SECTION 4: ADMINISTRATIVE CHALLENGES

Introduction

The Baskin School of Engineering has undergone rapid growth during the first few years of its existence, and this pace is projected to continue. As the first professional school at UCSC, the operations of the Baskin School have resembled a start-up business, with both the campus and the School evolving and learning together in a grand experiment to create a unique 21st century engineering environment for teaching and research. The leadership role of the Baskin School on behalf of the campus in helping to plan and implement academic programs at the Silicon Valley Center while developing essential industrial partnerships throughout the Silicon Valley has added further complexity to the broad task of establishing a professional school.

The Baskin School continues to take the lead on a variety of interdivisional collaborations in both academic and research programs. In particular, we plan to develop and offer degree programs at both the undergraduate and graduate levels, in collaboration with the Physical and Biological Sciences, Social Sciences, Humanities, and Arts divisions. As with our successful initiatives in the Silicon Valley, the Baskin School seeks broad based collaborations and connections to enhance both instruction and research programs, as 21st century engineering must be intellectually and professionally diverse to be relevant and effective (see examples in Section 2).

As the Baskin School has quickly evolved and grown, operational resources have often lagged behind academic program development and implementation—the faculty have been recruited and hired even though essential administrative and research infrastructure was not in place. In planning for continued expansion of the schools instruction and research programs through AY2010-11, a major challenge is to sustain the necessary infrastructure to ensure success. More resources will be needed to meet this challenge.

Key elements in this process include the following areas:

- Development and Industrial Relations Plan;
- Adequate and Appropriate Space;
- Adequate Faculty Salaries, Housing and Start Up;
- Staffing and Operational Support;
- Technology Investment; and,
- Library Resources.

1. Development and Industrial Relations Plan

Overview

Fund-raising efforts at the Baskin School of Engineering are critical to the long-term success of the school. New campus leadership in 2005 is demonstrating an increased emphasis on the importance of development, both centrally in University Relations and in divisional development operations. University Relations is beginning the planning process for a major comprehensive campaign for the campus. Thus, strategic planning

and priority setting at the Baskin School will be deeply examined during 2006. Long-range strategic planning for development and fund-raising operations at the Baskin School is balanced over three critical areas:

1. Advancing corporate relationships;
2. Building a pipeline of donors; and
3. Major gifts.

The success of the Baskin School's fund-raising is beginning to accelerate due, in large part, to the increase of visibility for the school in the Silicon Valley technology community. Success in a number of specific niche areas of research – like computational genomics, storage systems, wireless networks, biomedical devices, and nanopore technology – is the primary cause. Evidence of success in these niche areas is the significant federal and state funding awards that have benefited each of these areas. The visibility that accompanies such funding has already resulted in the first major gift from a non-affiliated private individual - $1M Kumar Malavalli Endowed Chair in Storage Systems Research.

Research success has also driven the growth of corporate giving. To date, such giving is primarily in the form of research gifts - $25-100K annual support, often funding graduate fellowships. However, this success and the growth of corporate relationships with these research faculty and centers has resulted in several significant corporate in-kind gifts, i.e. Cisco Networking Labs ($400K), Symantec network software ($500K), IBM storage cluster ($150K). Over the next 3-5 years, significant effort to institutionalize these relationships between the Baskin School and corporate donors will enable the development office to realistically pursue larger corporate gifts with potentially broader impact and alignment with the school's strategic plan. Regardless of the fund-raising potential, corporate relationships have positive impacts on a wide array of internal and external relations areas of activity. These benefits are very important to the Baskin School – internships, career opportunities, technology transfer, government funding – though they are difficult to quantify in the context of development activities.

This improved visibility attracts attention and support from individuals throughout the Silicon Valley technology community and beyond, but the Baskin School's maturing alumni base is also being energized by these successes. As the Baskin School approaches its 10th anniversary, alumni are naturally beginning to approach a level of maturity that will increase the likelihood for increased giving, particularly for annual giving. Many alumni, particularly graduate alumni, are beginning to experience higher levels of financial maturity. Thus, the pool of prospective alumni donors with significant capacity is, and will continue to grow in the near and long-term future.

This growth in the number of prospective donors and the complexity of donor relationships presents significant challenges for the Baskin School Development Office. As of 2005, this office consisted of one giving officer and one administrative staff. Additional staff will be required to continue to increase the level and quality of the development operation. An assistant director of development will be hired early in 2006, but additional support staff and giving officer(s) will be required in the near future if we

are to establish a significant informational base and explore long-term potential partnerships.

Advancing Corporate Relationships

To develop corporate relationships, the Baskin School Development Office will coordinate and manage 20-30 corporate relationships and support the operation and creation of two research center-based industry affiliate programs. This represents a significant increase in the number of managed corporate relationships, but during FY2006-07, University Relations will hire a central corporate development office. Since the Baskin School is the primary point of contact for the vast majority of corporate relationships on campus, the Baskin School stands to benefit significantly from the efforts of this position. In addition, the Silicon Valley Initiatives via the UARC and BIN-RDI will also be considering a corporate relations officer in some form. The continuing advance of the Technology and Information Management (TIM) graduate program, to be offered via the Silicon Valley campus at Moffet Field, combined with the increased focus on corporate relations stands to increase the level and number of corporate relationships and fund-raising opportunities.

During FY2006-07, the Baskin School development office will focus on increasing collaboration with faculty, individuals and teams, to continue to share prospect strategy design and tactical implementation. As of 2005, the highest priority relationships include HP, IBM, Microsoft, Google, Cisco and Symantec. These corporations have the highest potential to develop broad relationships with the Baskin School and campus, as well as the philanthropic capacity for significant impact. Other important corporate relationships exist with Adobe, Agilent (Avago), Apple, Plantronics, Hitachi GST, Seagate, National Semiconductor, and Intel. These are lower in priority because the relationship is focused on specific faculty members or research areas or because the philanthropic capacity is lower.

The Storage Systems Research Center (SSRC) currently operates a moderately successful industry affiliate program. The development office has supported and advised the operation of this program, developing a strong understanding of the needs of such programs in order to achieve sustainable success. Building upon success, and learning from the shortcomings of the SSRC, the development office will coordinate and support the Dynamic Ad-hoc Wireless Networking Group (DAWN) toward the creation of a similar industry affiliate program during FY2006-07.

Corporate giving to the Baskin School has risen steadily over the past five years, from nearly $1M in FY2000-01 to over $1.5M in FY2004-05. Improved corporate relations efforts both within the school and at the campus level will continue to support continued increases in research support and in-kind equipment grants – the primary recipients to date. This growth should be $3-4M annually by FY2009-10 if trends and focused efforts continue, along with relatively stable economic growth in the regional technology sector.

Building a Pipeline of Donors

In order to take advantage of the maturing alumni base and the growth in prospective donors through increased visibility of research niches, a strategy for building a long-term pipeline of donors must be implemented in FY2006-08. This strategy includes:

- Creation of a leadership annual giving program;
- Increase in the number and quality of donor/alumni engagement events and programs;
- Development of more and better volunteer leadership opportunities; and
- Development of a more accurate and up-to-date alumni base.

Annual giving to the Baskin School has steadily increased - $20K in FY2003-04, $28K in FY2004-05 and $50K in 2005. Such increases cannot be attributed exclusively to specific Baskin School development efforts, but rather to central development efforts and improved visibility with alumni. Budgetary and human resource constraints have severely limited the ability to communicate with and solicit Baskin School constituencies. The Baskin School has had an annual giving society ($500+) – the Dean's Club – since FY2003-4 but has not fully implemented its operation. Highest priority will be given to the Dean's Club annual dinner and the quarterly Dean's Club e-newsletter. Subsequently, priorities will shift toward the redesign of the Dean's Club Program, the testing of targeted direct mail/email communications and solicitations, and annual personal solicitation visits.

As of FY2005-4, school-wide donor/alumni engagement events consisted of only the Annual Engineering Alumni Reunion and Dean's Club Dinner. Emphasis will continue to be focused on the quality and size of these two events. During FY2006-07, the Baskin School will also give high priority to the creation of an annual faculty presentation in Silicon Valley in collaboration with the UCSC Alumni Association. Upon the increase of development staffing, the development office will form an Alumni Board focused on the design and implementation of a senior design contest, providing a large number of engagement opportunities for board members and alumni through board activity and judging. The development office will also begin to provide support and advice on department level alumni events.

The development office will continue to support the marketing efforts of the Baskin School in a number of ways. In addition to advising on publications, communications, and events, examples of development marketing priorities from FY2005-06 include the nomination and acceptance of Jack Baskin into the Silicon Valley Engineering Council's Hall of Fame, annual Alumni Awards, and corporate sponsorship/involvement in the annual faculty retreat.

Volunteer leadership opportunities will continue to be a major activity of the development office. As of FY2005-06, this included staffing, management and strategic planning related to the Dean's Advisory Council (DAC) and the Regional Advisory Board (RAB). Primary to the mission of such groups is assisting the Baskin School to secure the necessary resources to achieve its strategic goals. Membership on these boards is a very important opportunity to effectively engage high-capacity prospective donors

and volunteers. The addition of the Baskin Engineering Alumni Board (BEAB) will complete a broad range of volunteer opportunities for the Baskin School constituent base.

Annual giving goals set for the programs described above, combined with a 7% alumni participation rate goal, suggest that annual giving should grow to contribute between $200-300K annually by FY2009-10.

Major Gifts

The Baskin School development office major gifts program is managed and operated by the Director of Development, Steve Bourdow, who joined the Baskin School in July 2004. Major gift programs focus on building and strengthening institutional relationships with individuals who have the financial capacity to make a gift of at least $25K. As of FY2005-06, the pool of prospective major donors numbered 130 individuals. A major gift program strives to balance such a portfolio evenly between donors who are at different stages of relationship – discovery, cultivation, stewardship. As of 2005, this balance was 55%, 38%, 7%, respectively. The Director of Development works closely with the Dean and key faculty to cultivate key donor relationships toward solicitation (stewardship), balancing the latter two categories. The Assistant Director of Development (pending FY2006-07) will seek to develop relationships with less engaged major donor prospects. Closely tied to the leadership annual giving programs, these combined efforts will balance and grow a pipeline of major gift donors focused on the key priorities of the Baskin School.

Key Fund-Raising Priorities (FY20050-6):

(amounts are gift size required for each opportunity)

1. Attracting top faculty
   - Endowed Chairs ($500K+)
   - Corporate support of start-up packages ($100K+, cash or in-kind)
   - Dean's discretionary funding ($100K annual – DAC)
2. Growth of graduate student body
   - Endowed fellowships ($150K+)
   - Corporate research gifts ($25-100K)
3. Increase faculty research
   - Entrepreneurship program, corporate gifts, foundation gifts
   - Increase number of corporate campus visits
   - Industry affiliate programs
4. Increase undergraduate enrollment
   - Endowed scholarship ($50K+)
   - Expendable scholarship
5. Infrastructure support, furnishing space
   - E2 naming opportunities ($50K-$5M)
   - Teaching and Learning Center ($1M)
   - Corporate in-kind gifts

Overall Forecast – 2009-10

It is expected that as the Baskin School and its development operation and donor base matures during the period between FY2006-2010, major gifts from individuals and alumni will contribute approximately 50% to fundraising totals. While the depth of understanding on the strength of the current pool of prospective major gift donors is relatively weak, some forecasts can be approximated. Year to year growth in fundraising for the division over the past five years has averaged 12.5%, excluding extraordinary one-time gifts. By including growth above this average in annual giving and corporate giving, supported by trends and focused efforts, overall fundraising for the Baskin School should be $9-12M annually.

2. Adequate and Appropriate Space

The Baskin School will continue to need additional space as programs expand. The severe space shortage that restricted SOE growth was partially alleviated by completion of the new E2 building in 2004. However, with faculty expected to increase over 40% in the next five years, space shortages will again be problematic without careful planning and allocation of campus resources.

The first space challenge will be to ensure that the campus proceeds with plans to relocate as soon as possible non-engineering services and programs out of the BE and E2 buildings to facilitate the growth of engineering programs. This includes campus services such as Financial Aid, Printing Services, and the Post Office, plus academic programs such as Mathematics and Economics. Provided sufficient resources, space currently used by these functions will then be available to help accommodate SOE program growth. This growth includes important technology laboratory space for instruction and research used full-time by students and faculty.

The second space challenge is to provide resources to modify and sustain available space within the BE and E2 buildings appropriate to programmatic uses. Examples include funding renovations to create new laboratory space for BME and EE, including wet laboratories, clean rooms, laser optic rooms, autonomous systems vehicle development and storage space, and vibration sensitive facilities. Campus capital funding for Alterations 2 & 3 Projects within BE (to begin in 2006) will partially complete some laboratories, but the space will be insufficiently furnished to support faculty and student research without the allocation of further funding. Planned expansion of the BME Program will require additional wet and dry instructional laboratory spaces beyond what is available following these renovations, requiring either new space to be constructed or other existing space to be modified. Moreover, as other space within the BE building becomes available to SOE, it will require renovation to be appropriately suited to faculty and student needs for instruction and research. Significant resources will be required for all these types of space.

The third space challenge is to identify and implement solutions to allow for contiguous occupation of instruction, research and office space by faculty and academic programs.

Under current campus planning, the BME program will be spread across multiple buildings and facilities, with offices in the new PSB building, partially completed wet laboratories in the BE building, a some laboratories in the Sinsheimer building, and computational space in the BE and E2 buildings. In addition, campus plans to construct a Bio-Medical Building will include additional BME wet laboratories in yet another facility. SOE and the campus would be well served to begin long term capital planning for a separate Bioengineering Building properly designed and equipped to facilitate the future direction of instruction and research in this field.

3. Adequate Faculty Salaries, Housing and Start Up

Similar to other areas of the campus, the Baskin School faces major challenges in recruiting and retaining the highest quality faculty. The competitive problems associated with faculty salaries, housing costs, and start-up packages as outlined in our initial Academic Plan five years ago remain today.

The available engineering salary scale impairs our ability to make competitive offers to tenure track faculty candidates, particularly in technology related fields. Competition comes not just from other higher education institutions, but also from private industry. There are disadvantages as well simply from the cost of living in the Santa Cruz area and greater San Francisco Bay area, which diminishes the real consuming value of salaries. SOE is further hampered by limited upgrading funds, as the Baskin School has yet to reach a size or maturity that yields normal turnover savings to help provide resources for upgrading faculty salaries. We need assistance from the campus to create resource flexibility that enables hiring the very best faculty at salaries equivalent to those offered elsewhere.

Housing costs are an additional problem in attracting and retaining qualified tenure track and tenured faculty. Again, Santa Cruz is part of a larger economic environment with some of the highest housing prices in the nation, so we are naturally disadvantaged compared to institutions in other regions. For SOE to be successful in developing unique 21st Century engineering programs, new approaches must be identified to mitigate housing costs for faculty and enhance recruitment of top scholars from throughout the world.

Start-up funding continues to be the single biggest challenge in successful faculty recruitment, as SOE offers are often not competitive with the resources provided by older and more established engineering schools. This affects particularly our ability to hire underrepresented minority faculty where there is extreme competition from other institutions. SOE has pursued extramural funding to help increase start-up packages, but additional campus resources are necessary as well. Unfortunately, limitations in start-up funding adversely impacts the quality of faculty recruitment, both in attracting and keeping the top candidates. This became most apparent recently with recruitment efforts in departments such as BME. Available wet laboratory space to be provided to faculty after completion of the Alterations 2/3 Project in the BE building will be incomplete and unfurnished—so further start-up funding will be necessary to make the labs operational.

Recent BME faculty candidates reviewing the project plans for such space have turned down SOE offers because they view the incomplete laboratories as a lack of commitment by the campus administration to create and sustain successful programs.

4. Staffing and Operational Support

The statewide budget problems of recent years impacted creation of a sustainable staffing and operational infrastructure within the Baskin School. While faculty recruitment proceeded at a rapid pace and the school experienced growth, campus support funding allocations were decreased due to budget reductions. This especially disadvantaged a new professional school since core infrastructure was not sufficiently established. Some essential components of staffing support were created, while others, such as separate departmental staffing, were not. In reality, individual departments exist in terms of clusters of faculty and available academic degrees, but there are not physically separate and adequately staffed departmental offices with the Baskin School at this time.

As SOE continues to grow, staffing and operational support lags behind. Faculty often cannot rely on the extent of support services and resources available in other programs due to limited staff. The level of staffing positions relative to faculty positions within SOE lags behind those evident within other engineering schools throughout the University of California. As a result, faculty often must function as their own administrative assistants which is not an efficient use of resources. Professional schools simply require a higher level of staffing and operational support than some other academic programs. For example, at UC Irvine, besides centralized staffing reporting to the Dean's Office, the engineering school strives to provide resources equivalent to one permanent staff FTE for every four ladder rank faculty FTE.

Recruitment and retention of qualified staff, especially in technology support areas, also presents a major challenge to SOE. The competitive climate fostered by proximity to Silicon Valley sometimes makes university staff salaries unattractive. Given that part of SOE's mission is to further expand the academic presence of UCSC within the Silicon Valley, staff performance expectations, standards, and competitive pressures require the highest caliber of professional staff. Unfortunately, we are restricted by campus staff human resource practices that can impede using the job classification and salary levels necessary for success. This has been especially evident in frustrated efforts to hire permanent staff to support academic programs at the Silicon Valley Center.

SOE will require additional resources from the campus, extramural sources, and industry partners to build the necessary staffing and operational support levels as the school expands.

5. Technology Investment

The programmatic cornerstone of the Baskin School is technology. Our focus to create academic excellence exclusively the fields in bio-technology, info-technology, and nano-technology sets SOE apart from the traditional patterns adopted by engineering schools

established in the 20th century. And this makes technology even more integral to success. Technology is more than a tool used to complement and support instruction and research; it also is the primary object of much instruction and research.

In this regard, on-going investment in technology is essential, and the requirement to upgrade and expand technology for SOE programs is never-ending. One emerging demand is to enhance provision of videoconferencing and distance learning capabilities between the main UCSC campus and the Silicon Valley Center to support new academic programs offered in both locations. Changes in the technology curriculum are creating demands for expanded instructional laboratory space and dedicated teaching and fabrication space, along with the equipment required for such facilities. Within the realm of computer resources for SOE faculty, students and staff, there is demand for expanding and enhancing network infrastructure, wireless computing, virtual private networks, enterprise computing services, computational computing capacity, and increased number of data centers.

SOE has been successful in generating extramural funding to help keep pace with some technology demands, but additional resources will continue to be necessary. A portion of these costs should be provided from campus resources as part of regular operations, but it is unclear how the dynamics and service levels for technology support will be realized given the recent ITS consolidation. Tradeoffs and priorities have not been identified as they relate to sustaining high quality support for academic based computing, although this is a goal shared by many. The ITS consolidation removes resources from academic divisions into a centralized operation, reducing flexibility for faculty to directly influence the allocation of technology resources. As the process to overcome this challenge is developed and implemented, SOE will still need resources to move forward to keep pace with technological advances and changes.

Specific requirements include:

- General purpose video conferencing facilities (i.e. equipment) for research and short-term needs for campus and off-campus initiatives. This is critical for the SVC academic and research programs;
- Equipment to provide each (SOE?) conference room with a moderate level of video teleconferencing equipment;
- An inventory of desktop video conference equipment available for checkout by SOE community members;
- Expanding the numbers of scanners, so that every floor of each SOE building has a combination copier, scanner and printer;
- Improvements to existing telephone system, adding wireless capability to forward calls;
- Campus network connections to:
    - CENIC CalRen High Performance Research network
    - CENIC CalRen Experimental/Development Network
- SVC connection to CENIC CalRen HPR;
- SVC Virtual Private Network;

- Installation and maintenance of a Virtual Private Network at SOE with ability to support multiple levels of service;
- By AY2007, all SOE servers to have Gb/s connections;
- Wire molding for future lab spaces;
- Connection of backup generator power to be-g router;
- Installation of UPS units for all network switches;
- Two working UPS units for each main router;
- Two high-speed fiber uplinks to separate routers for every switch closet;
- Uniform wireless communications for voice and data throughout the engineering complex;
- Multiple wireless systems, each aligned for the specific support of enterprise, research, and instructional needs;
- Four computational computing server projects;
- Improve existing data centers to have power and cooling supplied by standard generator power and N+1 redundancy for critical support systems;
- Equipment for new labs (see above); and
- Equipment for new research and instructional lab support.

Details on these requirements follow:

1. Videoconferencing and Distance Learning, - Expand and Upgrade Capabilities
Present videoconferencing and distance learning facilities are too few for future requirements. Presently all of these are located in general assignment classrooms, which are operated by campus media services and scheduled by the registrar. These locations although useful for larger undergraduate courses, are nearly impossible to schedule for low enrollment graduate courses and research collaborations.

The School is actively participating in numerous remote site research and instructional activities, some examples include the Silicon Valley Center, UCSC Extension Sites in Silicon Valley and a new initiatives at Los Alamos National Labs in New Mexico. In addition, due to limited main campus space and local housing costs, additional growth will need to occur at remote sites such as 2300 Delaware Street, NASA- Ames Research Facilities, Monterey Bay Science and Technology (MBEST) and at an expanding number of UCSC Extension sites.

Presently there are four distance learning classrooms spread among the Jack Baskin Engineering and Engineering 2 buildings. All of these are located in sizable general assignment classrooms, that are normally scheduled for classes throughout the quarter. At present there are no general-purpose video conferencing facilities for research groups and short-term needs. Easy to operate video conference facilities will be required to accommodate not only off campus initiatives but to enable principal investigators to collaborate in a far more efficient and effective manner. A goal should be to equip each conference room with a moderate level of video teleconference equipment.

The School should have an inventory of desktop video conference equipment available for check out by SOE community members as needed. Desktop video conference systems are relatively inexpensive and would reduce travel to off-site locations providing additional time for SOE community members to be more productive. Some form of training community members in the use of desktop video conference equipment and use would be highly beneficial as well.

2. Copying, Printing and Scanning

SOE faculty members require expanded copying, printing and scanning capabilities. As of December 2005, two copiers in the School (one in Baskin, one in Engineering 2) provide scanning services and none are connected for printing. The School should work towards expanding the numbers of scanners available, so that every floor of each building has a combination copier, printer and scanner. Scanning serves to reduce the amount of paper and energy used, reduces the load on the environment and provides for increased efficiencies of faculty, staff, and students.

3. Telephones

Investigations at improving the existing telephone system should be initiated. SOE community members are often roaming between laboratories, classes and meetings. The telephone system should have wireless capability that does not interfere with wireless networking. It should also provide the ability to forward calls immediately to wherever the client is located, whether that be in their office or at our remote sites. As of December 2005, many SOE members are relying upon personal cell phones to compensate for the inadequacies of the campus telephone system. This should be remedied.

4. Computing Resources

A. Networking Infrastructure

The computing network infrastructure is the life-blood of any modern advanced research facility. SOE has recognized this and has invested heavily in the fastest, most reliable and robust networking system. These investments far exceed any other division or unit on campus. Still, SOE computer networking requirements traditionally exceeded our most expansive predictions. As of December 2005, our 10/100Mb and limited Gb switched computer network to the desktop is doing reasonably well with some room for additional capacity. However this is immediately after a redesign that coincided with the opening of the Engineering 2 building. Over $500K of improvements were made to provide expanded conduits between buildings, install fiber optic trunk cabling and replace main routers and switches.

Since the computing network is so vital to the School, this section is segmented into 5 main areas; (i) campus internet connection (UCSC - CENIC HPR initiative); (ii) Silicon Valley Center internet connection (SVC - CENIC HPR initiative); (iii) SOE Network Operations; (iv) SOE Building cable plant and network equipment stardards; (v) Network robustness and reliability standards and improvements.

(i) ***Campus Connection to the Internet (UCSC to CENIC HPR or Dark Fiber Initiative)***. As of December 2005, the UCSC connection to the internet is provided via two 2.5 Gb/s connections, one of which is leased. These connections serve the entire campus and are considered by senior managers in ITS and by faculty in SOE, PBSci and Lick Observatories to be inadequate and constrictive to research.

Campus research initiatives and the demands of network video conferencing will require the campus to rapidly and drastically improve data connections to educational network in California. This network is operated by the Corporation for Educational Network Initiatives in California (CENIC). Two networks UCSC should be connected to:

(a) CENIC CalRen High Performance Research (CalRen HPR) network; and

(b) CENIC CalRen Experimental/Development Network.

Presently UCSC is one of the few UC campuses not connected to either the CENIC HPR nor Experimental networks. This must be recognized by campus leaders as a major roadblock to future growth on the UCSC campus and should be considered a top priority for funding. ITS Director for Core Technologies has made achieving these connections a top goal for the campus. SOE must support this initiative in whatever way possible.

(ii) ***Silicon Valley Center Connection to the Internet (SVC to CENIC CalRen HPR).*** Networking requirements that the Silcon Valley Center also require a direct connection to CENIC CalRen HPR and Experimental networks. There are state initiatives to bring the CENIC network to the NASA Ames complex. However additional effort by campus will be required to bring that connection perhaps 1 mile to the buildings that house SOE community members. SOE members need to have the same level of networking and computing system access whether they are located in one of the Engineering Buildings or at the Silicon Valley Center. Therefore a Virtual Private Network (VPN) is required for connections between SOE facilities on the main campus and those at the Silicon Valley Center.

(iii) ***SOE Internal Network Operations.*** Engineering and Computers Science schools run their own networks because requirements of the researchers are not

yet considered needed for other campus units and sometimes the services are not scalable. It is vitally important that local control and management of the SOE internal networks be maintained. As of December 2005, the technical staff of SOE has been consolidated into the ITS organization. Historically the ITS Networking group has needed to maintain a consistent set of networking service levels that typically funded far below the minimum requirements of SOE. There is significant concern by faculty and technical staff that should NTS attempt to pick up networking for SOE, then our non-scalable service levels cannot be maintained. Thus SOE must maintain network operation and management within the local IT specialists for SOE.

(iv) ***SOE Building Cable Plant and Network Switching Improvements.***

During the December 2001 writing of this document, network delays were present due to a bottleneck in our single main router and backbone trunks and because SOE only had a single Gb/sec connection to the main campus. When the Engineering 2 building was outfitted for networking, vast improvements were made to the network cable plant backbone and main routers. These improvements now allow all network closets (switch locations) to be optically trunked (dual homed) to two modern Cisco 6500 main routers (be-g and e2-g). Trunking on these main switch closets is using 1Gb/sec multimode and single mode fibers and we anticipate that higher throughputs may be obtained. These throughputs may require the use of jumbo frames and higher bandwidths, something our networking investments can scale into. Therefore recent improvements provide a capable network backbone that can handle increased traffic from the larger numbers of systems.

Networking at the edge (switch to desktop) is using 100Mb/s switch gear with a limited capability to provide 1Gb/s to the desktop. Due to expanded desktop videoconferencing and collaboration tools, desktop installations should take the form of the highest data rate possible within reasonable cost. We anticipate increased requirements for Gb/s Ethernet to the desktop. Gb/s service levels are currently required for any SOE servers receiving central tape backup services. We anticipate that by AY2007, all SOE servers (with or without tape backup) will require Gb/s connections. Network edge requirements will drive replacements of 10/100MB/s network switches or augmented with addition Gb/s switches.

Applied Sciences Alterations Phase I project made use of wall mounted wire moldings for many instructional and research labs. These wire moldings allow for easy upgrades, alternations of both networking and power wiring at reduced costs. Engineering 2 did not use wall mounted wire molding and subsequently we later needed to install more network connections. Additional alternation projects

should incorporate wiremolding for lab spaces as our networking and power requirements are always increasing and changing. This configuration allows us to make those changes rapidly and at reduced costs.

(v) ***Network Robustness and Redundancy.*** SOE Networking has been designed to allow continued operations through the most common single points of failure. These include loss of power, disconnection of network trunk, loss of a power supply and even loss of a main router. As of December 2005, most SOE switch closets are dual homed to two routers; all switch closets have local UPS support; all switches are purchased and installed with redundant power supplies and both routers have two UPS units with different sources of power. The e2-g router is connected to backup generator power, however the be-g router is not.

Continuous improvements in network robustness and redundancy are required to make the network a resilient as possible. As of December 2005, the following actions should be taken:

- Connect backup generator power to be-g router;
- Continue to install UPS units for all network switches;
- Ensure two UPS units are working for each main router; and
- Continue to dual home all new switch closets including those in the new PSB Building.

B. Wireless Computer Networking

Uniform wireless communications for voice and data throughout the engineering complex is considered a necessity that provides enhanced productivity for faculty, students and staff. At present there is a spotty coverage of 802.11b wireless coverage using both the existing School's wireless system (Tsunami) and the Campus Enterprise wireless system (CruzNet). The school is in the process of installing a 802.11b/g wireless network to provide uniform coverage through Engineering 2 and the Baskin Engineering Building. We envision this system to provide coverage for both the SOE mac addressed authentication system and the more restrictive and secure CruzNet system.

The CruzNet system in place on much of the UCSC campus meets a low level need for wireless, however SOE faculty and students require a less restrictive and more flexible wireless system. CruzNet policies are set to protect campus administrative users and systems and do not account for many research and instructional requirements which faculty and graduate students in the School require. Thus the ability to provide multiple wireless systems, some enterprise level (such as CruzNet) and others more aligned with research and instructional needs must be available. This can be provided for by allowing multiple wireless systems to coexist by using different service set identifiers (SSIDs) for different services. Local ITS specialists and CruzNet personnel should work together to achieve a system that accommodates multiple levels of service.

C. Virtual Private Networks

Increasing requirements of SOE community members for access to services from non-SOE managed networks will require the use of a secure means to connect to shared resources. A Virtual Private Network (VPN) should be installed and maintained so that faculty, students and staff members can securely use computing resources at the School from any location in the world.

A second VPN is needed to extend SOE networking and services to the Silicon Valley Center. The SOE Silicon Valley Center VPN would allow SOE members at SVC to receive the same computer services that they currently receive when on site in Baskin Engineering or Engineering 2.

D. Enterprise Computing Services – Email, Webserver, Filestorage

The School of Engineering has since the beginning operated its own email system, web server, file storage and backup. As of December 2005, the UCSC campus is consolidating IT support under a single organization reporting to the Campus Vice Provost of Information Technology. Engineering Schools need to implement rapid advances on their email, web and filestorage systems. Quite often these rapid advances have benefits associated with them that other units on campus do not immediately require, appreciate or even comprehend. SOE must retain a separate email, web and file storage with backup that can be rapidly modified without the extensive budget, project and change management processes the remainder of the campus requires. The School recognizes a need for extensive governance and configuration management processes for campus-wide enterprises systems, however those processes inhibit risk taking and the adoption of bleeding edge technologies. SOE requires rapid advancement and adoption of bleeding edge technologies to obtain excellence in our programs. Many of these technologies are common place in other research engineering schools but are often considered ill-suited for the remainder of the campus.

E. Computational Computing, As of December 2005, SOE operated four shared general purpose unix login servers, 2 computational servers and a graduate computing lab (BE-340). These systems are currently inadequate for support of research and graduate instructional in the School. The computing infrastructure committee (CIC) has recommended the following projects be implemented:

- General purpose computational cluster computing system – for use only by SOE students, this would provide a multi-system general purpose login server. At times the system would also permit, multiple job processing to various computers as well;
- Secure Computing System – for use by faculty and students involved with proprietary data, such as the MOSIS research program.
- General Purpose Login Servers – multiple Linux, Sun Solaris on Sparc, Sun Solaris on X86, Mac OS10 servers are required to compile, test and run various instructional and research efforts under these different operating systems.

- Graduate Computing Laboratory Expansion – currently BE340 is available for general purpose graduate computing. Department faculty in Computer Engineering and Computer Science have setup department labs in the Engineering 2 building. Those new labs along with labs for the AMS, BME and EE departments should be equipped to allow new students without research sponsorship a place to work with appropriate computing resources.

F. Physical Infrastructure Improvements – Data Centers

The School has research work and services that is critical to researchers throughout the world (for example Genome Data). Some of this data and computational capability must remain operational 24/7/365. As such, the School needs to have data center facilities and support that is robust and can operate through power outages, earthquakes and individual system failures. The School should partner with ITS on a multi-faceted approach towards improving and developing data centers with as much redundancy and robustness as possible. These plans should take into account short-term needs and abilities along with the longer term view that a major campus data center will be built at the 2300 Delaware Street building.

As of December 2005, the School (including CBSE) operates out of four datacenters (BE213, BE250, E2-208, E2-594). Short term plans include relocating all critical core computing services to the E2-208 data center as E2-208 has modern data center infrastructures for fire suppression, backup generator power, main UPS support with emergency power off, redundant air conditioning and seismic isolation rack mounting. The acknowledged single point of failure for E2-208 is the lack of air conditioning during a power outage. That problem must be address immediately as well as backup power air conditioning for the E2-594 data center.

Longer term plans should include a through review of the facilities in BE213, 250 and 252 with the intent to develop a prioritized improvement list that would bring these facilities to the highest reliability status as possible. Some of these improvements may include the following:

- Backup generator power to BE213, BE250, to include backup power to air conditioning;
- Install FM200 fire extinguishing systems to BE213, 250, 252;
- Increase the size of UPS systems for BE250;
- Install seismic “iso-base” plates for racks in E2-594, BE213, BE250; and
- Ensure all network routers and switches connecting these data centers to the internet have UPS, redundant power supplies and connections to backup generator power.

5. Special Class Instructional Laboratories –

A. Addition and Expansion of Existing Labs, As of December 2005, the School has 10 special class instructional labs primarily used by the Computer Engineering and Electrical Engineering Departments. A list of these labs is as follows:

- BE-104 Digital Logic Lab;
- BE-111 Signals Lab;
- BE-113 Circuits Lab;
- BE-115 Robotics Lab (new since December 2001);
- BE148 Laser/Optics Lab (new since December 2001);
- BE150 Advanced Digital Logic Lab;
- BE161 Electromagnetics & RF Lab;
- BE162 Semiconductor Materials Lab;
- BE168 Networking Lab (new since December 2001); and
- E2-592 - Advanced Networking Lab (new since December 2001).

Several additional labs will likely be established after December 2005. Instructional labs in various states of planning or investigation include:

- Senior Projects Labs, two each (for CMPE-EE123A/B);
- Biomolecular Engineering Labs, two each;
- Computer Gaming Lab;
- Silicon Valley Center Lab; and
- Nanofabrication/Characterization Lab.

B. Dedicated Computer Science Instructional Labs

As of December 2005, the Computer Science department uses the UCSC Campus instructional computing (IC) laboratories. The IC laboratories are general-purpose computing environments arranged to serve a wide variety of courses from all campus departments and divisions. Computer Science undergraduate studies require far more access to hardware and software than is physically obtainable from these campus open labs. Also many CS courses would like their undergraduate students to install, administer, experiment with and maintain software as part of the curriculum. This is especially true for operating systems, E-Commerce, internet and database software. Many of our Junior Colleges transfer students had these resources at their JC Campus only to find it lacking at UCSC.

In the December 2001 version of this document, it was said "the School plans to investigate providing a few specialized Computer Science computing labs principally for upper division courses. These labs would not be open to the general campus population and could be configurable depending upon the sole needs of the CS Department. Many CS courses would likely continue to utilize the campus IC labs when possible, especially for lower division courses where requirements for unimpeded access are not required."

As of December 2005, the School has not identified space or funding to provide dedicated Computer Science undergraduate computing labs.

6. Research and Instructional Laboratory Support

A. Machine Shop Requirements

Presently the Division of Physical and Biological Sciences (PBSci) operate a machine shop with a single machinist. The machine shop has two areas; a staff operated machine shop and an area where students, after considerable training, are allowed to use. The availability of the PBSci machine shop facilities to SOE community members historically has been spotty at best. The shop is only available when the PBSci machinist is present and not deeply involved in his own projects.

SOE researchers and especially students working on senior projects require less restricted access to the shop. Quite often they are working round the clock on projects and require after hours access to the shop. SOE faculty requested the School either develop its own machine shop or provide resources and means to expand the PBSci Machine Shop access for after hours use.

B. Fabrication Space

A shop area to do fabrications of circuit boards, simple hardware and to house our new laser cutter system is needed. This fabrication space previously existed within the BELS group, however that space was reallocated when the BELS group was relocated for the Nanotechnlogy lab (BE64).

C. Outside Shop and Research/Robotic Vehicle Assembly Area

SOE faculty have requested work space for larger robotic vehicles. Gabriel Elkheim of the Computer Engineering Dept currently has a robotic sailboat and may receive a robotic land vehicle used in DARPA's autonomous land vehicle challenge. Shop space to house, assemble and test these vehicles is necessary to continue this research.

7. Silicon Valley Center – Requirements

A number of faculty and students will be working out of the Silicon Valley Center at NASA Ames Research Park. This location will need to support instruction, research work and faculty working intermittently between this site and the main UCSC campus. As of December 2005, it is hoped that SOE members will be working out of Building 19 at the NASA Research Park. At some point in the future two new buildings may be constructed. An instructional classroom and office building may be commissioned by Foothill-De Anza College District. UCSC may lease instructional and office space in the proposed building. The other building is expected to be a wetlab nanotechnology

research building that will be part of the Bio-Info-Nano Research and Development Institute.

A. SVC Server Room

As of December 2005, it is expected that over the next two years, up to 3 racks of research servers may be installed at the SVC Building 19 site. When the new buildings are programmed and designed for NASA-Ames Research Park, an important part is to include a Tier III or IV data center as part of that construction.

B. Video Conferencing

It is expected that the campus will provide a most amount of video conferencing and distance learning equipment at the Building 19 site. This is required to permit faculty to teach simultaneously to students at SVC and the UCSC main campus. It is also necessary for researchers collaborating between the two sites and elsewhere in the world.

C. SVC-SOE Virtual Private Network (VPN)

A VPN is needed to extend SOE networking and services to the Silicon Valley Center. The SOE Silicon Valley Center VPN would allow SOE members at SVC to receive the same computer services that they currently receive when on site in Baskin Engineering or Engineering 2. Presently the campus runs two separate VPNs to the SVC site, however neither will permit SOE networking services to operate. In December 2005, campus networking personnel acknowledge a need to setup a third VPN to provide SOE members at SVC this access.

8. Physical Security, Infrastructure and Environmental Monitoring Infrastructure

The campus should invest in remote camera systems, omnilocks, card-key access to rooms and hard-wired doors for sensitive areas such as laboratories containing expensive equipment. Electrical and environmental monitoring is needed to ensure laboratory facilities are receiving proper utilities and that problems are noted before significant research work has been adversely affected.

A. Building and Laboratory Physical Security

The Engineering 2 building was built using centrally monitored and controlled card-key access system. Jack Baskin Engineering building uses hard keys for most labs and individual combination cipher locks (omnilocks) for instructional lab spaces. Often hard keys are not returned or are lost by various students. Physical security to many of these lab spaces cannot be controlled to a reasonable level. Nearly all of these labs contain very expensive test equipment and computers. It is imperative that a robust physical security system that can

quickly lock out undesired individuals be implemented. It is recommended the card key system installed in Engineering 2 be extended to the Jack Baskin Engineering building outer doors. For Baskin Engineering, all lab doors should be equipped with the card key system (optimum solution) or with omnilocks.

B. Electrical Power Monitoring and Improvements

Since December 2001, the electrical grid serving Baskin Engineering and Engineering 2 has failed with seemly increasing and lengthy occurrences. Some of these failures are attributed to PG&E electrical distribution problems; however an increasing number of failures have been due to campus electrical grid shortcomings, either in capacity or in maintenance.

Campus Electrical Engineers have expressed concern about the deteriorating shape of the University owned electrical distribution system. Most of this system is over 40 years old and is close to absolute capacity. In some cases, a single failure may cause the campus to go dark for days. For a research campus, this is unacceptable and must be remedied. The campus must should install a second feeder to the core of campus and provide electrical capacity and reducancy that is needed for new buildings on campus.

While these grid failures have occurred, SOE and other units on campus have experienced a higher than normal rate of failure of computer, UPS and electronic test equipment components. SOE faculty feel these failures are due to noisy line power, power surges and potential currents on neutral and ground wires. Sometime after December 2005, SOE expects to bring on line several nanotechnology and Biomolecular Engineering Labs. These labs will be far more sensitive to “dirty” electrical power than computer systems. Monitoring of the electrical systems serving Baskin Engineering will be necessary to ensure proper filtering and conditioning of power is applied when needed. Monitoring of the electrical systems serving the Engineering 2 building is recommended to reduce the possibility of system failures due to long term dirty electrical power.

C. Environmental Monitoring

Several areas of Baskin Engineering and Engineering 2 require monitoring of environmental parameters such as temperature, humidity, and air flow. This is needed to ensure laboratory work proceeds without disruption and/or destroying results of sensitive fabrications and experiments. These monitoring systems should be tied back to an automated reporting system to immediately alert facilities and laboratory personnel to environmental problems.

6. Library Resources

In this age of the Internet and Worldwide Web, electronic access to technical journals, conference proceedings and related materials and databases is key to the success of successful graduate programs, across all divisions. This is particularly true of the professional societies. At the same time, need for access to traditional printed technical materials is declining. Electronic versions of some technical journals can be very expensive, especially from the European for-profit publishers. However, it is becoming increasingly important that faculty and graduate students have access to online research resources from the major technical publishers. Therefore, it is recommended that the campus place a high priority on investigating ways of providing faculty and graduate students with electronic access to the principal research and instruction resources in fields of relevance to the School. Each department should be consulted on the specific online resources are of greatest importance to their research and teaching.