Strategic Plan

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Dear Frank
It was very nice
meeting you at
NEEDHA Conference
Carlos

CARLOS R.P. HARTMANN
Professor & Chairperson

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Chapter 1

Introduction

The formation of the Division of Computer and Electrical Systems (CES) was proposed as part of the strategic plan developed in 1996 under the leadership of Dean Bogucz [7]. In September of 1996 the faculty of the College of Engineering and Computer Science (ECS) approved this strategic plan as a working document to guide the College during the next four years. This division, CES, consists of only one department, namely, the Department of Electrical Engineering and Computer Science (EECS).

The faculty of EECS is comprised of the faculty of the former Department of Electrical and Computer Engineering (ECE) and the faculty of the former School of Computer and Information Science (CIS). All the academic programs of the former CIS and ECE units are now in EECS.

The Department of EECS has been functioning as a department for over a year, during which time we have witnessed a harmonious integration of CIS and ECE as well as a fiscal performance that has surpassed our most optimistic expectations.

This year has shown that we can work together to forge our own future. Therefore, now is the time for us to decide what we want our future to be and to chart a plan to realize our goals—that is, to formulate and embrace our strategic vision.

Strategy is the science and art of generalship. Its essence is the ability to put into place plans and resources that can achieve a goal. The quality of a strategy depends on its effectiveness.

Vision is the ability to see what will, or may, come to pass. Its essence is the ability to see clearly. The quality of vision often depends on seeing things from many perspectives and the ability to integrate the many perspectives into a coherent view.

A *strategic vision* is the organization of plans and resources aimed at attaining goals based on the possible outcomes we desire. The clarity of vision and the effectiveness of a strategy rest on many factors: the rightness of the goal, inspiration for energy, tough-mindedness to see things as they are, cleverness and creativity to find solutions, hard work to transform plans into actions, and the ability to adapt when circumstances call for change.

Strategy is distinct from *tactics*—the actual operations and maneuvers supportive of a strategy. Here, we focus on strategy as opposed to tactics. When our department strategy is adopted and "owned" by the faculty, specific actions or tactics will be developed.

During the formulation of our strategic vision we have the opportunity to reflect, re-focus, and redouble our efforts in pursuit of our goal to be an excellent department of electrical engineering, computer engineering, and computer science where excellence is interpreted in the broadest sense.

When we are successful in implementing the strategic vision we will be a department that: 1) is forward-looking and visionary, 2) relevant, 3) acts with integrity in support of larger societal values, 4) continuously strives for improvement, 5) acts as a community, and 6) has high quality in whatever it chooses to do. Our goal is to orchestrate our resources and combine our diverse abilities to create unique capabilities that strengthen our research and improve the quality of the academic experience for our students.

Chapter 2

Context

The quality of our strategic vision depends on our ability to see clearly the context of our efforts. We exist within a specific university, we are part of a specific college, and we are members of specific disciplines.

2.1 Higher Education at Syracuse University

2.1.1 Mission and Vision

The Syracuse University Mission is: *To promote learning through teaching, research, scholarship, creative accomplishment, and service.* The ECS Mission refines the University's Mission as follows [7]: *To promote learning in engineering and computer science through integrated activities in teaching, research, scholarship, creative accomplishments, and service.*

What is crucial in both statements is the emphasis on *learning* as the goal for the activities of teaching, research, scholarship, creative accomplishments, and service. Student-centered learning is served by teaching; faculty- and staff-centered learning is served by research. All groups are served by scholarship, creative accomplishments, and service.

The Syracuse University Vision is: *To be a leading student-centered research university with faculty, students, and staff sharing responsibility and working together for academic, professional, and personal growth.* The ECS Vision is [7]: *To earn recognition among student-centered research universities for engineering and computer science programs that produce leaders for a high-technology, knowledge-based, global economy.*

What is significant in both the University and College vision statements is the focus on student-centeredness, research, and the goal to be outstanding among other student-centered research institutions. This focus differs from previous goals of being an outstanding research institution. We need to pay close attention to what it means to be student-centered and the role that research plays in student-centered research universities.

2.1.2 Student Centeredness

Developing a meaningful signature and student centeredness are crucial if we are to thrive. The following is excerpted from an internal report written by Dr. Robert Diamond, Assistant Vice Chancellor for Instructional Development.

> The University enters this period with many talented faculty and staff and a number of outstanding programs, but, it is an institution that lacks a clear sense of mission and priorities and a sense of community. In its effort to become a leading research institution, the quality of SU's undergraduate programs has suffered and some faculty have individual priorities that have little to do with the needs and future of the institution. While many new initiatives have been undertaken to address these issues, there still exists a lack of cohesiveness among units, a lack of clear understanding of what Syracuse University is

or hopes to be, and a lack of understanding on the part of each individual (faculty members, staff, and administration) of the role they might play in strengthening and re-shaping the institution.

The problems confronting Syracuse University are complex, yet identifiable. They include:

- As a private institution that is primarily tuition driven, Syracuse must develop an undergraduate experience that attracts well-qualified students. The total experience (i.e., programs, services, faculty, physical plant) must be perceived by the public as being of high quality and good value, particularly when compared with institutions with lower tuition rates. We must be able to differentiate ourselves in the market place with special "SU" signature programs and services.
- The University must identify those graduate programs and areas of specialization and research where it has the strengths and capacities to compete nationally and internationally for resources and recognition.
- Given budget constraints, the University must develop and utilize its resources (human and material) in the most effective way possible.
- With limited discretionary dollars, the University must recognize and support its most valuable resources—its faculty and staff. (Research has identified a number of cost-effective actions that an institution can take to improve the lives of its faculty and their commitment to the institution.)
- As one of the major institutions of higher education in the region, the University faces the challenge of making greater use of community resources to the benefit of both.
- The institution must develop a sense of community and produce a clear and consistent message concerning the University's mission.

In response to some of the above issues, the College has put forth its model of student centeredness, which has the following features:

- The commitment that all programs relate directly to students and their learning experiences
- The commitment that research is an integral element of the learning environment
- The flexibility for students to pursue the diversity of learning opportunities available in a broad university setting
- The commitment to world-class quality in courses and programs

Left to the departments are the details of establishing distinctive programs. The department's response in Section 3 is a refinement of the mission and vision of the College and University.

2.1.3 Research in a Student-Centered Research University

One of the signatures of a student-centered research university is the high degree of interconnectedness between research and education at all levels. Within the department's history are some examples. It is no accident that the department's past research into radar systems and signal processing also produced a rich set of courses and text books in electro-magnetics, linear systems theory, and detection and estimation. The department's computer engineering (CE) program is the second oldest accredited CE program in the nation, predating most other programs by a decade. Research by Computer and Information Science (CIS) in logic and types is reflected in text books by J. A. Robinson and J. R. Reynolds.

Left unattended, the time between research and its impact on professional training and practice can be decades. Many agencies such as the Defense Advanced Research Projects Agency (DARPA) and the National Science Foundation (NSF) are increasingly critical and concerned about such delays. For example, a major proposal evaluation criteria for DARPA is the *effectiveness of the technology transfer plan.* It is no longer good enough to publish results and make tools available on the Web. Plans must speak to the steps that will be taken to have the results incorporated and adopted by the profession. It is no accident that *education, training, and human resources* is one of five areas of national concern identified by the White House National Science and Technology Council's (NSTC) Committee on Computing, Information, and Communications (CIC) [8]. (See Section 2.2).

This increasing concern over research having impact on the profession is an opportunity for student-centered research universities. Fundamentally, technology transfer is about producing people who are *knowledgeable and capable* users of techniques and tools. A student-centered research university can establish its reputation on:

1. Using research as a source for innovation in its academic programs in a timely manner, and
2. Using its academic programs to produce professionals who are distinctively well-prepared for either professional practice or academic research.

From the mid-1980's through the mid-1990's, Intel sought our masters graduates from computer engineering. The stated reason was that our graduates received training in computer-aided design that was unique compared to that of other universities. Our graduates could make contributions immediately, as opposed to graduates of other universities who required as much as six months to "come up to speed."

Our research and student focus give us potential advantage over non-research universities and research-focused universities. We have the opportunity to incorporate research into our academic programs immediately, whereas non-research universities do not. Universities that are primarily research-focused may not include continuous innovation of their academic programs as part of their primary mission.

Relevant and innovative research that has impact on areas of national importance and the profession, even if it is done on a smaller scale than in research-focused universities, can be a source of distinction *if our research results are well-integrated into academic programs on a continuing basis.*

2.1.4 Assessment and Accountability

Academic Programs

Assessment and accountability have received much attention at the University. The *FBOH* is one measure of accountability. Vice Chancellor Vincow's February 26, 1997, address was *Introducing the Next Phase of Assessment at Syracuse* [12].

The focus on assessment and accountability is not limited to the University. It is a national trend that has increased in importance over the last decade. Governor Roy Romer of Colorado, in his 1995 Report for the Education Commission of the States, wrote:

> For all its rich history, there are too many signs that higher education is not taking seriously its responsibility to maintain a strong commitment to undergraduate learning; to be accountable for products that are relevant, effective and of demonstrable quality; and to provide society with the full benefits from investments in research and public service.

The desire for accountability and assessment of outcomes is not limited to politicians and budget makers. In 1985 the Association for American Colleges identified eight essential items of content and skill for which higher education programs should assume responsibility:

1. Inquiry: abstract and logical thinking and critical analysis
2. Literacy: writing, reading, speaking, and listening
3. An understanding of numerical data
4. Historical consciousness
5. An ability to distinguish science from other kinds of inquiry
6. A sense of values: the ability to make choices and to accept responsibility for them
7. Appreciation of and experiences in the arts
8. International and multi-cultural experience

Today, the view that goals should contain clear statements of outcomes, and that these outcomes are to be assessed, is well established. In fact, many accreditation bodies have adopted such a view—ABET is one of them [4].

The department recognizes that when developing our mission and vision, we must develop them within the context of finding what is of lasting value and how we will assess what our students learn.

Research

Assessment of research leads directly to discussions on what constitutes research. Agreement on a *single* definition of research across disciplines is unlikely. Nevertheless, there is general agreement that if the following six conditions exist, then scholarly and professional activity has occurred, (see [2] p. 12).

The Basic Features of Scholarly and Professional Work

1. The activity requires a high level of discipline-related expertise.
2. The activity breaks new ground, is innovative.
3. The activity can be replicated or elaborated.
4. The work and its results can be documented.
5. The work and its results can be peer-reviewed.
6. The activity has significance or impact.

The above list of criteria is a starting point for deciding how to assess scholarly activity.

2.2 State of the Professions

Governor Romer's call to "provide society with the full benefits from investments in research and public service," and accountability for "[academic] products that are relevant, effective and of demonstrable quality," lead us directly to consider national research priorities as they relate to electrical and computer engineering and computer science.

For example, the National Science and Technology Council (NSTC) of the White House, through its Committee on Computing, Information, and Communications (CIC), has identified the following areas of national concern [8]:

- High-end computing and computation
- Large-scale networking
- High-confidence systems
- Human-centered systems
- Education, training, and human resources

Common to all these areas is a desire for research and education to manage complexity inherent in the *information age*. The size and complexity of information systems, coupled with the rapidity of change, has created daunting problems in performance, cost, reliability, security, and integrity. There is an explicit desire to shrink dramatically the time between research and the visible impact on the quality of products the profession produces. Each area is multi-disciplinary in nature.

The Institute of Electrical and Electronic Engineers (IEEE), an organization with 27 different technical societies, lists the following as the "Grand Challenges" to the Electrical Engineering profession[1]:

- Allow easy access to knowledge and information
  - Space communication technology
  - Applications of very small aperture antennas for communications
- Information access in developing countries
  - Emerging information technologies
  - Video compression for video telephones
  - Mobile radio advancements
- Provide ready access to improved health
  - Reliable, cost-effective medical diagnostics and prosthesis
  - Design/manufacturing for a sustainable planet
- Simplify the transactions of daily life
  - The paperless office
  - The cashless society

[1] For further information, see http://www.ieee.org/newtech/challenges/.

- Allow mankind to live in dignity and comfort
  - Intelligent highways and transportation systems
  - Abundant, clean, safe, affordable energy
  - New, high-value-added products and industries

Modern communication and information technology is the common thread in all these challenges and is expected to be a dominant economic factor in the coming decades, based upon the current and projected investments of influential high-technology companies [1].

When selecting our priorities, the department recognizes that to have impact on any of the above areas requires increased levels of collaboration between department faculty and faculty of other units. Our strategy includes the examination of probable partnerships with high potential payoff relative to national goals.

Chapter 3

Strategic Vision

3.1 Our Mission—Why We Exist

The mission of the department is:

1. Assisting students to be **ready for work and ready to change**. In particular, this means preparing students to make professional contributions immediately upon graduation and throughout their professional careers, and to adapt to technological and societal changes. This is to be accomplished by developing their

   - depth and breadth of knowledge in electrical engineering, computer engineering, or computer science as evidenced by an understanding of engineering and science coupled with the capacity to produce feasible and responsible solutions to complex problems;
   - literacy as evidenced by skills in writing, reading, speaking, and listening;
   - critical thinking as evidenced by skills in interpretation, analysis, evaluation, inference, argumentation, and reflection;
   - values as evidenced by the ability to make reasoned and ethical choices and to accept responsibility for them;
   - interpersonal skills as evidenced by leadership ability, appreciation for diversity, and the capacity to work effectively with others;
   - lifetime learning skills as evidenced by the ability to adapt to innovation and change.

2. Assisting the faculty to do scholarly and professional work that

   - contributes to the knowledge and practice of electrical engineering, computer engineering, and computer science;
   - educates electrical and computer engineers and computer scientists;
   - serves the interests of our professions, university, and the wider community.

3.2 Our Vision—What We Want to Be

Our vision is to become a department of electrical engineering and computer science that is recognized as one that

- produces engineers and scientists who are distinctively well educated by virtue of programs that are technically deep and innovative;
- conducts research that is recognized for its high quality and impact by virtue of its relevance, depth, and innovativeness;

- integrates its research with its teaching as a source of innovation and distinctiveness;
- consists of a scholarly, diverse, and supportive community of students, faculty, and staff where people are treated with respect and integrity.

3.3 Our Departmental Strategy

To achieve our strategic vision we plan

- to develop synergism among the various academic programs of the department, and
- to focus investments in infrastructure, faculty, and teaching to promote the areas of future investment of the department or cross-disciplinary interactions.

This will be achieved by

- supporting faculty appointments of persons whose skills foster the areas of future investment or promote cross-disciplinary activities;
- using infrastructure investments that will impact upon areas of future investment or multiple disciplines;
- developing curricula that provide diversity in our programs while eliminating duplication of efforts and resources;
- increasing the level of student participation, especially that of undergraduates, in research and teaching.

Chapter 4

Phases of Strategic Plan

4.1 Basic Principles

The basic principles followed in the strategic planning process are as follows:

- *The process must be fair and open.* All decisions are reviewed by all the department faculty and voted upon by the faculty.
- *The process must engage the faculty.* Faculty are consulted on all parts of the process.
- *The process uses outside facilitators.* The use of outsiders who are familiar with strategic planning and curriculum development allows the department faculty to concentrate on the content of the plan and curricula.
- *The process establishes criteria prior to decisions on scholarly and academic programs.* Agreeing on criteria before deciding on what to emphasize in the scholarly and academic programs reduces the likelihood of personal conflicts and gives decisions a rational basis.

4.2 Overview of Phases

Figure 4.1 is a diagram showing the sequence of objectives. Each objective is described in later sections. The plan is carried out in two phases. The first phase, now completed, identifies goals and needs relative to our scholarly and academic programs. Based on our self-assessment, educational, and research goals, it gives the rationale for new faculty in terms of identified needs and objectives.

The second phase is the detailed design work of: 1) programs that meet our stated educational and research goals; 2) methods used to assess the extent to which we are meeting our goals; 3) how the work is to be distributed among the faculty; and 4) the basis for faculty rewards. This phase is to be completed by the beginning of Fall 1998. Much of this work will meet the multiple needs of accreditation, college planning requirements, and the university assessment initiative.

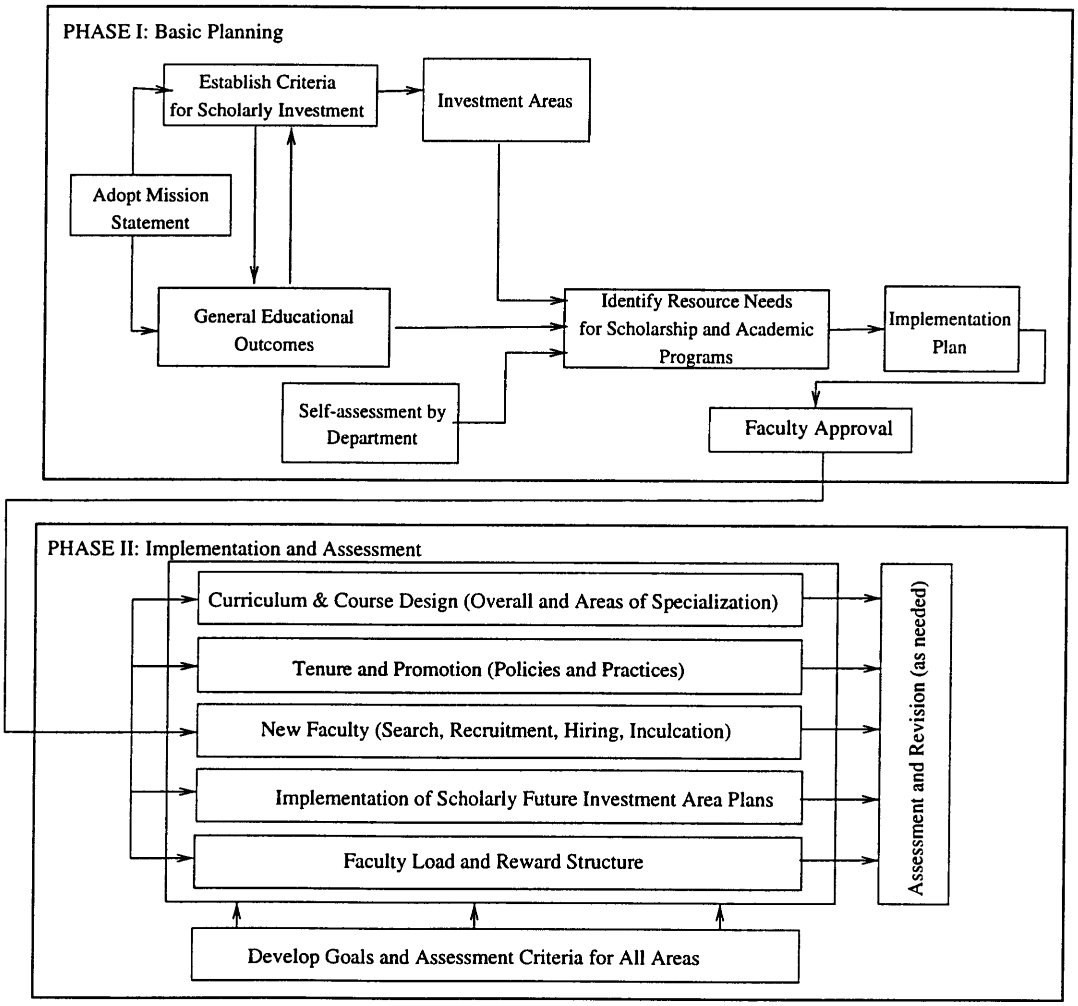


Figure 4.1 Flow of Objectives

Chapter 5

Phase I: Basic Planning

5.1 State of the Department and Current Needs

In this section we give a brief account of the state of the department. More detailed information can be found in Appendix A.

Within EECS there are four B.S. degree programs (computer engineering, computer science, electrical engineering, and systems and information science), five M.S. degree programs (computational science, computer engineering, computer science, electrical engineering, and systems and information science), and three doctoral degree programs (computer engineering, computer and information science, and electrical engineering). In addition, EECS offers four minors (computational science, computer engineering, computer science, and electrical engineering) and two graduate-level certificates in computational science.

In the AY 1997–98 there are 31 tenured/tenure-track faculty, one part-time faculty, two research faculty, and two visiting faculty.

The department has 359 undergraduate students that account for 41% of the College's undergraduate population, and there are 265 M.S. and 167 doctoral students that account for 60% of the College's graduate students.

In the fiscal year (FY) 1996–97, EECS delivered 50% of the College's undergraduate credit hours of instruction and 69% of the graduate credit hours.

The fiscal performance of EECS, as measured by FBOH (fringe benefit/overhead ratio), during FY 1996–97 was outstanding. The $FBOH_1$ for FY 1996–86 stood at 57, while the $FBOH_2$ was 69. The increase of the EECS $FBOH_1$ for FY 1996–97 compared with that of FY 1995-96 was 217%, while the increase of the EECS $FBOH_2$ was 187%.

The involvement of EECS faculty in theoretical as well as experimental research in many areas has resulted in the publication record for 1996 shown below. Several laboratory facilities that support these efforts are detailed in Appendix A.

- 43 papers published in technical journals
- More than 100 papers published in proceedings of conferences or presented at conferences
- 7 chapters of books published
- 4 books published
- More than 100 invited presentations given

As a consequence of the 1992 downsizing the number of EECS faculty was reduced to less than half of the total number of faculty of the former CIS and ECE. The consequences of downsizing are:

- Some research areas were abandoned, and others do not have minimum critical mass.

- The department lacks the viability to cover all the courses without the help of adjunct faculty, but even with adjunct faculty many of our courses have a very high enrollment.

If we want to have a viable program that is attractive to students, we must hire new faculty.

Although the College has made a significant investment in its computing structure, the equipment in many CE and EE laboratories is outdated and needs to be upgraded. The Unix laboratories in CST are rapidly becoming outdated and also need to be upgraded.

5.2 Criteria for Determining Scholarly Areas for Future Investment

Given the limited resources of the department, college, and university, not all research areas can receive equal support. In order to develop the quality and recognition of the department's research efforts most effectively, the department will identify research areas of future investment. These areas will be given preference in the investments of new resources. At the departmental level such resources can include laboratory space and equipment, travel funds, and preference in hiring.

In order to avoid arbitrary selections of these areas of future investment, we first need to consider carefully the criteria by which we will make the selection. These criteria will also be used for periodic reassessment of the areas.

As the department spans three major disciplines, the interpretation of scholarship must be defined with sufficient breadth to cover each discipline. As pointed out earlier, there is general agreement that scholarly activity has occurred if the following six conditions exist, (see [2] p. 12).

The Basic Features of Scholarly and Professional Work

1. The activity requires a high level of discipline-related expertise.
2. The activity breaks new ground, is innovative.
3. The activity can be replicated or elaborated.
4. The work and its results can be documented.
5. The work and its results can be peer-reviewed.
6. The activity has significance or impact.

The faculty recognizes that there are several categories of research and that, in principle, areas of future investment can be in any of these categories:

- Pure research that extends the theoretical foundations of a discipline
- Applied research that relates theory to practice in a discipline
- Pedagogical research that investigates and explores instructional methods, technology transfer, and assessment

The selection of the areas of future investment will be based on the criteria given below:

- Nationwide competitiveness: (Which areas have the highest potential of achieving long-term national recognition or nationwide excellence? Should we focus more on interdisciplinary research?)

- Balances among popular areas (as indicated by the job market), areas of existing strength, and areas of importance

- Funding opportunities

- Existing research strength (as indicated by publications, national reputation, funding profiles, supervision of doctoral dissertations, activities of former and current doctoral students, etc.)

- Cost-effectiveness

- Promotion of collaboration between faculty

- Educational needs

In addition to the above criteria that were approved by the faculty, opportunities to make use of regional resources (e.g., Rome Laboratory, CASE, NPAC, Anaren, Lockheed Martin, etc.) will be considered.

5.3 Selected Scholarly Areas for Future Investment

Using the criteria depicted in Section 5.2, three areas for future investment were identified. Two of these areas were designated as primary areas, and the third as an incubation area. In the AYs 1998–99 and 1999–00 the primary areas will receive substantially more resources than the incubation area. The primary areas are:

- RF and Wireless Information Systems

- Trusted Real-Time Networked Computing

The incubation area is:

- Applied Formal Methods and Theoretical Computer Science

Furthermore, one area was identified by the chairperson as a "speculative" area in which the potential for future payback is very high, and it will receive a moderate amount of resources for the next three years. The area of speculation is:

- Photonics and Molecular Electronics

A detailed description of each of these areas can be found in Appendix B.

5.4 General Educational Outcomes

Brief descriptions of the overall programs of Electrical Engineering, Computer Engineering, and Computer Science appear below.

> Students in the Electrical Engineering programs at Syracuse University develop problem-solving skills coupled with practical design and implementation experience. Rigorous mathematical and scientific preparation enables students to apply the fundamental principles of electrical engineering to analog and digital components and systems in many areas such as antennas, communications, controls, integrated circuits, photonics, and signal processing. The flexible curricula allow students to design their own programs of study to fulfill their career objectives.
>
> Computer Engineering at Syracuse University combines the principles of electrical engineering with the concepts of computer science to graduate engineers proficient in the design and evaluation of computer systems, software, and networks. Our students are educated in high-level systems complexity as well as low-level component functionality. This provides them with the theoretical foundation and practical preparation necessary for a rapidly changing profession.
>
> Students in the Computer and Information Science programs at Syracuse University attain a solid grounding in the logic, design, and analysis of algorithms, as well as a substantial mathematical maturity and facility for using formal methods. They are capable of developing systematic software in a variety of programming languages. Significant flexibility in the program enables interdisciplinary work.

Specifying the educational outcomes for our undergraduate and graduate students lists the skills we want them to have upon completion of their programs. This is a distinct shift from the traditional faculty-centered viewpoint of "what do we *teach*?" to a student-centered viewpoint of "what do our students *learn*?" This will stimulate us to explore different pedagogical approaches to meet different learning needs.

The educational outcomes we expect for all our undergraduate and graduate students are given below.

1. **Bachelor of Science Programs**
   Students must demonstrate an ability to
   (a) apply knowledge of mathematics and science;
   (b) design and conduct experiments, analyze and interpret data;
   (c) design systems to meet specifications;
   (d) function independently and on teams;
   (e) identify, formulate, and solve engineering and scientific problems;
   (f) understand professional, ethical, and safety considerations;
   (g) communicate effectively, both orally and in writing;

(h) understand the role of science and engineering in society;

(i) recognize the necessity for lifelong learning;

(j) use the modern tools necessary for professional practice;

(k) understand contemporary issues through a broad liberal arts education.

2. **Professional Master of Science Programs**
Students must demonstrate (in addition to #1 above, as appropriate):
   (a) the educational outcomes required of BS students in their disciplines;
   (b) proficiency in core technical concepts and their applications;
   (c) a mastery of advanced specialized topics.

3. **Doctoral Programs**
Students must demonstrate (in addition to #1 and #2 above, as appropriate):
   (a) a breadth of knowledge in their disciplines;
   (b) a mastery of material in their specialties;
   (c) original contributions to their fields.

5.5 Resource Needs for Scholarship and Academic Programs

In order for our scholarships and academic programs to blossom we need to hire a minimum of eight faculty, seven of whom will hold tenured/tenure-track positions, while the other will hold a visiting position. We note that by the end of Spring 1998 EECS will lose three tenured faculty, and with great probability another one. So, these seven new tenured/tenure-track positions are, in effect, an addition of only three faculty.

All of the new tenured/tenure-track faculty will support research in the areas of future investment and instruction in the academic programs, while the primary responsibility of visiting faculty is to support our instruction needs (stated in Section A.7). The hiring plan for tenured/tenure-track faculty in the next two AYs is given in Table 5.1. The plan also requests that a visiting faculty line be created in Fall 1998.

Table 5.1 Tenured/Tenure-Track Faculty Hiring Plan for AYs 1998–99, 1999–00

<table>
<tr><th></th><th>Faculty Joins EECS</th><th>Support for Research Area</th><th>Support for Acad. Programs</th></tr>
<tr><td>1 Senior (Jr.) Faculty</td><td>Fall 1998</td><td rowspan="2">RF and Wireless Information Systems</td><td rowspan="2">EE</td></tr>
<tr><td>1 Senior (Jr.) Faculty</td><td>Fall 1999</td></tr>
<tr><td>1 Senior (Jr.) Faculty</td><td>Fall 1998</td><td rowspan="2">Trusted Real-Time Networked Computing</td><td rowspan="2">CE and CIS</td></tr>
<tr><td>1 Senior (Jr.) Faculty</td><td>Fall 1999</td></tr>
</table>

In order to support the RF and Wireless Information Systems area, the plan requests that a laboratory technician be hired in Spring 1998.

In Fall 2000 the department scholarship and academic programs will be reviewed by an ad hoc committee formed for this purpose. Particular attention will be paid to the future investment areas. Since the results of this review will influence the selection of the three new hires, these three new faculty positions will be filled in Fall 2001.

As pointed out earlier, we urgently need to upgrade our laboratories. Our plans for upgrading them are depicted in Tables 5.2, 5.3, and 5.4. Details of the plans can be found in Appendix D.

Table 5.2 Electrical Engineering Laboratory Plan

Laboratory	Fiscal Year				Link	Lab Supports
	1997–98	1998–99	1999–00	2000–01	Location	
Wireless Communication	$ 8,300	$141,500	$ 92,200	$ 50,700	331	Instruction Research
Photonics	—	40,000	30,000	30,000	317	Instruction Research
Electrical Machinery	—	10,000	9,000	—	320	Instruction
Robotics	—	10,000	6,000	—	202	Instruction
General Lab Needs	15,000	75,000	60,000	60,000	Various	Instruction
Subtotal	$23,300	$276,500	$197,200	$140,700		

Table 5.3 Computer Engineering Laboratory Plan

Laboratory	Fiscal Year			Location	To Support
	1998–99	1999–00	2000–01		
Multimedia	$106,400	$80,900	$80,900	To be Determined	Instruction Research
VLSI/CAD	85,800	60,300	60,300	To be Determined	Instruction Research
Instructional	56,800	32,000	32,000	Link	Instruction
Subtotal	$249,000	$173,200	$173,200		

In Table 5.5 we give the total amount needed to upgrade and create new laboratories within a four-year period. In this table we also depict the amount the plan requests from the College beyond the Core Budget (page 40) for the four-year period. Note that the ratio of the amount requested to the amount needed is larger in the early years, since in the later years a part of the equipment will be acquired through external funding.

Table 5.4 Computer Laboratory Plan

Fiscal Year	Resources Needed	Purpose	To Support
1997–98	$43,700	Integrate Unix Systems	Instruction Research
1998–99	$90,700	Upgrade Unix Systems	Instruction Research
1999–00	$30,000	Purchase Projection Equipment	Instruction

Table 5.5 Total Resources for Laboratories

Fiscal Year	1997–98	1998–99	1999–00	2000–01
Amount Needed	$67,000	$616,200	$400,400	$313,900
Amount Requested From ECS	$55,000	$400,000	$250,000	$130,000

5.6 Action Plan

5.6.1 Goals

- **Develop Phase II**
  During the Spring 1998 semester we will develop Phase II of the Strategic Plan. In Figure 4.1 the flow of objectives for this phase is depicted. More details about this phase are given in Section 6.

- **Increase Number of Undergraduate Level Courses for Non-EECS Majors**
  In the last few years we have experienced an increased demand for our service courses—i.e., courses that teach programming languages such as PASCAL, C, Java, etc., to non-EECS majors. We predict that this demand will continue to grow in the next few years, principally because

  - of the increased use of computers in every aspect of life;
  - among the proposed set of learning outcomes for **all** Syracuse undergraduate students to achieve before graduation [12] is the skill of being able to

    > *demonstrate the use of computer and information literacy skills for personal productivity and knowledge acquisition.*

  Table 5.6 provides information about the service courses for three semesters.

  Service courses are taught by Teaching Assistants. Even though most of the students who take service courses are not ECS students, we will use the ECS average undergraduate tuition discount rate of 49.1% when calculating $FBOH_1$ for service courses. Assuming an average of 25 students per course, the average

Table 5.6 Service Courses Data

Semester	Number of Service Courses	Average Number of Students per Course
Fall 96	8	22.4
Spring 97	8	30.9
Fall 97	11	28.5

$FBOH_1$ for each of these courses is approximately 92; thus each course contributes greatly to improving the department's $FBOH_1$, and consequently that of the College.

Table 5.7 gives the number of service courses we plan to teach in the next few years, with an average of 25 students per course.

Table 5.7 Projected Number of Service Courses per Semester

Academic Year	97–98	98–99	99–00	00–01	01–02
Service Courses Per Semester	11	12	13	14	15

We also have been teaching service courses during the summers—seven in the summer of 1997—and the plan projects an increase in the number of service courses to be taught in summer. Although we have experienced a lower average enrollment in courses taught during the summer than in those taught during the academic year, Teaching Assistants who teach them during the summer are paid substantially less than those who teach them during the academic year, and they do not receive remitted tuition benefits. Therefore, for an average enrollment of 15 students per course, each course provides an $FBOH_1$ of 103, again assuming the undergraduate tuition discount rate of 49.1%.

Table 5.8 gives the number of service courses taught in the summer of 1997 and the number we plan to teach during the next few summers with an average of 15 students per course.

Table 5.8 Projected Number of Summer Service Courses

Summer	1997	1998	1999	2000	2001
Number of Service Courses	7	7	8	9	10

Each course requires two hours per week of computer laboratory availability. Therefore, using the College's laboratories to deliver 15 service courses per semester will make these laboratories unavailable to other students. The demand to schedule courses in the CMS clusters is increasing substantially. For example, in Fall 1997 we could schedule only one of the four sections of ECS 101 in one of the CMS clusters. We therefore propose that the College incorporate into its plan the construction of a 30-seat PC laboratory for teaching ECS 101, ECS 102 (PC-version), the service courses, etc.

- **Develop Master's Level Courses for Non-EECS Majors**
  We have been very successful in developing and delivering service courses to undergraduate students majoring in programs outside ECS. We propose to develop master's level service courses suitable to be taken by graduate students who are not majoring in ECS. These courses will expose students to the latest technological advances, without relying upon the underlying theory, and will be delivered by EECS doctoral students.

  Dean R. von Dran of the School of Information Studies has expressed an interest in such courses. Courses for other units, such as the S. I. Newhouse School of Public Communications and the School of Management, also could be developed.

- **Develop Requirements for Certificates**
  The concept of certificates may be very appealing to part-time students who do not want to pursue a master's degree, but who would like to take a sequence of four or five courses in a particular area. Instead of a diploma, students would receive a certificate acknowledging that they have successfully completed a series of courses in a specific area. This certificate would be especially appealing to professionals who want retraining.

- **Revise SIS Master's Degree Program Requirements**
  The SIS master's degree program is an interdisciplinary program that combines essential topics in computer science and mathematics with study in another discipline for which computing is relevant. This 33-credit program requires candidates to satisfy a core program by taking at least two courses from the following list:

CIS 622	Concrete Mathematics for Computer Science
CIS 623	Structured Programming and Formal Methods
CIS 645	Combinatorics and Graphics Theory I
CIS 675	Design and Analysis of Algorithms
MAT 605	Fundamentals of Analysis
MAT/IOR 625	Probability and Statistics I
MAT 635	Linear Algebra
MAT 636	Group Theory
MAT 683	Methods of Numerical Analysis I

  As is apparent from the courses in the above list, the core program does not provide the student with a coherent set of courses. Furthermore, all courses listed above are of a theoretical nature, which means that students of a more practical nature are not attracted to this degree.

  We will revise the requirements for this degree to make it attractive to more practically oriented students.

- **Revise SIS Bachelor's Degree Program Requirements**
  The SIS bachelor's degree is an interdisciplinary degree whose program requires that students complete the same core courses that are required of CS majors. Many of these core courses are of a theoretical nature. In order to bring this program more in line with its interdisciplinary nature and attractive to more practically oriented students, we will revise the requirements of this program in Fall 1998.

- **Deliver Service Courses Over the Internet**
  In Fall 1995 we pioneered a service course taught entirely over the Internet. Students were in touch with the instructor via email or telephone. This course was so successful that in the summer of 1996 we developed another service course to be delivered over the Internet. These two courses have in the current semester (Fall 1997) a combined enrollment of 102 students. The $FBOH_1$ generated by these two courses is therefore approximately 291, again assuming the undergraduate tuition discount rate to be 49.1%.

  We will develop a series of new service courses to be delivered over the Internet.

- **Deliver Interactive Multimedia Courses Over Networks**
  Our service courses delivered over the Internet do not require any special classroom setting. However, some more advanced courses cannot be effectively delivered without students being present or telepresent in the classroom.

  The plan calls for the development of courses that can be delivered over the Intranet, the Internet, or dialup networks. Thus, by using multimedia and high-speed networks, students can be telepresent in class and can participate in class discussions. The resources needed for such a project are:

  1. Collaborative environment software
  2. Multimedia server
  3. Dialup capabilities
  4. Synchronous high camera, large TV monitor, projector, multimedia computer

  The resources necessary to deliver these courses are minimal compared with the benefits to be derived by increasing the number of part-time students from local industry. Furthermore, Prof. Salim Hariri has secured a committment from ILINC for free use of its collaborative environment software.

  The plan requests $20,000 to equip a classroom to be used to deliver high-quality interactive multimedia courses over networks.

- **Accreditation for Computer Science Program**
  Our CS undergraduate program is not accredited by the Computer Science Accreditation Board (CSAB).

  In the last few years we have experienced a shift in direction in regard to accreditation. Five years ago the most prestigious CS programs in the country (Carnegie Mellon, MIT, Stanford, and the University of California at Berkeley, among these) were not accredited. Only the CS programs of less well-known departments were accredited. However, the CS programs at MIT and Berkeley are now accredited.

  As a consequence of this accreditation push, most of the CS programs will seek accreditation, and in about five years high school students interested in a CS degree will be electing to attend colleges and universities that have accredited CS programs, just as high school students interested in a career in engineering now elect to attend schools with accredited engineering programs.

The ECS engineering programs will go through an ABET accreditation review in the AY 1999–2000, thus the AY 1999–2000 is a perfect time to seek accreditation for our CS program.

- **Develop Three-Year M.S. Plan for EE**
  The rapid pace of technological change means that people will typically have four to seven career changes in their lifetime.

  In the next millennium we will experience a climate that requires jobs and career changes at a much faster pace than we are now seeing. Therefore, many persons who now belong to the work force will be looking for ways to make a career change.

  A three-year M.S. plan in EE would be attractive to individuals who now have a B.A. or B.S. degree in other areas and thus do not have the appropriate background but would like to work in areas related to EE.

  We already have similar M.S. programs for CE and CS. They require approximately 60 credit hours of course work, of which approximately 30 credits are remedial undergraduate courses that are regularly taught as part of our course offerings.

  The plan calls for developing a three-year program for EE no later than Spring 1998.

- **Raise Quality of Incoming Students**
  Our challenge is to raise the quality of incoming students and at the same time fulfill the enrollment targets set by the plan.

  To accomplish this with undergraduate students, the following steps will be taken:

  - Send our undergraduate programs brochure to high school counselors in regions from which most of our students come.
  - Institute a contest for prospective students who visit campus during Fall and Spring Receptions in order to keep a continuous flow of correspondence between prospective students and the department.

  To raise the quality of our graduate programs, the following steps will be taken:

  - Funds will be available to enable each research group to produce a brochure highlighting its projects. These brochures will be mailed to universities from which most of our graduate students come.
  - A poster highlighting our graduate programs will be produced and mailed no later than September 1998.

- **Improve Ranking of Undergraduate and Graduate Programs**
  Even though our undergraduate programs rank in the nation's top 15% (according to [6]), we must strive to increase this standing. According to the 1993 NRC Report, our CIS and EE doctoral programs lie at the bottom of the second quartile of the nation's research universities. Therefore, we must also strive to increase their rankings.

  In both cases we must first understand the criteria used for the ranking. For this purpose, an ad hoc committee will be formed in Fall 1998 to arrive at specific recommendations for increasing the ranking of our undergraduate and graduate programs.

5.6.2 Faculty Hiring

Table 5.9 summarizes the hiring of new faculty according to the plan delineated in Section 5.5.

Care must be taken to ensure that the faculty we hire are able to make significant and balanced contributions to the future investment areas and to our academic programs. We will look closely at the list of academic areas of need in Appendix A.7.

We will take an active role in seeking applications from minorities and persons belonging to under-represented groups.

Table 5.9 Timetable for Hiring EECS Faculty

AY	1997–98	1998–99	1999–00	2000–01	2001–02
Faculty Search	2 T/TT 1 VF	2 T/TT	1 VF	3 T/TT	
Faculty Joins EECS		2 T/TT 1 VF	2 T/TT	1 VF	3 T/TT
Faculty Leaves EECS				1 VF	
Note: T/TT = Tenured/Tenure-Track Fac.; VF = Visiting Fac.					

5.6.3 Expectations for Each Investment Area

Each of the areas of future investment is expected to

- submit at least one major group proposal requesting funds to support research every year. The first proposal is to be submitted no later than December 1998;
- submit at least one major proposal requesting funds to set up/upgrade laboratories every year. The first proposal is to be submitted no later than December 1998;
- develop a cohesive sequence of graduate and undergraduate courses that are related to the research of the area of future investment for approval by the EECS and ECS faculties in Fall 1998;
- develop a seminar series;
- have a strong publication record;

- produce by the end of the spring semester of 1998 material for publicizing the research area (such as a descriptive brochure, Web page, etc.);
- develop a three-year detailed plan by the end of January 1998.

Chapter 6

Phase II: Implementation and Assessment

Figure 6.1 shows the flow of objectives for Phase II. Approval by the ECS College faculty of any changes in programs/courses, bylaws, etc., approved by the EECS faculty during Phase II will be sought during the Fall 1998 semester.

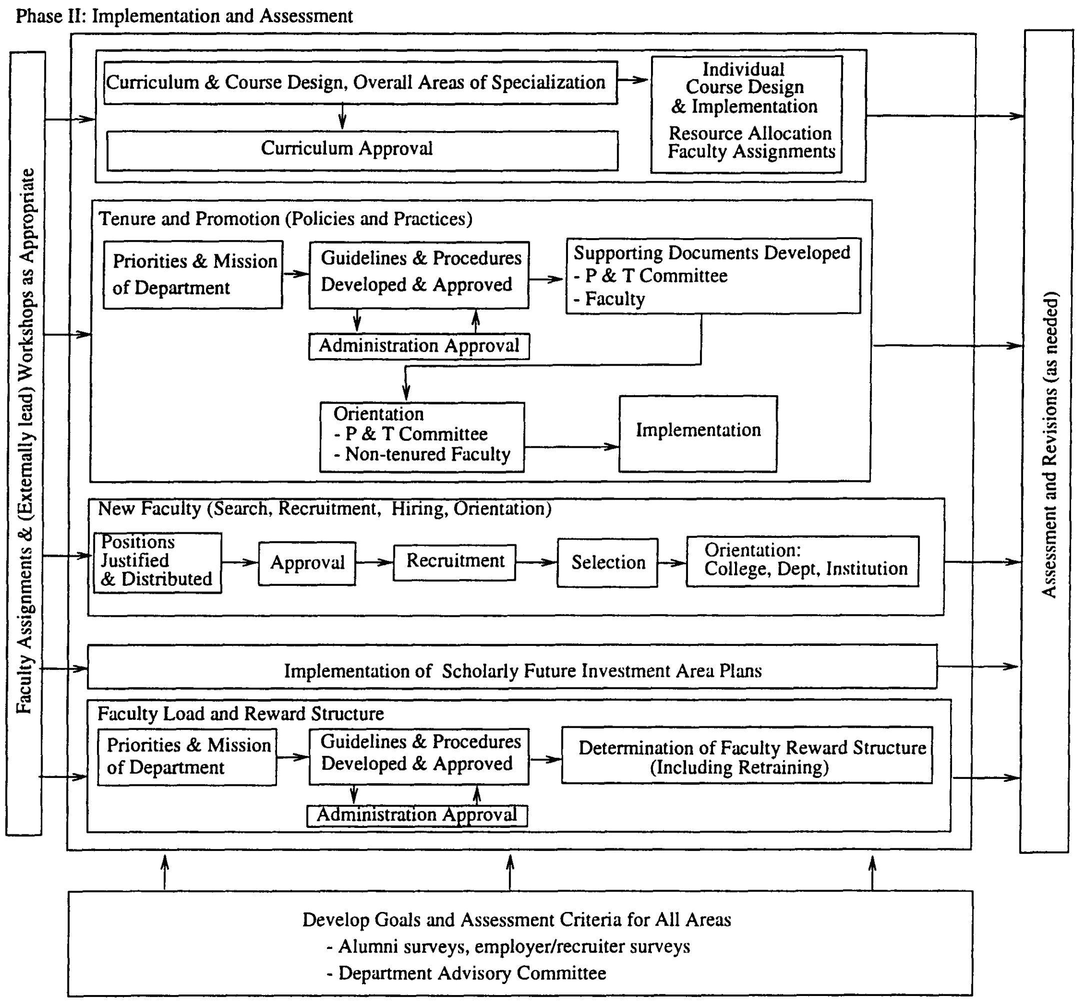


Figure 6.1 Flow of Objectives for Phase II

Phase II is a detailed design of:

- CE, CS, and EE curricula, based on general educational outcomes and selection of academic areas of emphasis;
- tenure and promotion policies and practices;
- search and integration of new faculty into the department;
- implementation of the scholarly areas of future investment;
- faculty reward structure, based on the department's mission and priorities.

Each of the above areas will have its own working group.

6.1 Externally Facilitated Working Groups

In each of the above areas, with the exception of the implementation of plans for scholarly areas of future investment, we can use generally applicable development processes. Diamond in his book, *Designing and Assessing Courses and Curricula: A Practical Guide* [3], outlines numerous processes for curriculum and course development, tenure and promotion, and design of faculty reward structures. Tierney and Bensimon in their book, *Promotion and Tenure: Community and Socialization in Academe* discuss ways to support newly hired faculty.

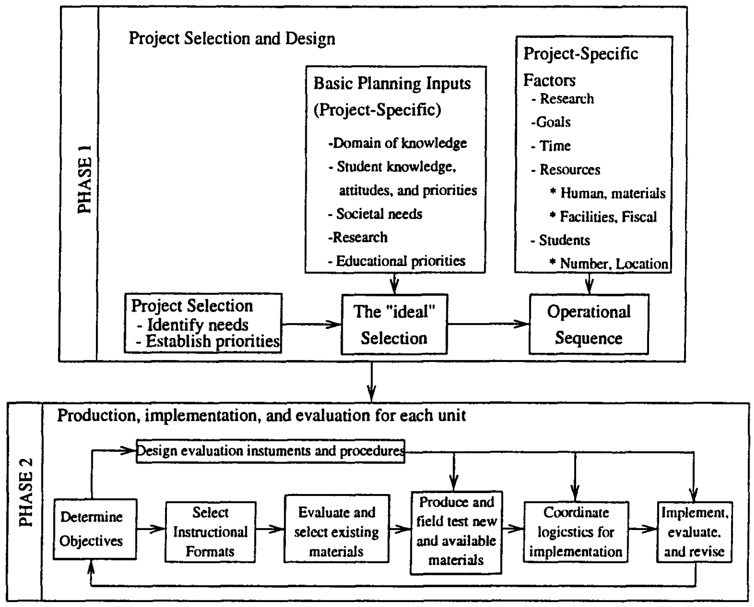
Robert Diamond and the staff of the Center for Instructional Development (soon to be renamed the Center for the Support of Teaching and Learning) will facilitate the subcommittees in these *processes.* While the processes and questions are generic and are adaptable to our situation, the *content* is specific to CE, CS, and EE. The department, not the facilitators, is responsible for content.

The advantage of using process facilitators from outside the department is that they support a process that is open and fair. Specifically, all faculty members will have an opportunity to participate fully. The facilitators will not have a technical point of view to promote, but are responsible for helping us through the process. This will minimize conflicts of interest between governance of the development process and technical points of view. Also, as they are experienced with the design of other curricula and courses, we will be able to follow the best practices in this area, which will strengthen our case for accreditation.

6.2 Curriculum and Course Design

Figure 6.2 gives an overview of the curriculum development process described in [3]. (Note that "Phase 1" and "Phase 2" in the figure are not the same as "Phase I" and "Phase II" of the Strategic Plan).

A key part of the design process is the development of the "ideal sequence" before deciding on the actual or "operational sequence." Identification of the ideal better supports the identification of educational outcomes and prevents inaccurate and premature assumptions about resource constraints from affecting the design.



Source: Robert M. Diamond

Figure 6.2 Process for Curriculum Development

6.3 Tenure and Promotion

The current department came from the merger of the Department of Electrical and Computer Engineering with the School of Computer and Information Science. The tenure and promotion practices of both need to be reconciled in sensible ways. Although what constitutes scholarship differs among fields, as noted in Section 5.2, there are features common to all fields that are the basis for evaluating scholarly work. Furthermore, as there is now an equal emphasis on teaching and academic programs, tenure and promotion policies and practices must be consistent with this.

6.4 New Faculty

The remaining tasks for hiring new faculty are recruitment, selection, and orientation. As we have just finished Phase I, we are in a good position to state our scholarly and academic goals. Given that we are a student-centered research university and that our department goals give equal weight to scholarship and academic programs, the new faculty we recruit must be able to contribute to both research and teaching. This must be stated explicitly as part of our search plan.

Faculty selection will be made while keeping in mind research investment areas and academic program needs. Orienting and supporting new faculty when they arrive is crucial to maximize their chances of success, both personally and from the point of view of supporting the department's goals.

6.5 Implementation of Scholarly Investment Area Plans

By the end of January 1998 each investment area will have submitted its plans for developing research, funding, and education programs. These plans will be put into action and each area will be evaluated based on the plans it submitted.

6.6 Faculty Reward Structure and Retraining

Setting priorities and planning strategically are meaningless unless the department faculty are rewarded for making and supporting the changes. As some areas of research and teaching will be emphasized over others, faculty who wish to change areas will be supported in making those changes. They will be given reduced teaching loads during this transition period and will have funds available to attend classes, workshops, conferences, etc.

Chapter 7

Projection of Fiscal Performance

As pointed out in Section 5.1, the fiscal performance of EECS for the FY 1996–97 was outstanding as measured by the metrics adopted by Syracuse University. The $FBOH_1$ ($FBOH_2$) for the FY 1996–97 for EECS stands at 57 (69), far above the Dean's target of 25 (50) for ECS in the FY 1999–2000. The increase of the EECS $FBOH_1$ for FY 1996–97 when compared with that of FY 1995–96 was 217%, while the increase of the EECS $FBOH_2$ was 187%.

Even though our performance was spectacular, our plan calls for

- an increase in the number of undergraduate and graduate credit hours taught by EECS, and
- practically unchanged indirect cost (IDC) revenue.

7.1 Revenue

- **Undergraduate Tuition**
  Table A.9 shows an increase in the undergraduate credit hours taught by EECS. We predict that this trend will continue, and the strategic plan predicts that in the FY 2001–02 the number of undergraduate credit hours delivered by EECS will be at least 9,542, which is 1,202 more credit hours than taught in the FY 1996–97. We point out here that the number of undergraduate credit hours taught by EECS in the FY 1996–97 is 2,304 more than in the FY 1992–93, therefore we have already increased the number of credit hours by twice as much for the same period. Furthermore, of these 1,202 credit hours, 1,184 will come from service courses.

  Credit hours will come from three sources, namely:

  - 5,342 credit hours from undergraduate EECS students
  - 2,700 credit hours from service courses
  - 1,500 credit hours from non-EECS students taking departmental courses or EECS students retaking courses in their majors

  Appendix C includes a rationale for predicting the number of credit hours of undergraduate instruction during FY 2001–02 as depicted above. In Appendix C we also give the rationale for the claim that in FY 1997–98 EECS will deliver approximately 8,578 undergraduate credit hours of instruction.

  Table 7.1 shows the plan's prediction of the number of credit hours of undergraduate instruction to be delivered by EECS.

Table 7.1 Prediction of EECS Undergraduate Credit Hours

FY	1997–98	1998–99	1999–00	2000–01	2001–02
# Cred. Hrs.	8,578	8,778	8,998	9,248	9,542

- **Graduate Tuition**
  Table A.9 shows a substantial decrease in the number of graduate credit hours delivered by EECS from FY 1992–93 to FY 1996–97. A large part of this decrease can be attributed to the closing of the off-campus centers. We also note that in the last five fiscal years, 1996–97 marks the first FY in which we have experienced an increase in the number of graduate credit hours taught by EECS.

  Table 7.2 shows the number of graduate credit hours taught by EECS during Summer and Fall of 1996 and 1997. For Fall 1996 and 1997, data does not include credit hours attributed to independent studies, master's theses, or doctoral theses.

Table 7.2 Graduate Credit Hours Delivered by EECS

	1996	1997	Increase
Summer	980	1,295	32%
Fall	2,592	2,916	12%

We predict that this upward trend will continue, and the plan calls for an increase in the number of graduate credit hours to be delivered by the department. We estimate this number for the FY 1997–98 using the following assumptions:

- The number of credit hours attributed to independent studies, master's theses, or doctoral theses delivered by EECS during Fall 1997 is the same as in Fall 1996.
- The total number of credit hours delivered by EECS during Spring 1998 will be the same as in Spring 1997.

Under the above assumptions, the estimated number of graduate credit hours to be delivered in FY 1997–98 is 7,690, a 9% increase over those delivered in FY 1996–97. We estimate that a yearly increase will continue for the next four years. The number of credit hours to be delivered by EECS in the next few years is predicted to be as shown in Table 7.3.

Table 7.3 Prediction of Graduate Credit Hours to be Delivered by EECS

FY	1997–98	1998–99	1999–00	2000–01	2001–02
No. Credit Hrs.	7,690	7,843	8,079	8,402	8,822

This prediction is based upon the following facts:

- There is an (estimated) 9% increase in graduate credit hours in FY 1997–98.
- An increase of 21% in the SU international student population has occurred in AY 1997–98, most of whom are in the sciences, management, and engineering.[1]
- Most of our graduate students are international students. Note: 82% of the graduate students in the core courses being taught in Fall 1997–98 are international students.
- The visibility afforded our department by research areas of future investment will attract graduate students to our programs.
- Syracuse University Continuing Education–University College (UC) is formulating a plan to advertise our professional master's programs.
- The Web page being developed this semester will substantially increase our visibility and will make it easier for students to apply.

- **Sponsored Research**
  As explained in Section A.5, the $FBOH_2$ metric includes indirect cost (IDC) revenue as a component of the net income credited to an academic unit.

  As Table A.11 shows, in the last four fiscal years an increase in IDC revenue has been secured by EECS faculty. An estimate of IDC revenue for EECS during calendar year 1997 follows. From 1/1/97 through 8/31/97, IDC revenue generated by EECS was $317,863. A linear prediction of IDC revenue for the entire year of 1997 is $476,794. Since more IDC revenue is generated during the summer, we predict that IDC revenue for EECS in 1997 will be $427,000, which is approximately the same as in 1996.

  In the next few years there will be two opposing forces acting upon the expected amount of external funding to be secured by the EECS faculty.

  On one side we have the following facts that tend to decrease the amount of external funding:

  - Department of Defense funding for research and development is predicted to be substantially cut in FY 1998 and 1999.
  - NSF funding is increasing; however, the awards are on the average around $100,000 a year per faculty member. These awards are not sufficient to support large projects.
  - Industrial contracts are even smaller than NSF awards. They average around $35,000 a year per faculty member.

  On the other side we have the following facts that tend to increase the amount of external funding:

  - A reward system that rewards faculty for seeking external funding will be in place in Spring 1998.

[1] "SU international population increases," *The Daily Orange*, SU's Student Paper, October 6, 1997.

- The research areas of future investment will foster collaborative research efforts among faculty, and as a consequence more opportunities for external funding will arise.
- Seven new faculty members will contribute to the increase of the total amount of external funding secured by EECS faculty.

For these reasons, we predict, as shown in Table 7.4, a very slow growth in the IDC to be secured by EECS faculty in the next four years.

Table 7.4 Projection of IDC Revenue for EECS

Year	1997	1998	1999	2000	2001
IDC Revenue	$427,000	$440,000	$450,000	$460,000	$470,000

7.2 Budget

The items discussed in this section serve as an explanation for the changes in the budget for the FY 1998–99 through FY 2001–02 in comparison to the budget for FY 1997–98. The budget for FY 1997–98 and the requested budget for FY 1998–99 through FY 2001–02 are shown in the table given at the end of this chapter.

- **Faculty AY Salary**
  This line reflects: the retirement of three tenured faculty and one part-time faculty in May 1998; the assumption that Prof. A. Choudhary will not return to EECS; the hiring of tenured/tenure-track faculty according to the schedule presented in Section 5.6.2; and the visiting position requested, starting in the AY 1998–99.
- **Exempt Staff**
  This line reflects the departure of a staff member.
- **Nonexempt Staff**
  This line reflects the addition of two new staff positions.
- **Technical Staff**
  This line reflects the hiring of a laboratory technician.
- **Teaching Assistants**
  This line reflects an increase in the number of Teaching Assistants (TAs). The rationale for this increase is based on the following algorithm:
  1. One TA is assigned to every service course.
  2. Every non-service course will be assigned a TA according to the number of students in the course. For every 25 students, one TA will be assigned. In other words, if N is the number of students in the course, then $\lfloor N/25 \rfloor$ TAs will be assigned to this course; $\lfloor x \rfloor$ is the integer portion of x.

  The number of TAs specified by the above algorithm for this and the last two semesters is given in Table 7.5. This data was obtained under the assumption that only one TA is assigned to ECS 102.

At the present time EECS has only 40 TAs, therefore the plan will stipulate a large increase in this number.

Table 7.6 specifies the number of Teaching Assistants and Teaching Associates requested in the plan for AY 1998–99 through AY 2001–02. The entries in this table also assume that ECS 102 will require only one TA.

Table 7.5 Number of TAs Specified by Algorithm

Semester	Fall '96	Spring '97	Fall '97
Number of TAs for Service Courses	8 (average of 22.4 students/course)	8 (average of 30.9 students/course)	11 (average of 28.5 students/course)
Number of TAs for Non-service Courses	43	36	49
Total number of TAs	51	44	60

Table 7.6 Projection of TAs Required

AY	1997–98	1998–99	1999–00	2000–01	2001–02
Number of TAs for Service Courses	11	12	13	14	15
Number of TAs for Non-service Courses	29	31	34	38	45
Total Number of TAs Requested	40*	43	47	52	60

*Already assigned to EECS

- **Adjunct Faculty**
As a consequence of new faculty being hired, we plan to decrease the number of courses taught by Adjunct Professors. However, we must bear in mind that incoming Assistant Professors will teach only two courses per AY for the first two years. Therefore, a decrease in the resources devoted to paying adjunct faculty is reflected in the later years of the plan.

- **Summer Appointments**
The amount on this line normally reflects the following payments:

  – two months' salary for Chairperson
  – one month's salary for each Program Director

The plan requests additional resources to compensate faculty members who are advising and who are responsible for the active admission processes of all our master's students. These faculty members advise approximately 250 students and process about 500 applications per year. Compensation for one month for the three faculty members is incorporated within the plan.

- **Graduate Associates**
  No change.

- **Operating Funds**
  An increase beyond that stipulated in the Strategic Plan of the College is requested in order to reflect the increase in the teaching and research activities of the department as predicted by the plan.

- **Equipment**
  The plan also requests an increase in the resources for equipment beyond that stipulated in the Strategic Plan of the College. It is imperative that we constantly upgrade our laboratories and computer laboratories. These facilities play an important role in the recruiting of both graduate and undergraduate students.

7.3 Adjustments

In this section we examine items that must be considered in determining the net income accrued by EECS.

- **Financial Aid**
  Undergraduate students receive from the university a return on tuition paid in the form of need-and-merit-based aid. The *tuition discount rate* is a figure that expresses the average percentage of tuition returned to students as financial aid. In 1996–97 the university-wide tuition discount rate was 37.7%, while in ECS it was 49.1%. Therefore, in calculating the net income from undergraduate tuition (gross undergraduate tuition income, less financial aid), we will use 49.1% as the tuition discount rate.

  Graduate students also receive financial aid. This financial aid takes several forms, namely:

  - Graduate credit hours used by TAs from their graduate scholarship awards (24 credit hours per year per award)
  - Tuition awards associated with University Fellowships (30 credit hours per year per award)
  - OSP tuition as cost sharing on research grants/contracts
  - Graduate scholarship awards provided by the Graduate School (24 credit hours per year per award)
  - Tuition waivers provided by the Graduate School (60 credit hours per year for EECS)

For purposes of planning for the next four years the following assumptions were made:

- On an average each TA will use 18 of the 24 credit hours awarded each year. The rationale is that TA-ships are usually awarded to doctoral students who take an average of five years to complete the Ph.D. degree after finishing a bachelor's degree. If the doctoral program requires 78 credit hours after the BS degree (CE and EE), the average number of credit hours used by a TA is 16 per year. If the doctoral program requires 90 credit hours (CIS), the average number of credit hours per year is 18. (We take the conservative assumption of 18.)
- We also assume that each University Fellow, on an average, will use 18 of the 30 credit hours awarded each year.
- OSP will provide, on the average, 150 credit hours per year as cost sharing on research grants/contracts.
- The Graduate School will provide yearly 152 credit hours (three scholarships of 24-credit hours of tuition and 80 credit hours to be dispersed in smaller amounts).

- **Summer Teaching**
In the summer of 1997 the faculty of EECS taught 18 sections of 17 different courses. We predict that by the summer of 2001 we will teach 22 sections of courses, an increase of one course a year. For each section taught, UC pays 12.5% of the AY salary of the faculty teaching the courses. We will assume that UC pays, on an average, $8,600 for each course taught. Furthermore, UC pays a maximum of $2,200 to Teaching Assistants to teach service courses during the summer.

FISCAL DATA

Core Budget	*All figures for 1998-99 and beyond in 1997-98 dollars*				
Fiscal Year	1997–98	1998–99	1999–00	2000–01	2001–02
Fac. AY salary	2,338,503	2,263,991	2,443,991	2,443,991	2,643,991
Exempt Staff	170,548	133,278	133,278	133,278	133,278
Nonexempt Staff	122,950	160,220	160,220	160,220	160,220
Technical Staff	61,475	101,475	101,475	101,475	101,475
Teaching Ass'ts	359,000	392,900	431,900	479,700	556,300
Adjunct Fac.	70,000	70,000	60,000	40,000	20,000
Summer App'ts	48,193	73,693	73,693	73,693	73,693
Grad. Associates	31,800	31,800	31,800	31,800	31,800
Operating Funds	305,000	340,000	360,000	380,000	405,000
Equipment	90,000	120,000	160,000	200,000	250,000
Core Total	3,597,469	3,687,357	3,956,357	4,044,157	4,375,757
Div. Portion of ECS Central Costs	275,000	275,000	275,000	275,000	275,000
Summer–UC	170,200	178,800	189,600	200,400	211,200
Adjusted Total	4,042,669	4,141,157	4,420,957	4,519,557	4,861,957

Salary Summer Courses–UC					
Summer	# Summer Courses	Salary Faculty	#Service Courses	Salary Students	Total Salary
1997	18	$154,800	7	$15,400	$170,200
1998	19	163,400	7	15,400	178,800
1999	20	172,000	8	17,600	189,600
2000	21	180,600	9	19,800	200,400
2001	22	189,200	10	22,000	211,200

Financial Aid													
AY	#TAs	#Cred.	#TA Aid	#Fellows	#Cred.	Fellow Aid	Waiver Creds.	Waiver Aid	OSP Creds.	OSP Aid	Grad. Aid	UGrad. Aid	Total Aid
1997-98	40	18	$380,880	6	18	$57,132	152	$80,408	150	$79,350	$597,770	$2,463,902	$3,061,672
1998-99	43	18	409,446	7	18	66,654	152	80,408	150	79,350	635,858	2,521,349	3,157,207
1999-00	47	18	447,534	8	18	76,176	152	80,408	150	79,350	683,468	2,584,541	3,268,009
2000-01	52	18	495,144	9	18	85,698	152	80,408	150	79,350	740,600	2,656,349	3,396,949
2001-02	60	18	571,320	10	18	95,220	152	80,408	150	79,350	826,298	2,740,796	3,567,094

Fiscal Projection	*All figures for 1998-99 and beyond in 1997-98 dollars (Grad tuition = $529/cr, UG tuition = $585/cr, UG tuition discount rate = 49.1%).*										
Fiscal Year	UG Credits	Grad Credits	Total Credits	Gross Tuition	Financial Aid	Net Tuition Income	IDC IMG	Total Increase	Adjusted Budget	$FBOH_1$	$FBOH_2$
1997–98	8,578	7,690	16,268	$ 9,086,140	$3,061,672	$6,024,468	$427,000	$6,451,468	$4,042,669	49	60
1998–99	8,778	7,843	16,621	9,284,077	3,157,207	6,126,870	440,000	6,566,870	4,141,157	48	59
1999–00	8,998	8,079	17,077	9,537,621	3,268,009	6,269,612	450,000	6,719,612	4,420,957	42	52
2000–01	9,248	8,402	17,650	9,854,738	3,396,949	6,457,789	460,000	6,917,789	4,519,557	43	53
2001–02	9,542	8,822	18,364	10,248,908	3,567,094	6,681,814	470,000	7,151,814	4,861,957	37	47

Chapter 8

Summary and Conclusions

8.1 Summary of Resources Requested

A summary of the resources requested by the plan follows.

8.1.1 Personnel

Table 8.1 Personnel Lines Requested

AY	Personnel Lines
1997–98	• One technical staff person
1998–99	• Two tenured/tenure-track faculty •One visiting faculty
1999–00	• Two tenured/tenure-track faculty
2000–01	• None
2001–02	• Three tenured/tenure-track faculty

8.1.2 Infrastructure Resources

Table 8.2 Infrastructure Resources Requested

AY	1997–88	1998–99	1999–00	2000–01
Resources Requested	$55,000	$400,000	$250,000	$130,000

8.2 Conclusions

The ongoing strategic planning process we are using consults the entire faculty, is comprehensive, phased, based on principles endorsed by the department faculty, and is selectively facilitated by knowledgeable people outside the department. The plan is comprehensive, as it includes vision and mission statements, identification of areas of investment for scholarship, identification of areas of emphasis for academic programs, curriculum and course design, assessment, new faculty hiring and orientation, and faculty reward structures. The first phase, which is now complete, dealt with vision, mission, general educational outcomes, and identification of areas of investment for scholarship. Phase II, which will be started soon and completed in the Fall 1998 semester, deals with the identification of areas of academic emphasis and the detailed design of curricula, courses, assessment mechanisms, hiring of new faculty, and faculty reward structures.

The basic principles followed in the strategic planning process are as follows:

- *The process must be fair and open.* All decisions are reviewed by all the department faculty and voted upon by the faculty.
- *The process must engage the faculty.* Faculty are consulted on all parts of the process.
- *The process uses outside facilitators.* The use of outsiders who are familiar with strategic planning and curriculum development allows the department faculty to concentrate on the content of the plan and curricula.
- *The process establishes criteria prior to decisions on scholarly and academic programs.* Agreeing on criteria before deciding on what to emphasize in the scholarly and academic programs reduces the likelihood of personal conflicts and gives decisions a rational basis.

The process so far has been successful. There was participation of over 75% of the department's faculty. The strategic plan has been modified and vastly improved by several faculty members and faculty committee inputs. The four investment areas for scholarship are much more inclusive and far-reaching than originally anticipated. Faculty in these areas are already collaborating on research proposals and educational initiatives. The goals of the process so far have been met. Faculty perceive that they were consulted and engaged in significant ways in the strategic plan. While many faculty meetings were held to discuss and approve various portions of the plan, faculty attendance at meetings *increased* over time.

The keys to engaging the faculty were the mechanisms used to keep the process open and fair. The central concept was the explicit identification and approval of the *criteria* to be used for decisions. This created common ground with enough detail so that competing proposals could be evaluated fairly and openly based on their merits. In fact, each proposal was improved by using approved criteria as those criteria identified weak areas that were strengthened in later revisions.

At this point, the faculty have a better sense of cohesiveness among the department's three major programs of computer engineering, computer science, and electrical engineering. As an indication of this increased cohesiveness, the faculty is in the process of adopting a single uniform guideline for Ph.D. studies in the three programs.

Our success to date runs counter to the common wisdom that it is impossible to engage the faculty of an entire department in planning efforts. While it was tempting for the department chair and a small group of faculty to write the entire plan and make all the decisions, this process that consulted the whole faculty produced a vastly superior plan that is now endorsed and owned by the whole department. We are eagerly anticipating the detailed design process in Phase II.

Appendix A

Self-Assessment Data

A.1 Academic Programs

Within EECS there are four B.S. degree programs, five M.S. degree programs, two engineer degree programs, and three doctoral degree programs. In addition, EECS offers four minors and two graduate-level certificates.

- **Undergraduate Programs**
  All of our undergraduate degree programs have been recently revised to give the flexibility to students to tailor their programs of studies to their own professional interests and to pursue a variety of minors. This flexibility provides an opportunity for students to broaden their educational experience and prepare themselves to pursue careers in fields outside engineering and computer science if they so desire.
  - B.S. in Computer Engineering (CE)
    * Minimum number of credit hours required: 130
    * Accreditation: ABET accredited in 1993 for a maximum six-year term
    * Last program revision: AY 1996–97
    * Short description: Computer engineering studies the design of the hardware for digital systems, including computers, the interface between software and hardware—including device drivers, microcode, and moving software functions into hardware—and the engineering design of software systems, usually termed software engineering.
    * Distinctive features: The program has been revised to provide more flexibility in the curriculum, permitting the student to create a program that is specific to computer engineering, or is more general and includes a technical track from within the College. A student can complete a minor, although some technical minors may require additional course work.
  - B.S. in Computer Science (CS)
    * Minimum number of credit hours required: 122
    * Accreditation: not accredited; planning to apply for accreditation in 1999
    * Last program revision: AY 1995–96
    * Short description: Computer science focuses on programming, algorithms, large-scale software development, and the principles of computing that underlie these areas. Syracuse's program weaves together an emphasis on fundamental principles with new developments in computing, producing graduates prepared either to begin careers or to pursue advanced studies in the field.
    * Distinctive features: The program readily permits a minor in any field of interest, or even a few minors. Double majors with other technical fields, especially mathematics, may also be undertaken, usually without extra course work.

Table A.1 The Gourman Report's Ranking of CE, CS, and EE Undergraduate Programs

B.S. Program	Ranking	Score of a Maximum of 5.0
Computer Engineering (CE)	14	4.35
Computer Science(CS)	37	3.80
Electrical Engineering (EE)	39	4.30

- B.S. in Electrical Engineering (EE)
  * Minimum number of credit hours required: 132
  * Accreditation: ABET accredited in 1993 for a maximum six-year term
  * Last program revision: AY 1996–97
  * Short description: The electrical engineering program provides fundamental knowledge on analog and digital circuits, time and frequency domain signals and systems, electronic devices, and electromagnetics. Application areas emphasized include communications, robotics and controls, electromechanical devices, and integrated circuits.
  * Distinctive features: Has the flexibility to concentrate on electrical engineering or to customize the curriculum with up to three minors. Attention is given to each individual student.
- B.S. in Systems and Information Science (SIS)
  * Minimum number of credit hours required: 122
  * Accreditation: none exists
  * Last program revision: AY 1995–96
  * Short description: The interdisciplinary program in systems and information science is offered to students interested in integrating the ideas and techniques of computing with other areas such as education, engineering, management, visual and performing arts, the sciences, and a host of areas that can be enhanced by computers.
  * Distinctive features: In effect, this program permits the student to design an individualized major combining a solid grounding in computer science with study in some other field of interest, consulting with and obtaining the approval of the faculty in both areas. Minors or a double major may be part of the program as well.
- Minors in EECS
  The department offers minors in computational science, computer engineering, computer science, and electrical engineering. These minors allow students both within the College and outside the College to complement their knowledge by fulfilling the requirements for one or more of the above minors.
- Ranking
  The Gourman Report, 1997 edition [6], has ranked three of our undergraduate programs as depicted in Table A.1.

  These undergraduate programs are ranked among the top 15% of the undergraduate programs in the nation. The *Fiske Guide to Colleges—1998* [5] has listed the computer science program among the 12 strongest undergraduate programs of Syracuse University.

- **Master of Science Programs**
  All of our master's programs have a thesis or non-thesis option and, of these, three are professional master's programs that can be completed within a one-year period. Most of our graduate courses are taught as evening classes in order to facilitate the completion of the programs of study of part-time masters students from local industry.

  Our programs are designed to develop technical depth and professional expertise in modern technologies. The EECS faculty has a unique mix of backgrounds in research, teaching, and industrial experience.

  - M.S. in Computational Science
    * Minimum credit-hours requirement: 33
    * Time requirement: designed to be completed in more than one year
    * Short description: Using parallel computers, students learn to develop software for challenging scientific and engineering calculations. The program provides a thorough grounding in computing and numerical algorithms.
    * Distinctive features: Students use advanced parallel and distributed computing facilities to address difficult problems in many disciplines.
  - M.S. in Computer Engineering
    * Minimum credit-hours requirement: 30
    * Time requirement: designed to be completed in one year
    * Short description: Brings a student to a mastery of material related to the engineering design of computer hardware and software. Although the emphasis on hardware and software research is not equal, significant examples of both are available to students.
    * Distinctive features: Major areas of concentration are VLSI/CAD, distributed computing, and object-oriented design.
  - M.S. in Computer Science
    * Minimum credit-hours requirement: 33
    * Time requirement: designed to be completed in one year
    * Short description: This program provides advanced study of both the theory and the practice of computer science for professionals who must not only adapt to continuing technological advances but also contribute to those advances.
    * Distinctive features: The program covers a variety of topics in current computing techniques as well as a penetrating study of foundations. Otherwise well-prepared students without extensive backgrounds in computer science may complete the degree in three years, taking approximately 30 credits of preparatory, undergraduate courses.
  - M.S. in Electrical Engineering
    * Minimum credit-hours requirement: 30
    * Time requirement: designed to be completed in one year

    * Short description: Provides electrical engineering students advanced education in a selection of areas in addition to core subjects; offers students an opportunity to take part in state-of-the-art research programs.
    * Distinctive features: Provides a choice of several electrical engineering areas on which to focus; students may complement electrical engineering education with a coherent selection of courses in other relevant programs.
  - M.S. in Systems and Information Science
    * Minimum credit-hours requirement: 33
    * Time requirement: designed to be completed in more than one year
    * Short description: This interdisciplinary program combines essential topics in computer science and mathematics with study in another discipline, chosen by the student with CIS approval, for which computing is relevant.
    * Distinctive features: Students design their own programs of study in close consultation with the faculty. Proposed programs must be approved by a faculty committee.
  - Master's Level Certificate in Computational Science
    * The computational science master's level certificate recognizes that a student has acquired knowledge about computing and about computational techniques and how to apply them in a primary field of study. This certificate is available to any graduate student who obtains a master's or doctoral degree from Syracuse University and whose courses satisfy the requirements of this certificate.

- **Engineer Programs**
  The degrees of Electrical Engineer and Computer Engineer allow qualified students to pursue their graduate education beyond the master's degree. These programs provide mastery of a field of knowledge and familiarity in related fields, and they help students develop a capacity for independent study. The program consists of course work, qualifying examinations, and a project. Students must complete 60 credits beyond the bachelor's degree, including six credits for the engineering degree project.

- **Doctoral Programs**
  The doctoral programs emphasize mastery of a field of knowledge, familiarity with allied areas, aptitude in the use of research techniques, and responsibility for the advancement of knowledge.
  - Ph.D. in Computer Engineering (CE)
    * Minimum credit hours required beyond a B.S.: 78
    * Short description: Extends the breadth of an M.S. degree and permits research in a variety of areas, including software engineering, multimedia, high-assurance systems, distributed computing hardware and software, CAD design tools, and systems high-assurance systems.
    * Distinctive features: Awards a significant number of degrees each year. Faculty are interested in a variety of topic areas.
  - Ph.D. in Computer and Information Science (CIS)
    * Minimum credit hours required beyond a B.S.: 90

    * Short description: The Ph.D. program combines advanced study with research in computer science or computational science. Areas of research include logic programming, neural networks, artificial intelligence, algorithms, parallel and distributed computing, programming languages, semantics, and complexity.
    * Distinctive features: A number of faculty and students work in high-performance parallel and distributed computing, including distributed information systems and web techniques. There are also active research groups in evolutionary computing, formal methods, coding, and theoretical subjects.

- Ph.D. in Electrical Engineering (EE)
    * Minimum credit hours required beyond a B.S.: 78
    * Short description: The Ph.D. in electrical engineering involves advanced course work with depth and breadth as well as original research. Areas of specialization include communications, signal processing, electromagnetics, photonics, VLSI, and intelligent systems.
    * Distinctive features: Dedicated faculty with extensive research experience and external funding; research opportunities in forward-looking areas.

- Doctoral-Level Certificate in Computational Science
    * The computational science doctoral-level certificate recognizes that a student has acquired knowledge about computing and about computational techniques and how to apply them in a primary field of study, and has made a contribution to computational science through the research of the dissertation. This certificate is available to any graduate student who obtains a doctoral degree from Syracuse University and who satisfies the requirements of this certificate.

- Ranking
  The 1993 National Research Council (NRC) report ranked our doctoral programs in computer and information science (CIS) and electrical engineering (EE) as depicted in Table A.2. No ranking of doctoral programs in computer engineering was provided in the NRC report.

Table A.2 NRC ranking of CIS and EE doctoral programs

Doctoral Program	Ranking	Total Programs Ranked
Computer and Information Science (CIS)	44	108
Electrical Engineering (EE)	49	126

The 1993 NRC report placed both the CIS and EE doctoral programs in the second quartile of the nation's research universities. Provision must be made in our strategic plan for increasing the ranking of our doctoral programs.

A.2 Personnel

- **Faculty**
  In AY 1997–98 there are:
  - 31 tenured/tenure-track faculty members. Of these, 8 are affiliated with CE programs, 11 are affiliated with CIS programs, and 12 with EE programs.
  - 1 part-time faculty
  - 2 research faculty
  - 2 visiting faculty

  The list of EECS faculty, with a short description of their research interests, is given below. It is important to mention that Professors Robert Sargent, Edward Stabler, and Donald Weiner will retire in May of 1998.

  Ercument Arvas Professor; Ph.D., Syracuse University, 1983; electromagnetic theory, transmission lines, microwave engineering, engineering math, digital signal processing

  D. Paul Benjamin Visiting Assistant Professor; Ph.D., New York University, 1985; theory formulation and its application to software design; problem solving in artificial intelligence and robotics

  Howard A. Blair Associate Professor; Ph.D., Syracuse University, 1980; mathematical logic in computer science and artificial intelligence; logic programming

  Per Brinch Hansen Distinguished Professor; Dr. Techn., Technical University of Denmark, 1978; programming languages for concurrent systems

  Chien-Yi (Roger) Chen Associate Professor; Ph.D., University of Illinois, 1987; multimedia object-oriented databases; multimedia transport protocols; network performance modeling; and VLSI/CAD

  Shiu-Kai Chin Associate Professor; Ph.D., Syracuse University, 1986; computer-aided design; VLSI design; formal methods; computer security; software engineering

  Alok Choudhary Associate Professor; Ph.D., University of Illinois, 1989; high-performance computing and communications; system software, compilers; multimedia systems and databases; input-output

  James W. Fawcett Part-time Associate Professor; Ph.D., Syracuse University, 1981; software, control systems, computers, communications

  Garth H. Foster Professor; Ph.D., Syracuse University, 1966; APL; prototyping; computer applications

Geoffrey C. Fox Professor; Ph.D., Cambridge University, 1967; supercomputer; parallel architectures; concurrent algorithms and their applications in industry and academia

Prasanta Ghosh Associate Professor; Ph.D., Pennsylvania State University, 1986; microelectronics; solid-state devices; optoelectronics; thin film processes; power engineering

Amrit L. Goel Professor; Ph.D., University of Wisconsin, 1968; software engineering; metrics; testing; reliability; object-oriented metrics and testing; fault-tolerant software; applications of neural networks in software engineering

Salim Hariri Associate Professor; Ph.D., University of Southern California, 1986; high-performance distributed computing; high-speed communication protocols and networks; software tools for parallel and distributed computing

Carlos R. P. Hartmann Professor; Ph.D., University of Illinois, 1970; coding theory; fault detection in digital circuits; data compression

Can Isik Associate Professor; Ph.D., University of Florida, 1985; robotics; control theory; computational intelligence; applications of neural nets and fuzzy logic

Kamal Jabbour Associate Professor; Ph.D., University of Salford, 1982; computer networks; computer applications to power systems

Yaoguo Jia Visiting Professor; Ph.D., Syracuse University, 1985; computer architecture; software and systems

Douglas V. Keller, Jr. Research Professor; Ph.D., Syracuse University, 1958; surface and interfacial science of materials—in particular, adhesion and wetting phenomena; coal science; separation science; friction; lubrication; wear

Philipp Kornreich Professor; Ph.D., University of Pennsylvania, 1967; fiber light amplifiers; lasers; image propagation through fibers

Jay Kyoon Lee Associate Professor; Ph.D., Massachusetts Institute of Technology, 1985; electromagnetic waves; microwave remote sensing; antennas

Harold F. Mattson, Jr. Research Professor; Ph.D., Massachusetts Institute of Technology, 1955; coding theory; combinatorial mathematics; applied algebra

Kishan G. Mehrotra Professor; Ph.D., University of Wisconsin-Madison, 1971; neural networks; algorithms applied statistics; reliability analysis

Chilukuri K. Mohan Associate Professor; Ph.D., SUNY-Stony Brook, 1988; artificial intelligence; automated reasoning; neural networks; equational specifications

Susan Older Assistant Professor; Ph.D., Carnegie Mellon University, 1996; semantics of programming languages; concurrency; logics of programs; formal methods

Daniel J. Pease Associate Professor; Ph.D., Syracuse University, 1981; design and development of shared and distributed parallel systems, software, and tools; performance estimation of user's C, C^{++}, Ada, Fortran 77, and Fortran 90 applications on different parallel architectures

Frederick Phelps Professor; Ph.D., Johns Hopkins University, 1967; iconic communications; systems; teaching/learning methods

James S. Royer Associate Professor; Ph.D., SUNY-Buffalo, 1984; theory of computation, including computational complexity, theory of machine learning, theory of programming languages, and the connections between logic and computation

Robert G. Sargent Professor; Ph.D., University of Michigan, 1966; modeling methodologies; model validation; methodology areas of discrete event simulation including model specification and efficient and parallel/distributed computation; strategical and tactical experimental design; data analysis

Tapan K. Sarkar Professor; Ph.D., Syracuse University, 1975; radiation, design and fabrication of printed circuits; antenna design (radio and TV communication); adaptive and real-time digital signal processing

Ernest E. Sibert Professor; Ph.D., Rice University, 1967; computational logic; logic programming and parallel computation

Q. Wang Song Associate Professor; Ph.D., Pennsylvania State University, 1989; electro-optics; optical interconnections; real-time holography; photonic switching

Edward P. Stabler Professor; Ph.D., Princeton University, 1961; computing systems; computer-aided logic design; software engineering

Stephen Taylor Associate Professor; Ph.D., Weizmann Institute of Science, 1989; parallel architectures and concurrent programming; software engineering; computer graphics; concurrent simulation techniques

Pramod K. Varshney Professor; Ph.D., University of Illinois, 1976; computing and communications

Hong Wang Professor; Ph.D., University of Minnesota, 1985; signal processing; communication engineering; radar/sonar systems

Donald Weiner Professor; Ph.D., Purdue University, 1964; communications systems; nonlinear networks; signal processing; radar systems; weak signal detection in non-Gaussian environments; analysis of random data

- **Staff**
  In the AY 1997–98 there are:
  - 9 non-technical staff (8 full-time and 1 part-time)
  - 6 technical staff (5 full-time and 1 part-time)

A.3 Research Areas

Artificial Intelligence
Image segmentation and restoration; pattern and shape recognition; computer vision; expert systems; autonomous mobile robots; learning control using fuzzy logic and neural networks; robot planning and control; microprocessor systems for producing tactile graphics for the blind and other aids for people with disabilities.

Communications and Signal Processing
Detection and estimation theory; distributed signal processing and data fusion; adaptive signal processing algorithms and architectures; radar signal processing; knowledge-based signal processing; image processing; digital communications; information theory and coding; parallel algorithms for signal processing; complexity of DSP algorithms; communication networks; photonic communications; weak signal detection in non-Gaussian environments; analysis of bistatic radars.

Computer-Aided Design and Architectures
Computer-aided design techniques for routing; simulation, verification, and synthesis; silicon compilation; formal verification; high-level synthesis; system integration; VLSI design; applications of declarative programming languages; algorithms and architectures for parallel and distributed systems.

Distributed Information Systems
Multimedia systems; object-oriented databases; multimedia transport protocols; high bandwidth networks; distributed conferencing; visualization and virtual reality; multimedia storage systems, including optical systems; video on demand; distributed multimedia applications; web technology.

Electromagnetic Fields and Antennas
Electromagnetic aperture problems; application of matrix methods to radiation and scattering systems; iterative methods for large electromagnetic problems; analysis of printed circuits; analysis of cross talk in integrated circuits; adaptive and signal processing antennas; antenna arrays; antenna array synthesis; development of high-pulsed power systems; electromagnetic compatibility; analysis of small radomes; radio direction-finding; time-domain radar; microwave remote sensing of earth terrain; wave propagation in random media; scattering from random surfaces; scattering from composite dielectric and conducting targets; radar clutter modeling; radar polarimetry; millimeter and microwave integrated circuits; numerical solution of electromagnetic field problems.

High Confidence Design
Formal methods; formal specification, synthesis and verification of software and hardware; computer security; network security.

Logic Programming and Logic in Computer Science
Model theory and complexity; non-monotonic reasoning; relationships with game theory and hybrid systems; applications to artificial intelligence; applications to qualitative investigations; dynamical, chaotic, and fractal properties of logic programs and related automata.

Microelectronics
Development of solid state sensors; nonlinear dielectric optical materials; thin film growth and processes; modeling of composite materials; integrated electronic and optical services; optical image processing.

Modeling and Discrete Event Simulation
Model paradigms; model validation; methodology areas of discrete event simulation, including model specification, sequential and parallel computation, and output data analysis.

Neural Networks
New learning algorithms, adaptive connection systems, self-organizing networks, pattern recognizers, spatio-temporal networks, modular networks, hierarchical networks, evolutionary algorithms, fault-tolerant neural networks, models of biological systems, classification and clustering algorithms.

Optics and Wave Phenomena
Wave propagation and applications, linear and nonlinear, dispersive and nondispersive; acousto-optic interactions; optical information processing and optical bistability; optical wave mixing; holography; optical interconnects; optical computing algorithms and architectures; pipelined optical binary computing; wave propagation through random media; waves and fields in anisotropic media; nonlinear echoes.

Parallel and High-Performance Computing
High-performance parallel and distributed computing; "grand challenge" applications in data assimilation, astrophysics, and plasma simulation; parallel and concurrent programming languages and techniques, particularly for irregular concurrent computations; high-speed communication networks and protocols; software tools and programming environments for parallel/distributed systems; performance evaluation.

Photonics and Optical Engineering
Optical information processing; interconnection and communication networks; fiber optics, fiber light amplifiers, and lasers; photorefractive and bio-optical materials and their applications in wave-mixing and dynamic holography; micro-optic fabrication; optical computing; electro-optics; optical memory; optical wave propagation and diffractions.

Programming Languages
Denotational semantics, logics of programs, formal methods, semantic models of parallel programs, fair behavior and liveness properties of parallel programs, applications of semantic models to program design, parallel program correctness.

RF and Wireless Engineering
Analysis and design of RF and Wireless and satellite communication circuits and systems.

Software Engineering
Software models; metric and formal methods; fault-tolerant software and software reliability; software reusability; object-oriented software engineering methods and tools; techniques for software engineering data analysis; distributed and parallel software development; trusted systems.

Theory of Computation
Computational complexity of higher-order functionals, complexity of "lazy" computation, biological models of computation, and computational learning theory.

A.4 Research Laboratories

ATM High Performance Distributed Computing (HPDC) Laboratory
On-going projects focus on developing and evaluating enabling technologies, intelligent proactive network management, multimedia applications and high-performance distributed computing applications. Current projects include a low-latency, multi-threaded, message-passing system, an intelligent network management system, a virtual distributed computing environment, and a hierarchical modeling and analysis of HPCC systems and their applications. Computing and networking technologies are built around a laboratory of IBM RS6000 workstations interconnected using two IBM 8260 ATM hubs. Connections to PC laboratories are provided through IBM 8285 ATM concentrators (25 ATM Mbps ports).

Fiber Fabrication Research Laboratory
This laboratory has a facility for fabricating specialty optical fibers; vacuum systems, including a special ultra-high vacuum system for evacuating ampoules; various furnaces, including a high-pressure furnace for preform fabrication; a fiber-pulling tower capable of drawing about 3 km of fiber from a 20 cm preform; and extensive fiber analysis equipment, including a special fiber microscope and an automatic optical spectrum analyzer. A process has been developed here for fabricating fibers with very thin layers of optically active material layers at the core cladding boundary. The optically active materials are semiconductors, metals, and magnetic materials. These fiber devices are typically 3 to 20 mm long and have a large variety of application in communication, computer memories, and sensors. Examples of these applications are fiber light amplifiers, blue light lasers for CD ROM applications, etc. Both graduate and undergraduate students participate in this research.

Photonics Laboratory
The Photonics Laboratory has five fully equipped optics rooms. Each has a vibration isolated optical table and various kinds of optical devices and elements. It has a one-dimensional detector array, a digital rail, a CCD camera and image processing system, a digital scope, and various photo-detectors and laboratory accessories. In addition, we have a 5-W Argon Ion laser, a 50 mW He-Ne laser, and a number of semiconductor lasers. Research efforts include information processing for two-dimensional and three-dimensional data related to military as well as commercial applications, micro-fabrication of electro-optical diffractive optical elements, photonic switching as related to computer and communication networks, real-time holography for free-space beam steering and optical intersections, and three-dimensional optical memory and molecular electronics for the future generation of high-density and large-capacity digital storage devices.

RF, Wireless, and Signal Processing Laboratory
Fabrication facilities exist here to make printed circuits with accuracy up to 70 microns, both for VLSI and microwave CAD. Equipment for charactering devices directly in both time and frequency domains is also available. The laboratory is equipped with a Waveform Processing System capable of analyzing devices up to 18 gigahertz. In addition, a Vector Network analyzer operating from 45 megahertz to 26.5 gigahertz can not only characterize noise figures of devices, but can also measure various network parameters of printed circuits, devices and antennas. This equipment is computer controlled for higher accuracy and ease of measurement. In addition, a high-power Quantronix laser system provides the capability of performing research in impulse radar technology. With the help of laser-activated photo-conductive switches it is possible to generate kilovolt amplitude electrical pulses of 300 picoseconds duration. Several SUN SPARCs stations-10 provide the capability of solving challenging problems in electromagnetics and signal processing. By adding DSP boards to Pentium processors it is also possible to carry out real-time adaptive signal processing.

Scalable Concurrent Programming (SCP) Laboratory.
This laboratory specializes in the design, implementation, and analysis of programming tools and techniques for high-performance distributed computing. Central research problems concern the integration of a broad array of computing technologies and the development of efficient resource management strategies. A central theme is the coupling of programming tools with non-trivial industrial applications. Examples of these concurrent applications include the simulation of neutral and ion transport in plasma reactors used for VLSI manufactur-

ing, analysis of spacecraft launch vehicle instabilities, and thruster contamination in satellite manufacturing. The applications operate on a broad variety of computing platforms that include networks of workstations and PC's, multicomputers such as the Avalon A12, and multi-processors such as the SGI PowerChallenge. Within the laboratory, high-performance networking is used to couple a variety of high-performance concurrent computers.

A.5 Statistics

- **Enrollment Data**
  - Undergraduate Programs

Table A.3 Undergraduate Student Enrollment

Fall Enrollment	B.S. Degree: Students Enrolled				B.S. Degree: Enrollment Comparison	
	CE	CIS	EE	Total	ECS	Ratio
93	86	111	136	333	974	34%
94	81	96	114	291	826	35%
95	100	123	89	312	920	34%
96	114	147	87	348	920	38%
97	127	161	71	359	881	41%

Table A.3 above indicates that the enrollment of undergraduate students in EECS has increased substantially since 1994. Furthermore, the proportion of EECS undergraduate students with respect to the total number of undergraduate students in the College has also increased.

  - Graduate Programs

Table A.4 Graduate Student Enrollment

Date Enrollment Was Taken	M.S. Students Enrolled				Ph.D. Students Enrolled			
	CE	CIS	EE	Total	CE	CIS	EE	Total
93/1	252	156	215	623	53	62	68	183
94/1	217	161	142	520	57	72	62	191
95/1	145	118	127	390	51	86	48	185
96/1	105	90	99	294	51	84	38	173
97/1	110	77	78	265	48	82	37	167

Table A.4 indicates a substantial decrease in the number of M.S. students from 1993 to 1997. Even though we can attribute this decrease to the closing of the off-campus centers during the period from 1993 to 1995, we must realize that the decrease from 1995 to 1997 is due to our inability to attract masters students to the main campus as we did previously. The number of doctoral students during the period covered by this table has decreased slightly. For a faculty of 33, however, the number of doctoral students is very high, especially the number of CIS doctoral students. For a faculty of this size, a more reasonable number of doctoral students would be around 100.

Table A.5 EECS and ECS Graduate Enrollment — A Comparison

Date Enrollment Was Taken	M.S. Students Enrolled			Ph.D. Students Enrolled		
	EECS	ECS	Ratio	EECS	ECS	Ratio
93/1	623	NA	—	183	NA	—
94/1	520	690	75%	191	258	74%
95/1	390	575	68%	185	255	73%
96/1	294	536	55%	173	240	72%
97/1	265	485	55%	167	231	72%

Table A.5 shows that the decrease in the number of masters students in EECS was steeper than the decrease in ECS during the period of 1993 to 1995. This phenomenon was due to the closing of the off-campus centers. We see that during the period of 1996 to 1997 the decrease in the number of masters students in ECS and EECS was proportionally the same. The percentage of doctoral students in EECS has remained constant as compared to the percentage of doctoral students in ECS during the period covered by this table.

- **Graduation Data**
  - Undergraduate Programs
    Data presented in Table A.6.

Table A.6 Undergraduate Degrees Conferred

Period Degree Is Conferred	B.S. Degrees					
	Degrees Conferred				Degrees Conferred Comparison	
	CE	CIS	EE	Total	ECS	Ratio
12/92 to 8/93	15	19	24	58	161	36%
12/93 to 8/94	8	10	19	37	120	31%
12/94 to 8/95	10	12	18	40	147	27%
12/95 to 8/96	15	13	13	41	141	29%
12/96 to 8/97*	10	15	11	36	132	27%

*Incomplete data

  - Graduate Programs
    Data presented in Table A.7.

Table A.7 Graduate Degrees Conferred

Period	M.S. Degrees Conferred				Ph.D. Degrees Conferred			
	CE	CIS	EE	Total	CE	CIS	EE	Total
8/92–6/93	87	45	97	229	7	8	10	25
8/93–6/94	112	79	80	271	8	8	15	31
7/94–6/95	66	34	57	157	17	5	11	33
7/95–6/96	48	36	32	116	7	8	9	24
7/96–6/97	81	31	37	149	9	14	13	36

Table A.8 EECS and ECS Graduate Degrees Conferred — A Comparison

Period	M.S. Degrees Conferred			Ph.D. Degrees Conferred		
	EECS	ECS	Ratio	EECS	ECS	Ratio
8/92–6/93	229	282	81%	25	38	66%
8/93–6/94	271	321	84%	31	36	86%
7/94–6/95	157	198	79%	33	52	63%
7/95–6/96	116	139	83%	24	31	77%
7/96–6/97	149	277	54%	36	44	82%

Table A.8 shows that, of the graduate degrees conferred by ECS, EECS confers a large portion of them.

- **Credit Hours of Instruction**

Table A.9 Credit Hours of Instruction for EECS

Fiscal Year	Undergraduate Credit Hours of Instruction						Graduate Credit Hours of Instruction					
	CIS	CPS	CSE	ECS	ELE	Total	CIS	CPS	CSE	ECS	ELE	Total
92–93	2,250	9	1,185	0	2,592	6,036	2,805	204	4,020	0	3,098	10,127
93–94	2,021	12	1,179	0	3,144	6,356	2,838	99	3,975	0	2,604	9,516
94–95	2,640	74	1,395	105	2,959	7,173	3,000	64	2,892	0	2,197	8,153
95–96	2,665	80	1,572	249	2,594	7,160	2,375	270	2,646	11	1,695	6,997
96–97	2,892	111	1,427	1,576	2,334	8,340	1,977	366	3,144	63	1,501	7,051

Tables A.9 and A.10 give the undergraduate and graduate credit hours for courses with prefixes CIS, CPS, CSE, ECS, and ELE taught by EECS faculty and Teaching Assistants. They show that in the last few years the undergraduate credit hours of EECS instruction have increased in absolute terms and in relation to the total number of ECS credit hours of instruction taught. In absolute terms, the number of EECS graduate credit hours has decreased, but has remained around 70% in relation to the number of credit hours delivered by the College.

- **External Awards**
  Data is shown in Table A.11.

Table A.10 Credit Hours of Instruction for EECS—A Comparison

Fiscal Year	Undergraduate Credit Hours of Instruction			Graduate Credit Hours of Instruction		
	EECS	College	Ratio	EECS	College	Ratio
92–93	6,036	14,740	41%	10,127	13,789	73%
93–94	6,356	15,646	41%	9,516	12,530	76%
94–95	7,173	17,131	42%	8,153	11,416	71%
95–96	7,160	15,613	46%	6,997	10,243	68%
96–97	8,340	16,663	50%	7,051	10,165	69%

Table A.11 External Awards, Expenditures, and IDC Revenue

Fiscal Year	External Awards			Expenditures			Indirect Cost IDC		
	CE + EE	CIS	Total	CE + EE	CIS	Total	CE + EE	CIS	Total
92–93	1,985,671	255,252	2,240,923	1,296,647	256,674	1,553,321	279,762	69,318	349,080
93–94	1,804,900	115,385	1,920,285	830,730	149,508	980,238	196,376	33,192	229,568
94–95	3,886,244	225,000	4,111,244	1,136,429	180,195	1,316,624	189,720	53,075	242,795
95–96	1,530,473	339,093	1,869,566	1,661,921	256,472	1,918,393	268,215	71,349	339,564
96–97	2,601,312	517,702	3,119,014	1,966,544	541,053	2,507,597	368,395	119,265	487,660

- **Fiscal Performance**

The metrics adopted by Syracuse University to evaluate the performance of a unit are $FBOH_1$ and $FBOH_2$. FBOH ratio stands for "fringe benefit/overhead" ratio, defined as follows:

$$FBOH_i = \frac{Income_i - Expenditures}{Expenditures} \times 100, i \in \{1, 2\}.$$

$Income_1$ = income from undergraduate and graduate tuition.

$Income_2$ = $Income_1$ + indirect cost charged against grants and contracts.

The ECS targets for FY 1999–2000 are $FBOH_1$ at least 25 and $FBOH_2$ at least 50.

Table A.12 depicts $FBOH_1$ and $FBOH_2$ for the last two years as if the former CIS and the former ECE had been merged to form EECS prior to the FY 1995–96, and for the College for the last five fiscal years.

Table A.12 $FBOH_1$ and $FBOH_2$

Fiscal Year	$FBOH_1$ for EECS	$FBOH_1$ ECS	$FBOH_2$ for EECS	$FBOH_2$ for ECS
92–93	NA	−9	NA	12
93–94	NA	−7	NA	15
94–95	NA	1	NA	26
95–96	18	1	24	23
96–97	57	24	69	40

The $FBOH_1$ and $FBOH_2$ for EECS has soared during the FY 1996–97. Our fiscal performance during this FY has surpassed the most optimistic expectations.

A.6 Major Strengths

- **Professional Master's Programs**
  The College of Engineering and Computer Science at Syracuse University provides strong professional master of science programs in computer engineering, computer science, and electrical engineering. Our programs are designed to develop technical depth and professional expertise in modern technologies. The faculty of EECS has a unique mix of backgrounds in research, teaching, and industrial experience.

  Our Professional Master's Programs have focus areas in:

Communications	—	coding, system performance analysis
Computer Networks	—	high-performance systems, distributed processing
Electromagnetics/Optics	—	devices and systems, analysis techniques
Intelligent Systems	—	artificial intelligence, control, communications
Neuroscience	—	sensory transduction, information processing
Photonics	—	optical communications, optical data processing, lasers
Scientific Programming	—	parallel computation, web technologies, simulation
Signal Processing	—	space/time processing, radar and sonar systems
Software	—	design, development, and critical analysis
VLSI Circuit Design	—	VLSI, CAD, optical devices and circuits

  By choosing from a broad set of courses offered frequently by the department, each student, with the help of Graduate Student Advisors, may design a program that emphasizes areas most interesting to the student and that meets the department's academic requirements.

  Our graduates have found careers with Intel, Hewlett Packard, IBM, Bell Laboratories, General Electric Company, and many other high-technology companies both large and small all across the United States. A degree program can be completed in 12 calendar months, although a four-semester or an 18-month program is typical.

  Many in the Professional Master's Programs are international students from countries that include India, the Republic of China, the People's Republic of China, Malaysia, and South East Asian, European, and African countries. Syracuse University provides administrative and cultural support for needs unique to our international student population.

- **Research**
  A large portion of the EECS faculty is engaged in state-of-the-art research, as evidenced by the large number of doctoral students and doctoral degrees awarded (Tables A.5 and A.7).

  Many faculty research activities include undergraduate students who in a large number of cases are supported by external funding.

  Another gauge of the research activities of EECS faculty is the large amount of funding secured by them during the last few years, as shown in Table A.11.

The publication record of the faculty is also strong. As pointed out earlier, in the calendar year 1996 they compiled the following record:

- 43 papers published in technical journals
- More than 100 papers published in proceedings of conferences or presented in conferences
- 7 chapters of books published
- 4 books published
- More than 100 invited presentations given

- **Merger of CIS and ECE**
  The recent merger of CIS and ECE to form EECS has already begun to strengthen our academic and research programs. In this past year we have witnessed a close cooperation among the faculty of the two former units; joint proposals have been written, and several course overlaps were eliminated. The faculty has taken steps to function as a single unit, even though a formal merger has not yet been approved by the SU Senate.

  Furthermore, the breadth of EECS faculty interests has increased the choices of research areas available to students and has the potential to foster the creation of new courses, as well as the development of new areas of research.

- **Undergraduate Programs**
  We expect to attract better and better undergraduate students due to the following facts:
  - Our undergraduate programs are rated among the top 15% of the undergraduate programs in the nation.
  - The flexibility of our undergraduate programs gives students the opportunity to tailor their programs of study to their professional interests.
  - The continuing revision of our programs keeps them in pace with the changes in technology.
  - A strong emphasis on the fundamentals prepares our students to accept and adjust to change to maintain their productiveness in an era of rapid technological innovation.
  - The EECS faculty is at the forefront of new theoretical developments and technological innovations. They continually incorporate such changes into our curricula so that our students are ready for employment when they graduate.

- **CASE and NPAC**
  Having CASE and NPAC at SU provides an opportunity for EECS faculty to engage in research of an applied nature. Both centers foster collaborative research between EECS faculty members and industrial partners that can lead to industrial funding. The extensive facilities of CASE and NPAC are available to affiliated faculty and students, an additional advantage.

- **Proximity of Rome Laboratory**
  The faculty of EECS has a long history of sponsored research cooperation with Rome Laboratory (RL), which has also been a source of graduate students who added another dimension to our cooperation. In many cases, faculty members and graduate students are able to use the facilities of RL for their own research activities.

  Several RL researchers are adjunct faculty members of EECS. They enrich our course offerings by bringing expertise in areas not covered by the interests of our faculty.

- **Industrial Partnership**
  Dean Bogucz has taken aggressive steps to foster partnerships with industries, an effort that is already paying dividends for EECS. Our partnership with Intel has been strengthened and a partnership with Anaren has been initiated. Local industries that are potential partners are Philips Broadband Networks and Lockheed Martin.

  Our experience has shown that faculty members involved in these partnerships have a better understanding of the research and educational requirements of industry and can help us prepare students accordingly.

A.7 Concerns and Issues

- **Faculty Downsizing**
  As a consequence of the downsizing of SU, the number of faculty members of EECS is less than half the total number of faculty of the former CIS and ECE, thus many areas suffered losses of faculty members. Some areas were completely abandoned (computer vision, power systems, ...) and others do not have the minimum critical mass (software engineering, logic programming, control, ...) to sustain a viable research program. This lack of cohesiveness in research areas prevents us from gaining visibility in the research community.

  Another consequence of the downsizing is an inability to cover all of our courses without the help of adjunct faculty. This fact, coupled with the faculty buying out of courses, forces us to rely on a large number of adjunct faculty to deliver our courses. We acknowledge, however, that allowing faculty to buy out of courses helps to sustain a high level of research activity and acquisition of external funding, and that the courses taught by adjunct faculty greatly enrich our course offerings.

  We need faculty who are able to teach courses in the following areas:

  1. Electrical and electronic systems
     - circuits
     - systems
     - communication and controls
  2. Digital Design
     - VLSI
     - CAD
  3. Software Implementation

The 146 courses taught in the AY 1996-97 had an average enrollment of 29 students. Even with the help of adjunct faculty, some of these courses tend to have too high an enrollment. A list of courses with prefixes CIS, CPS, CSE, and ELE having an enrollment of 50 or more is given below.

*CIS 252	81
*CIS 275	75
*CIS 300/500	63
*CIS 554	54
*CPS 616	64
*CSE 161	75
*CSE 182	51
*CSE 561	74
*CSE 581	55
*CSE 607	64
*CSE 661	68
*CSE 687	79
*ELE 221 (Fall)	54
*ELE 221 (Spring)	50
*ELE 231	82
*ELE 232	74

We remark here that CIS 252, CSE 161, and ELE 231 were the first courses that the undergraduate students took in their respective majors.

The problem of downsizing will be further aggravated when EECS loses four more faculty at the end of Spring 1998. Therefore, if we want to keep our programs viable, the plan must request the hiring of new tenured/tenure-track faculty. The research interests of these new faculty should lie in a few focus areas in order to increase the cohesiveness of areas that will bring more visibility to our research programs. A plan for retraining existing faculty must also be in place to provide an opportunity for them to redirect their research interests to one or more of the focus areas.

- **CIS Doctoral Program**
  In 1991 the CIS doctoral program was reviewed by the New York Doctoral Review Committee, which raised several criticisms. The CIS faculty made several changes in the program in order to address these concerns, and a final report indicating all the recommended changes that were implemented was submitted in July 1996. We have just received the appraisal of this final report. The Review Committee still has several concerns and recommends that another site visit take place.

  The CIS doctoral program has too many students enrolled. We acknowledge that not all the students reported in Table A.4 are active, and that some are part-time students. We are in the process of identifying the inactive students and terminating their enrollment in the program. Also, students who are not making satisfactory progress toward finishing the doctoral degree are being identified and deadlines for degree completion are being imposed.

- **Facilities and Equipment**
  In the summer of 1997 the College made a significant investment in its computing

infrastructures. As a consequence, the "Fishbowl" is now a showcase laboratory for IBM equipment. However, the equipment in many of our CE and EE laboratories is completely outdated and needs to be upgraded. It has been reported that parents of visiting prospective students have commented on the obsolescence of this equipment. The Unix laboratories in CST also are rapidly becoming outdated and need to be upgraded.

We need more and better instructional facilities for computing courses:

> 1-019 CST is generally not available, is not big enough for some courses (like ECS 102), and the equipment is getting old.
>
> We need a major lecture hall set up similarly to 1-019, but with a better workstation and better projection, and perhaps another room that isn't so large.
>
> We need more laboratories for undergraduate instruction. The next laboratory should have better technology than the current ones (24-bit graphics, audio, faster network).
>
> We could greatly improve access to Unix systems by installing X11 software on the PC laboratories (ours and CMS clusters).
>
> Electrical Engineering and Computer Engineering laboratories need redevelopment.
>
> The conference room, 346 in Link, provides an inadequate environment for holding meetings or lectures.
>
> The plan must request appropriate funds to upgrade the instructional laboratories.

- **Undergraduate Enrollment**
  Even though the undergraduate enrollment in EECS has increased substantially since 1994, the enrollment of EE majors has decreased. We recognize that EE enrollments have decreased nationwide, and we must therefore devise a plan to increase our share of the pool of applicants.

- **Uneven External Funding**
  As Table A.11 shows, the external funding acquired by the EECS faculty is substantial. However, the number of awards secured by the faculty of the former CIS is significantly smaller than the number secured by the faculty of the former ECE. While we recognize that it is harder to fund theoretical research at the same level as applied research, the plan must nevertheless encourage all attempts to increase funding, particularly in computer science.

- **Physical Separation**
  The faculty and staff of EECS are now located in Link Hall and in the Center for Science and Technology. This physical separation has several undesirable effects:

  - It prevents the ease of interaction of faculty that leads to cooperative research.

  - It makes it difficult to distribute the staff's work load equitably and efficiently.

  The plan must propose the progressive unification of all faculty and staff in one building.

- **Diversity of Faculty and Staff**
  We prepare students to join the work force after finishing their degrees. In order to prepare them to be productive members of our society, it is necessary that we provide a work environment that is a reflection of what they will encounter when they leave the university.

  The composition of our faculty and staff does not mimic the diversity encountered in society. The only area in which we encounter diversity in our department is ethnicity. More than half of our faculty were originally from countries other than the United States. They represent several different countries. In other areas, we do not mirror the diversity of society. We have one Latino among our faculty, one person of color among our staff, all of our office staff are females, and all of our technical staff are males.

  In order to correct this situation, every time a search for a position is initiated a subcommittee of the search committee will be formed to identify, contact, and request applications of qualified persons from minority and under-represented groups.

Appendix B

Descriptions of Areas of Future Investment

B.1 RF and Wireless Information Systems

Ercument Arvas, Prasanta Ghosh, Can Isik, Philipp Kornreich, Jay Lee, Fred Phelps, Tapan Sarkar, O. Wang Song, Pramod Varshney, Hong Wang, Donald Weiner

B.1.1 Description

The area of RF and Wireless Information Systems brings together specializations such as communications, microwaves, antennas, and signal processing to solve problems that are challenging because of their magnitude, level of difficulty, and projected industrial impact. The objective of this area is threefold. One of the goals is to integrate the various faculty members in the electrical engineering program and then gradually link with faculty members in the other two programs who are interested and would like to participate in this initiative. The second goal is to prepare for the education and research of the next century since, according to many authorities, we are going to build an "Internet in the Sky" and according to some estimates predict that "we will spend 50 billion dollars by the turn of the next century to build and launch new satellites—and twice that for antennas, phones, switches, and other gear." Finally, our goal is to develop a center that will gradually attain international fame and recognition in a student-centered research university.

B.1.2 Justification

- **Nationwide competitiveness**
  As we see from the above quotes from Bill Gates, this area is going to spend at least 100 billion dollars to build the basic infrastructure.
- **Balances between popular areas**
  We already are known internationally for many of our sub-efforts in this global scheme. For example, we are known for our efforts in radar signal processing, computational electromagnetics, and CAD for high-frequency systems. We believe there will be a significant shortage of qualified students in this area.
- **Funding opportunities**
  We have performed research in this area not only for local industries but also globally. For example, to provide a partial list, we have worked with Hewlett Packard, Intel, IBM, Digital Equipment Corporation, Harris Corporation, Data General, Quad Design, Cadence, Honeywell, E. I. Dupont de Nemours and Company, and locally with Microwave Filters, Anaren, General Electric (now Lockheed Martin) and Phillips Broadband Systems. Internationally, we have interacted with Sony, Hitachi and Alenia. In addition, we have done work for the Navy, the Air Force, and DARPA.

- **Existing research strength**
  We have published numerous journal papers, written several books, and made innumerable invited presentations internationally. We have produced a large number of Ph.D. and M.S. students over the last five years, many of whom are in good managerial positions internationally at various organizations.

- **Cost effectiveness**
  We believe that hiring three additional faculty members and a technician will be cost-effective in proportion to the funded research and to graduate students.

- **Promotion of collaboration between faculty**
  We have significant collaboration between the various faculty members in the area of CAD of high-frequency digital propagation, and contacts are currently being established to promote the solving of challenging optimization problems.

- **Educational needs**
  The influx of new faculty members will promote our ability to fulfill the educational needs of high-quality graduate students.

B.1.3 Resources Needed

- **Laboratories:**
  We need to provide space for laboratories for the three new faculty in the area of hardware and mobile communication and multimedia signal processing. Each will probably require at least 700 square feet of space to start with. In addition, the cost of equipment for each area will be approximately $150,000. This will have a significant effect on revamping the undergraduate laboratories, because a package deal can be made with various companies to get their demo/beta versions of their software and demo/refurbished equipment at a fraction of the original cost and offer provider fee. For example, Hewlett Packard and Super Compact gave us their CAD software free. In addition, Hewlett Packard has provided free vector network analyzers (HP 8510, which cost about a quarter million dollars) to many universities; so a package deal can be made with a company to leverage various items of equipment.

- **New Faculty:**
  - We need a senior faculty in RF and Wireless Systems. The emphasis will be on the hardware aspects.
  - We need a senior faculty in the area of mobile/adaptive communications. Again, the emphasis will be on integrating various aspects of communication in a mobile environment.
  - We need a senior faculty in the area of multi-media signal processing. With so many satellite systems in place, there will be a great need to integrate the various multi-media signals, including image and holographic techniques.

- **Technician:**
  The target date for merging the microwave and communication laboratories is January 1, 1998. We will be making major equipment purchases, while utilizing much of the existing hardware. The technician needs to be involved from the beginning in coordinating these efforts and supervising the installation, utilization, maintenance,

and security of the equipment. Furthermore, since high-frequency equipment is very expensive, every effort will be made to determine how the same equipment can be used for undergraduate, graduate, and research facilities. A technician can start this optimization process immediately.

- **Space:**
  At a first approximation, it seems that about 2,100 square feet of new space is required to support the three new faculty and the technician.

B.2 Trusted Real-Time Networked Computing

C. Y. Roger Chen, Shiu-Kai Chin, Salim Hariri, Chilukuri Mohan, Susan Older, Steve Taylor, Pramod Varshney

B.2.1 Description

The importance of networked computing and information retrieval is cited by many as crucial to the nation's information infrastructure [10]. The challenge presented by this is the design, development, deployment, and assurance of complex systems in applications such as telecommunications, air traffic control, health care, mobile computing, and electronic commerce [11]. These are critical and expensive systems. They rely on a collection of switching systems, databases, network protocols, scheduling and routing algorithms, distributed hardware, and concurrent software. These systems must work correctly and economically with guarantees of performance, availability of service, safety, and security [9]. This is an area of tremendous federal and industrial need and the funding opportunities are expected to be high, as are the job market demands for students. This defines the scope of the focus area in Trusted Real-Time Networked Computing. More specifically, the engineering challenges in this area include (1) high performance protocols, architectures, and algorithms; (2) design of concurrent systems of hardware and software; (3) assurance of performance in real time; (4) testing and performance evaluation; (5) assurance of correctness, availability, integrity, and security; (6) multimedia system and technologies; (7) databases and information retrieval; and (8) heuristic search and optimization algorithms.

B.2.2 Justification

- **Nationwide Competitiveness**
  This is a highly interdisciplinary research area. It integrates the traditional research domains of software engineering, distributed computing, networks, supercomputing, security, high-assurance system design, multimedia, databases and information retrieval, and heuristic research and optimization algorithms, and it can be very well supported by the participating faculty in terms of both research interests and research strengths. Such a unique characteristic will also enable research activities in the proposed area of future investment to be competitive nationwide.

- **Balances between popular areas**
  As indicated by the job market, this is an area of existing strength and an area of importance. Since this area is at the core of state-of-the-art software system design and development, object-oriented programming and technologies, and networks and

distributed systems, it is well recognized to be one of the most important areas [1], and the demands of the job market will be very high. In addition, this is a research area which can effectively combine existing individual strengths of the participating faculty into a single, coherent research strength to compete nationwide.

- **Funding opportunities**
  This point has been well justified in the previous section.

- **Existing research strengths**
  The participating faculty have demonstrated in the past an excellent record of securing research funding from both industry and government, of publishing, and of producing successful, high-quality doctoral students. In addition, they all have been very active in the technical society.

- **Cost-Effectiveness**
  Laboratories have been established to support efforts in this area. Any additional investment will be used to further enhance existing facilities, rather than to build new ones. Since this is a highly popular area with a very high demand on the job market, it will certainly help to improve student enrollment. All of these considerations make investments in this area highly cost-effective.

- **Promotion of collaboration between faculty**
  The participating faculty work well as a team. This is an area in which we have mutually beneficial interactions with the CASE center, which will allow us to further extend our collaboration with external industry and organizations.

- **Educational needs**
  Our plan is to unify several ongoing research efforts in the department in order to have greater impact on (1) the collaboration of major research efforts and goals; and (2) to create a cohesive set of courses for educating graduate students for professional master's and Ph.D. research.

B.2.3 Resources Needed

- **Two New Faculty**
  Currently, networks and distributed computing can be covered by Dr. Salim Hariri, high-performance computing and visualization by Dr. Steve Tayor, security and high-assurance system design by Dr. Shiu-Kai Chin, heuristic search and optimization algorithms by Dr. Chilukuri Mohan, and multimedia and databases by Dr. C. Y. Roger Chen. What is needed most is strength in object-oriented systems and programming as well as distributed/client server systems. With new hires to cover these two areas, we will be able to blend the individual strengths to form a highly competitive, collaborative research team as well as deliver a coherent set of courses for educating students in professional master's and Ph.D. research.

  The two new faculty will be expected to be active in distributed-object technologies, object-oriented systems and programming, operating systems, client-server systems, distributed systems, and web technologies. They will also be expected to have a strong interest in system design. A knowledge and background in image processing, graphics, visualization, and/or compilers will also be considered relevant. Moreover, both will be expected to participate in teaching graduate and undergraduate classes in those areas. One will focus more on distributed-object technologies, systems, and programming, while the second will focus more on operating systems, distributed environments, and client-server systems.

- **Laboratories**
  Resources will be needed to assist in the upgrade, maintenance, and expansion of existing laboratories as well as in establishing new laboratories. In addition, resources for improving general infrastructures—which usually cannot be covered in the research contracts—will be needed.

- **A visiting research/teaching position**
  Depending on the activities of the team members, we may sometimes need more help in teaching, while at other times we may need help in carrying out research in a more flexible fashion. We envision that such a need can be best satisfied by having a visiting research/teaching position whose role and duties are jointly determined by the team members.

B.3 Applied Formal Methods and Theoretical Computer Science

Howard Blair, Shiu-Kai Chin, Susan Older, James Royer, Ernest Sibert

B.3.1 Description

The area of theory and formal methods integrates the research of several faculty in the department. As an integral part of our department's signature, the area should also influence the character and content of our courses and curricula. Broadly, this research area emphasizes the mathematical models of computing, the properties of these models, and the application of these models to core problems of computer science and engineering. More specifically, this research area includes the specification, verification, and (semi-)automatic implementation of software and hardware systems, as well as the underlying foundational subjects such as complexity, semantics of programming languages, concurrency theory, and logic.

B.3.2 Justification

- **Nationwide competitiveness**
  We have at least five faculty members in the combined areas of complexity, semantics, logic, and high-assurance design. Adopting theory and formal methods as a focus area allows us the opportunity to integrate these research efforts and undertake new collaborative efforts. In conjunction with the research efforts, we also have an opportunity to develop courses and nationally competitive curricula that emphasize these mathematical foundations and their applications. We have sufficient breadth to design and teach multiple tracks in our graduate programs, ranging from the theoretical foundations of computing to the formal construction and analysis of systems. Strong curricula attract quality students, which in turn strengthens the curricula and the department's research efforts.

- **Balance**
  The signatures of the department's academic programs emphasize the importance of providing our students with solid foundations in their given subjects so that they will be ready to work and ready to change. Our department has therefore already accepted the mathematical foundations of computing and their applications as essential to our curricula. There is the additional expectation that our research programs should inform our academic programs at all levels. Our research strength in these areas can only improve the quality of students we graduate. Finally, industry is interested in hiring graduates with skills and experience in using formal methods and tools. Semiconductor firms such as Intel, Hewlett Packard, and National Semiconductor all have active formal-methods groups.

- **Funding opportunities**
  Our current faculty members in this area have grants from NSF and the Department of Defense, including Air Force funding for collaborative research in the application of formal methods to the design of hardware and software for information security. DARPA's interest in formal-methods education and (more generally) in the development of high-confidence systems seems to indicate that funding will continue to exist in this area. The development of high-quality master's programs or specialties in software engineering should also encourage local industrial investment in our academic programs.

- **Existing research strength**
  Our department already has the core of a strong research group in this area. Our faculty members have actively participated in the organization of, and program committees for, workshops and conferences in the areas of nonmonotonic reasoning, intensional semantics and complexity, formal methods in computer-aided design, and formal-methods education. Recent faculty publications include the following topics: using continuous mathematical methods in logic, hardware verification and applications in network security, extending VLSI design with higher-order logic (including the fabrication of working chips), compositional semantics for reasoning about fair parallel programs, and computational complexity of higher-order functionals.

  There are three doctoral students currently involved in the specific subarea of continualizing formal systems; five doctoral students are involved in the applications of higher-order logic to hardware verification and security protocols. Recent Ph.D. graduates are doing formal-methods work at National Semiconductor and ORA, a formal-methods-based company.

- **Cost-effectiveness**
  This is not expensive research: we do not need to construct an expensive laboratory before initiating research. The main equipment-related costs are for compute cycles, which are fairly inexpensive.

  This type of research supports our educational programs in a very direct way. The signatures of our department's CE and CIS program explicitly mention the importance of the mathematical and logical foundations of computing. The low cost of the research also allows an inexpensive and immediate delivery of research results into the classroom: once again, the main costs are for compute cycles or site licenses for various software packages.

- **Promotion of collaboration between faculty**
  The area of theory and formal methods provides plenty of opportunities for pure research (in the formalisms and underlying science), applied research (in the specification, verification, and implementation of actual or prototype systems), and pedagogical research (in the transfer of such knowledge to the engineering students who will need and use the technology). As a result, there are also significant opportunities for collaboration among faculty, particularly in bridging the cusp between science and engineering. Professors Chin and Older have already received funding for collaborative work in the application of formal methods to the design of hardware and software for information security.

- **Educational needs**
  Aspects of theory and formal methods already form part of the core for the MS in both computer science and computer engineering (e.g., CIS 623, CIS 675, CIS/CSE 607, CIS 521). The signatures of the CE and CIS programs explicitly mention the importance of theoretical foundations and a facility for using formal methods. There has also been discussion of creating software-engineering specialties in our CE and CIS programs: basic logic and the application of formal methods are essential in any such program. However, we have the opportunity to develop a unique program containing multiple tracks with different emphases, from the foundations of computing to high-assurance design. In the last year alone, we have offered graduate-level classes on network security; formal specification, design, and verification; models of concurrent systems; CAD logic, including model checking; analysis of algorithms; and computation and complexity at higher-order types.

B.3.3 Resources Needed

- We need a "Commons Room," a place distinct from the mail room and conference rooms where people can interact and share research thoughts. (This room should not be limited only to faculty members of this area.) This room should include large whiteboards for technical discussions.
- Faster machines with 24-bit color-graphics cards
- A color printer
- Travel funds, including money for occasional colloquium visitors
- Funds for software packages (including site licenses) for both research and academic purposes

B.4 Photonics and Molecular Electronics

Robert Birge, Qi Wang Song

B.4.1 Description of the area

Photonics uses photons instead of electrons to address, carry, and process information. Because of the fundamental differences in physical properties between photons and electrons, they complement each other in many operations. As a result, photonics offers complementary and supplementary solutions to many information processing problems. The distinctive advantages of photons over electrons are high bandwidth and parallelism. When a large amount of information needs to be transported, photons appear very attractive, as evidenced by the widespread application of optical fibers. Molecular electronics is an emerging and highly cross-disciplinary field which lies at the interface of molecular physics, material science, biophysics, electrical and optical engineering, as well as computational science. Molecular electronics involves the encoding, processing, and retrieval of information at a molecular level, as opposed to the current semiconductor techniques in which the above functions are achieved via miniaturization of bulk devices. Therefore, molecular electronics suggests a fundamentally new concept in device miniaturization and operation. Molecular electronics and photonics both promise significant contributions to information technology. They are highly interwoven, especially here at SU where our research is concentrated in order to develop new materials and to use lasers to store, read, and manipulate large amounts of information in a three-dimensional format. This approach offers the potential to dramatically increase the storage density and transfer rate of digital storage devices. Our effort is of basic research in nature, although it has a clear direction towards long-term applications. As with all the emerging fields, this is a high-risk area. The near-term commercial application, if our predictions are correct and we are successful, is between six and ten years.

B.4.2 Justification

- **Nationwide competitiveness**
  This is an emerging and fast-developing area. If successful, it will have an impact on many areas of information technology. Because of our complementary specialties and existing infrastructure, SU is uniquely positioned to obtain and keep long-term national recognition.

- **Balance between popular areas**
  The research is towards application in information technology. We can supplement the current popular areas while preparing to position ourselves to become a contributor of impact if the research projections become a reality.

- **Funding opportunities**
  Our funding record has been among the best in the university. Our sponsors include the Air Force, NASA, the Keck Foundation, NIH, the Army, and the Navy. We are currently expecting a two-year, 2.1 million dollar contract from DARPA. We are also drawing attention from commercial companies.

- **Existing research strength**
  We are already very active and quite well known in this area. Dr. Birge, who has

been covered many times by the media, is an internationally renowned scholar in this area. Our combined expertise with material characterization, device fabrication, and simulation and engineering prototyping is unique. The capabilities of our facilities are complementary, and the cross-disciplinary effort has been fruitful in the past several years. We publish about a dozen refereed first-class journal papers and many conference papers each year.

- **Cost effectiveness**
  We already have a research infrastructure and activity at SU, both in EECS and in the Center for Molecular Electronics. Additional equipment support and possible hiring of a faculty in this area would obviously be cost effective.

- **Promotion of collaboration between faculty**
  This is a highly interdisciplinary area—we have been collaborating on research since the beginning. We can also foresee a collaboration with the RF and Wireless Information System area on topics such as device characterization and system applications.

- **Educational needs**
  We can introduce graduate students to the newly developed frontier of interdisciplinary research. Our current teaching responsibilities will not be changed.

B.4.3 Resources Needed

We need to upgrade our equipment to satisfy the increasingly demanding needs in state-of-the-art experimental investigation. The addition of new lasers, signal analyzers, and digital scopes, which we estimate to be $100,000 for three years, will significantly enhance our capabilities and our competitiveness nationwide. Please note that this money would also be used as SU matching funds for the proposals we will be writing in the next three years.

Appendix C

Credit Hour Income

C.1 Credit Hours from EECS Students

The projection for undergraduate EECS credit hours taken by EECS students was constructed based on:

- the number of credit hours required by each EECS undergraduate program;
- assumptions of the number of first-year students entering each program;
- assumptions about year-to-year retention of students;
- assumptions about the number of transfer students entering the junior year;
- assumptions that students in the CE, CS, and EE programs take technical elective courses within EECS;
- assumptions that students in the SIS program take technical elective courses outside EECS;
- assumptions that all EECS students take their free elective courses outside of EECS.

An entering class for EECS of 110 students is assumed for the AY 2001–02. This calls for an increase of

- 6 students in the CE program
- 13 students in the CS program
- 9 students in the EE program
- 2 students in the SIS program

This is an increase of 30 students above the incoming class of 80 students for Fall '97.

As historical data shows, not all students will stay in EECS when they finish their first year. The attrition rate has been estimated at 20%, thus about 80% of our students are expected to stay in EECS during their second year of studies at Syracuse University. From the second year to the third year a retention rate of 100% was used, assuming that the transfers from two-year colleges or from other units of the university offset the losses of EECS students. Finally, we assume that 90% of the students who start the third year will graduate.

The total number of credit hours that must be taken by EECS students under the above assumptions is 5,342. Table C.1 depicts the distribution of credit hours for each program.

Table C.1 Data used to estimate number of EECS undergraduate credit hours taught in FY 2001–02 to EECS students

Program		1st Year	2nd Year	3rd Year	4th Year	Total Students	Total Credits
CE	No. students	30	24	24	22	100	
	EECS credits	6	21	21	19		
	Tot. credits	180	504	504	418		1,606
CS	No. students	55	44	44	40	183	
	EECS credits	10	14	22	12		
	Tot. credits	550	616	968	480		2,614
EE	No. students	20	16	16	14	66	
	EECS credits	6	14	24	16		
	Tot. credits	120	224	384	224		952
SIS	No. students	5	4	4	4	17	
	EECS credits	10	14	13	3		
	Tot. credits	50	56	52	12		170
Total number of students						366	
Total EECS credits							5,342

C.2 Credit Hours from Service Courses

The plan predicts that 30 service courses will be delivered during the AY 2001–02, with an average of 25 students per course. It also predicts that 10 courses will be delivered in the summer of 2001, with an average of 15 students per course. Therefore, the total number of credit hours due to these courses is 2,700.

C.3 Credit hours from other sources

We now give the rationale for the claim that 1,500 credit hours will come from students outside of EECS taking EECS courses and EECS students retaking EECS courses.

In the FY 1996–97, EECS delivered 8,340 credit hours of undergraduate instruction. Of these credit hours, 1,516 were due to the service courses.

If we compute the number of credit hours needed by EECS students in the FY 1996–97, using the number of students who were in the first, second, third, or fourth year of their programs, we obtain 4,803 credit hours. This calculation is depicted in Table C.2.

We may therefore estimate that 2,021 ($2,021 = 8,340 - 4,803 - 1,516$) credit hours were due to students outside of EECS taking our courses or EECS students retaking courses in their major.

We take the conservative approach that this number will be 1,500 for the FY 2001–02.