital Equipment Company
Charles Dietrick, General Manager, Northern California District, Microsoft
Larry Kittelberger, VP/CIO, Allied Signal, Inc.
Richard Mattern, Executive VP, Strategic Planning, Via Systems Technologies
Frank Modruson, Partner, Andersen Consulting, Arthur Andersen & Co. S.C.
Scott Perry, VP, Advanced Platform Services, AT&T Corporation
Susan Pittman, General Manager, Products Support Operations, GE Aircraft
Theodore Raffetto, VP, Large Business Services, Bell Atlantic Network
Steve Schmidt, Section Manager, Management Systems & Information Function,
Procter & Gamble Co.
Ronald Vance, VP/CIO, AMP, Inc.
Lloyd Waterhouse, General Manager, IBM Global Services, IBM
James Wellendorf, General Manager, Information Systems & Technology,
Armstrong World Industries

Commonwealth Industry/Government and Other Executives (2/26/98):

William Blank, Director, Buchart-Horn/BASCO Associates
William Burgess, Senior Partner, Computer Sciences Corporation
Ted DellaVecchia, Senior VP/CIO, Capital Blue Cross
Paul Gustafson, Senior Partner, Computer Sciences Corporation
Kevin Harter, President, The Software Colony, Inc.
Darren Macioce, VP, Information Services, Highmark Blue Cross Blue Shield
Joseph Merilli, Branch Manager, Solution Technologies, Inc.
Daniel Moos, Senior VP/CFO, National Computer Security Associates
Lisa Murphy, VP of Technical Services, Keystone Medical Systems, Inc.
Barbara Nielson, Human Resources Representative, Stoner Associates
Larry Olsen, Deputy Secretary/CIO, Governor's Office of Administration
Alan Todd, President, KnowledgeSoft, Inc.

The School of Information Sciences and Technology

- **New educational opportunities leading to associate, baccalaureate, and graduate degrees, as well as minors and certificates**
- **Interdisciplinary approaches that capitalize on Penn State strengths at all locations**
- **A fundamental academic core that stresses analytical and problem-solving abilities, and builds strong communications, teamwork, and project management skills**
- **Leading edge research and outreach programs, including distance education and the World Campus**
- **Strategic partnerships with industry and government**
- **Positive impacts on economic and workforce development**

Figure 1: School of Information Sciences and Technology Framework

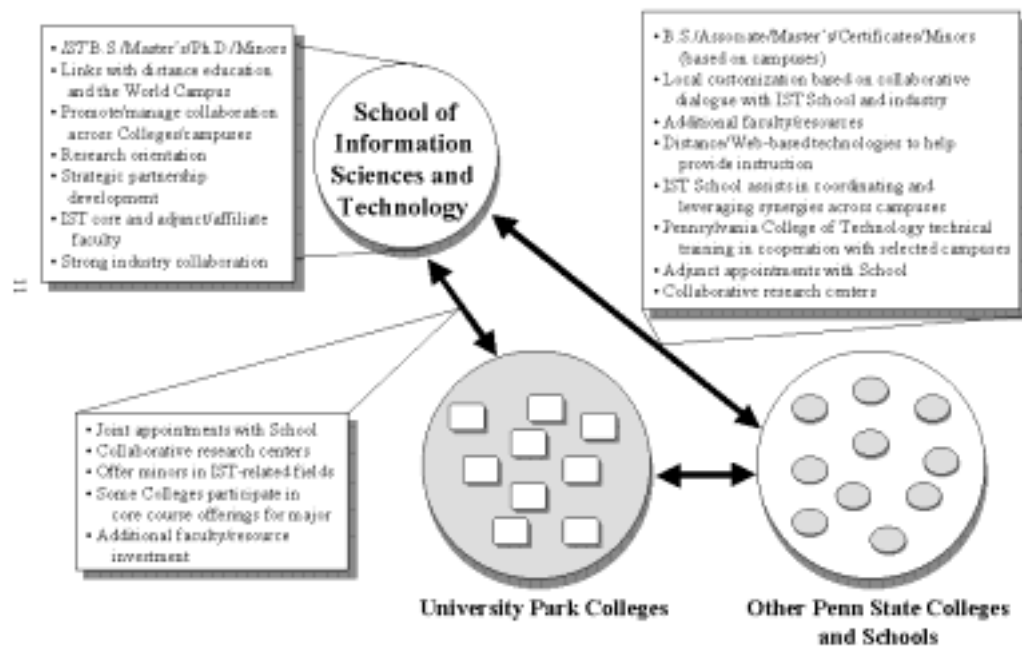
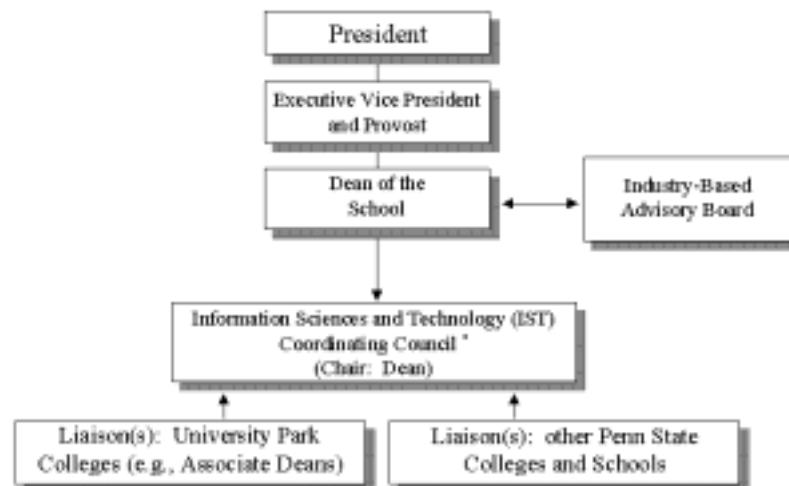
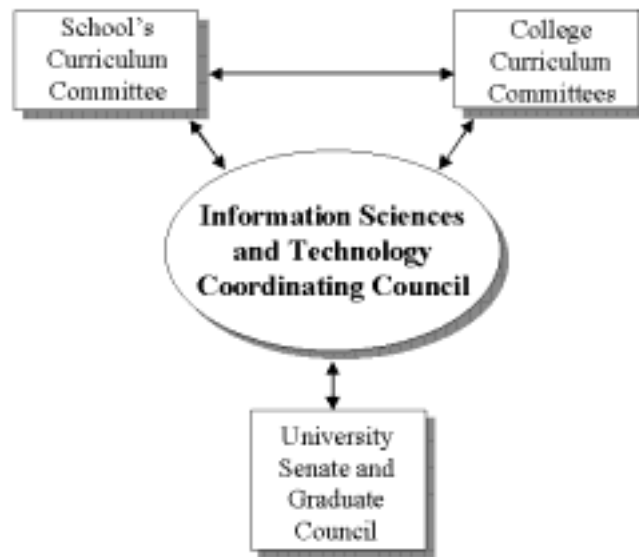


Figure 2: Organizational Relationships of the School of Information Sciences and Technology



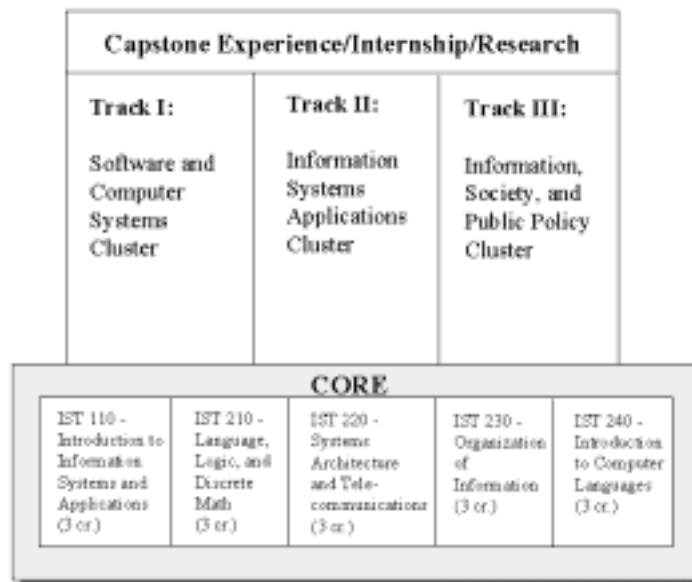
* IST Coordinating Council consists of a representative group of appropriate academic administrators who will ensure coordination of IST curricular offerings and programs throughout Penn State

Figure 3: Curriculum Development and Coordination



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Figure 4: School of Information Sciences and Technology Curriculum Model



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**Figure 5: Implementation Timetable
for the School of Information Sciences and Technology**

Public Release of IST Report	May 1998
Consultation with Departments/Colleges	May 1998
Consultation with Faculty Senate Committees	May - June 1998
Approval of Plan for External Support	July 1998
Consultation with Faculty Senate Council	July 1998
⊗ Presentation to the Trustees for Formal Approval	September 1998
Launch Search for Dean	September 1998
Begin Faculty Recruitment and Identify Interim Space	September 1998
Approval of Recruitment Plan for First Cohort of Students	September 1998
Follow-up Discussions with Industry Liaisons	October 1998
Approval of Preliminary Proposal for New Building	November 1998
Identification of Existing Faculty for Full or Joint Appointment	November 1998
Welcome First Class of IST Students	August 1999

Figure 6: Benchmark Universities

University of Auckland (New Zealand)	University of Michigan
University of British Columbia (Canada)	University of Nebraska at Omaha
University of California at Berkeley	New Jersey Institute of Technology
Cambridge University (United Kingdom)	University of Phoenix
Carnegie Mellon University	University of Pittsburgh
⊕ DeMonfort University (United Kingdom)	Rensselaer Polytechnic Institute (RPI)
Drexel University	Rutgers University
George Mason University	Simon Fraser University (Canada)
Georgia Institute of Technology	Stanford University
University of Limerick (Ireland)	University of Sydney (Australia)
University of Maryland at College Park	University of Texas at Austin
Massachusetts Institute of Technology	University of Wisconsin at Madison