

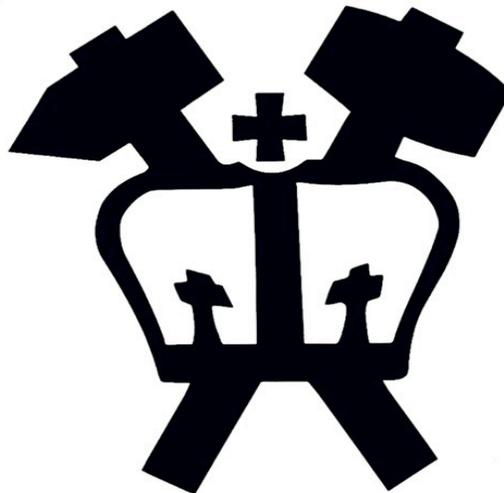
Report of the
Long Range Planning Committee

Of the SEAS Board of Visitors

The Fu Foundation School of Engineering and Applied Science
Columbia University

To Dean Zvi Galil

May 1, 2007



A 2020 Vision for SEAS

Table of Contents

Preface_____	page 4
SEAS Today_____	page 4
Present Competitive Standing	
SEAS in the Future_____	page 8
Selecting Academic and Research Areas for the Future_____	page 10
A Small School Needs to Focus	
Graduating "Non-Engineers"	
SEAS as an International Institution_____	page 13
New Globalization Initiative	
Other Recommendations_____	page 15
Using Technology in the Classroom	
Continuing Education Programs	
The SEAS Environment	
Physical Space Requirements_____	page 17
Funding the Long Range Plan_____	page 18
A New Campaign	
Declining Government Support for Research	
The Strategic Planning Process_____	page 20
Conclusion_____	page 22
Appendices	
A - Project Participants_____	page 24
B - SEAS's Accomplishments Over the Past Decade_____	page 25
C - SEAS - SWOT Analysis_____	page 26

Table of Contents continued

D - Competitive Positioning Appendices:

D-1 - Top Graduate Engineering Program Ranking Overview_____	page 27
D-2 - Top 20 Ranked Graduate Engineering Programs_____	page 28
D-3 - Schools with Research Centers and Most Research Expenditure/Faculty_____	page 29
D-4 - SEAS Grants Fewer PhDs Than Other Top-Ranked Engineering Schools_____	page 30
D-5 - SEAS May Have an Opportunity to Increase Faculty in the NAE_____	page 31
D-6 - Top-10 Schools are Usually in Top 5 of at Least One Specialty Area_____	page 32
D-7 - Strategic Plans: Competitive Schools_____	page 33
D-8 - Cost of Living Comparison_____	page 34

Preface

In May 2005, the Engineering Council of Columbia University's Fu Foundation School of Engineering and Applied Science, now renamed the SEAS Board of Visitors, was asked by Dean Zvi Galil to undertake an examination of the long range outlook for the School. The project involved studying the environment in which SEAS would operate, assessing the School's strengths and weaknesses (both on an absolute basis and relative to its peers), and making recommendations for a long range plan that SEAS could follow to achieve the agreed-upon vision.

This report is the result of nearly two years of effort by 30 participants, each of whom devoted a great deal of time and thought to this project. In their work, these participants met with faculty, administration, students, and McKinsey & Co. consultants. All of the interviews, research, findings, and presentations of the Committee (including some suggestions not adopted in this report) are contained in a web site at:

<http://projects.seas.columbia.edu/ecouncil/index.php>

In the course of conducting the study, the Committee chose to focus on a 15-year time horizon, as that represented a period long enough in which to effect significant change, yet short enough to be measurable and meaningful to the current participants. Fifteen years brought us to 2020, and hence we have nicknamed this plan "A 2020 Vision for SEAS". This document summarizes the findings and recommendations of the Planning Committee and prepares the ground for their implementation.

SEAS Today

SEAS is in the best shape it has ever been in, academically, financially, scientifically and emotionally. The School attracts a culturally diverse and intellectually rich community of students and faculty, who together form an environment that fosters innovation, technical knowledge for industrial proficiency, and societal leadership. The School has always focused on leadership training in classic engineering disciplines and applied science and on state-of-the-art research rather than on vocational training. SEAS is

acknowledged to be a superb engineering school, whose eminence is increasingly recognized by others.

A total of 3,262 students applied to SEAS this year, a 21% increase over last year. 18.1% were admitted, the lowest acceptance rate in the School's history. In the past decade, SEAS's undergraduate enrollment has increased by 40%, with students' average SAT scores several points higher than those of Columbia College. SEAS's faculty has increased during this period by 50%, with 15 members elected to the prestigious National Academy of Engineering. The School now houses four NSF-NIH funded interdisciplinary centers and its annual research funding has tripled since 1997. SEAS's annual fund has increased by a factor of 4 and SEAS students are currently involved with 30 different non-profit organizations working on more than 70 community projects as well as the international "Engineers Without Borders". SEAS's progress over this period has been recognized, with its national standing rising from 28 to number 19 in the 2007 U.S. News & World Report survey of America's Best Graduate Schools.

There is a contagiously positive spirit pervading the school that has resulted in a significant rise in its status within the Columbia community. Yet, despite the extraordinary accomplishments of SEAS graduates and faculty in research, industry, and society (see Appendix B for details on the school's most significant accomplishments), the School is not as highly rated in national surveys as its alumni, faculty, and students believe it deserves. While rankings are always debatable—with those in US N&WR being biased in several ways in favor of traditional engineering disciplines and against smaller schools—the fact is that SEAS is not, and has not been, rated among the top 10 engineering schools in the US. In fact, a top-10 ranking has never even been one of the school's stated goals. Given the consistent top-10 ratings held by Columbia College, Law School, Business School, Medical School, School of Journalism, International Affairs, Teacher's College and Architecture, SEAS ratings are indeed disappointing.

This Committee recommends that SEAS undertake, as a long range goal, the significant improvement of its national standing to reach top-10 status.

SEAS's stature has risen considerably over the last decade because of the changes made to selectively pursue research in key emerging technologies and applied sciences, to promote interdisciplinary activities and accommodate new technologies, to recruit the very best faculty in each field and to provide them with adequate resources to pursue their world-class research. Increasing the size of the SEAS faculty and the number of doctoral candidates in its student body is a necessary part of attaining an improved ranking. Presidential Fellowships have been very effective tools for recruiting the best graduate students and additional candidates. Resources should be made available to expand such programs. At the same time, the School should continue to hire internationally-renowned faculty who have the ability to make significant contributions to their departments and, in turn, to attract better students and funding. Growth of the undergraduate student body should follow the expansion of the faculty and of the graduate programs.

Distinguishing characteristics of the School include its location in New York City, as part of Columbia University, and its participation in the Core Curriculum, which differentiates the undergraduate program from most other engineering programs in the US. These strengths will endure for the future and are important to the success of this Long Range Plan.

Although it offers much to its students and faculty, SEAS suffers from its small size, which forces resources to be spread thinly over many competing departments and programs. The most basic questions facing the school today are whether it is "right sized" and, if it decides to grow, how much of an increase is required and how fast can that increase be enacted (see Appendix B for growth of SEAS 1995-2005).

Present Competitive Standing

Although some consider it flawed, the most widely followed ranking of domestic engineering programs (and the only one published annually) is the U.S. News & World Report survey of America's Best Graduate Schools. The methodology used to construct this list employs "qualitative" measures (peer reviews and recruiter rankings) and "quantitative" ones (GRE scores, acceptance rates, doctoral student-faculty ratio, percent of faculty in the National Academy of Engineering, total research expenditure, research

expenditure per faculty member, and total number of doctoral degrees awarded). Forty percent of a school's overall score is based on the qualitative factors, with the remaining 60 percent coming from the quantitative measures.

While qualitative measures make up a significant portion of the rankings, they are not easy to influence directly (e.g., it is difficult to convince other schools to respect SEAS more). To facilitate the planning process, we developed a model to predict a school's overall score based solely on quantitative measures. One point that came across in our analysis is that SEAS's overall ranking is roughly in line with what the model predicted it would be, based on quantitative inputs. By extension, our reputation among peers and recruiters is what one would expect, given the size of our school, our research budget, and the quality of our faculty and students.

Though the focus of our analysis was on graduate schools, we did examine undergraduate rankings as well. The methodology used to rank undergraduate engineering schools is purely subjective, so even though SEAS's undergraduates score relatively high on such quantitative measures as the SATs, the school is still ranked relatively low. We found that an undergraduate engineering school's ranking is highly correlated to that of its graduate school. Improving SEAS's graduate program should have a positive effect on the undergraduate school rankings as well. In addition, the School should better communicate the accomplishments of its undergraduate program, in order to improve its reputation among peers.

Appendix D contains highlights of our analysis of competing engineering programs, including an assessment of specific areas where SEAS needs to improve its activities. From this analysis, we concluded that the best way to improve SEAS's ranking is to start by increasing the size of the faculty and doctoral student body. The school is already relatively efficient (with \$635,000 in research expenditure per faculty member), but its small size (133 faculty doing research (out of a total of 151) and 545 doctoral students) places a cap on how much research it can undertake.

Assuming SEAS can grow while maintaining the quality of its faculty (represented by percentage in the NAE and research expenditure per faculty member) and graduate students (represented by GRE scores and

acceptance rate), we would need to expand the program by roughly 80% in order to reach the top 10. This would translate to 106 new faculty positions, \$68 million in additional research funds, and 67 more doctoral awards per year. If we relax our admission standards (which is not recommended), we would need to expand the program by 90% to achieve the same standing.

Conversely, an increase in the quality of our faculty or students would require a somewhat smaller increase in the size of the school. This could be achieved by focusing on major improvements in one or two specialty areas, with an eye toward attaining top-5 status in these specialties (see Appendix D-6). That would directly increase the school's overall research expenditure and would likely have a disproportionately positive impact on peer and recruiter assessments as well. For example, Carnegie Mellon, by focusing on its computer science program, is able to achieve a ranking of #6, while having only 75 more faculty members and awarding only 58 more doctoral degrees per year than SEAS. On a different front, we could work to increase the number of world-renowned SEAS faculty, helping to attract more highly qualified doctoral students and winning a greater share of research grants. The creation of a major NSF- or independently-funded research center would have a similar effect.

While SEAS certainly has room to rise, it is important to note that, as a small engineering school within a large liberal arts university, its place in the rankings is not unusual. In fact, the school's 19th-place position makes it the third highest-ranking Ivy: below Cornell (#10) and Princeton (#18), but above Harvard (#23), Penn (#29), Yale (#37), Dartmouth (#47), and Brown (#53). SEAS is the best engineering school in New York City. That being said, there's nothing specific that prevents us from becoming a top engineering school at the national level, given the necessary focus and commitment.

SEAS in the Future

A great deal has been written about the seminal role of science and technology in the 21st century. Many global universities, recognizing that they cannot maintain their preeminence without developing excellence in technology as well as liberal arts, have reacted by making engineering a new

priority in their future growth plans. This is a fundamental change in education—as fundamental as the 18th century evolution of Ivy League schools from teaching theology to teaching the liberal arts. This trend may be best exemplified by Harvard and Yale Universities, both of which have announced major new programs to create leading engineering schools. Columbia University already has a solid School of Engineering and Applied Science. The challenge for the future is how to turn that strength into a core capability for the entire University.

In the 21st century, engineering knowledge will grow in importance, as technology becomes the basis for global competition and development. SEAS's role on the world stage can become a leading one if it seizes the opportunity to become a globally-recognized center of engineering excellence. The School's combination of engineering, science, humanities, history, and social responsibility represents an ideal that developing countries are already seeking to emulate. As engineering and public policy continue to converge, engineers will have to be more aware than ever of the social impact of their work. The opportunity for SEAS could not be more bright or compelling.

With global corporations locating their engineering, design and manufacturing facilities in increasingly dispersed countries, SEAS must follow its "clients" (the companies that hire our graduates and fund our research) to these markets. By forming collaborations with local universities and educating its students in the skills needed to operate in this new world, SEAS will help ensure that it remains a source of engineering talent. Furthermore, as design and engineering work becomes more networked and collaborative, often involving engineers on three continents simultaneously, SEAS must train its engineers to understand local and global practices, and to appreciate the differences and similarities of the dispersed marketplaces in which they will be competing. SEAS will gain a great deal by maintaining local presences from which to educate, sponsor research, and recruit new teachers and the best students.

The Board of Visitors recommends that SEAS continue its commitment to provide a broad education for "global citizen engineers".

Selecting Academic and Research Areas for the Future

A Small School Needs to Focus

A small school, by definition, cannot offer as many courses as a large school. Traditionally, SEAS has resisted over-specialization, opting instead to offer a broad-based general engineering education supplemented by the opportunity to take liberal arts courses at Columbia College. The Committee debated whether SEAS would be better off as a highly-rated engineering school focused on state-of-the-art technologies rather than as a mid-rated, generalist engineering school. Our recommendation avoids both extremes and opts instead for a balanced program of teaching both emerging and traditional disciplines.

To attain top-10 ranking as a still "smallish" school, SEAS must focus on two or three research thrusts in each department, where it can attain and maintain global excellence and prominence, and then select the best from these candidates. To get the most out of a smaller effort, SEAS must give serious thought to establishing a strategy that can enhance its reputation across all departments, be implemented from the School's current base, appeal to its faculty, and assist its students in obtaining jobs in their selected fields. SEAS might choose from the same list of "hot" areas as other engineering schools (e.g., nanotechnology, biotechnology, and alternative energy). (See Appendix D-7.) Or, it might choose to focus on emerging societal needs and technologies rather than on mature industries. SEAS's Chemical Engineering Department has, for example, de-emphasized chemical plant design in favor of fuel cell design and alternative energy. A major focus on emerging technologies would continue SEAS's efforts to recruit new faculty "superstars" whose reputation often makes such a department world class from the outset. It is assumed that such faculty would be able to attract enough external funding and new graduate students to pay for their higher-than-average costs.

SEAS must also encourage its faculty to continue offering interdisciplinary instruction, whether across departments (such as nanotechnology, which involves mechanical engineering, materials science, applied physics and

chemical engineering) or across schools (such as the relationship between the Department of Bioengineering and the Medical School or the Earth Institute and several SEAS departments). These interdisciplinary efforts may require a redefinition of traditional departments and a level of interaction between autonomous parts of Columbia that has not existed before. Harvard's Planning Committee on Science and Engineering recently devoted the majority of its long term planning report to the management of such interdisciplinary efforts. SEAS and Columbia University's administration need to continue to actively promote such interdisciplinary efforts, highlighting them as a hallmark of a Columbia education.

We recommend that a standing committee of faculty, administration, students, and alumni address the issue of selecting new and interdisciplinary technology focuses in the near term, and monitor their implementation throughout the period covered by the Long Range Plan.

As shown in Appendix D-6, Columbia's traditional engineering departments often rate below their peers. To advance in the rankings and attain top-10 status, these gaps must be closed. These statistics highlight the ongoing need to hire the very best faculty members possible in both new and traditional departments and then encouraging/sponsoring more of them to apply to the National Academy of Engineering. Having SEAS professors on the NAE Peer Review Committees would be helpful in recruiting other great teachers and would also help to improve the School's rankings. Most such surveys do not reflect SEAS's great progress in Applied Sciences, which involve departments and disciplines that are tracked less actively than traditional engineering majors.

SEAS already has formed an Academic Development Planning Team, consisting of faculty, alumni, and administrators, which has the specific responsibility to address academic issues. These include changes to the curriculum, recommending new areas of concentration, recruiting new faculty, defining space requirements, and other related matters. The Team also will try to identify areas where SEAS can better integrate itself with other academic units at Columbia, and better utilize its unique location in New York City.

At the undergraduate level, the record breaking SAT scores of each entering class attest to the very impressive quality and sophistication of our student body. Students have told us repeatedly that they have chosen SEAS because of its well rounded engineering program, including the Core Curriculum, its New York City location and the state of the art research being performed by SEAS professors. They speak glowingly of the Gateway Labs as an introduction to engineering disciplines and speak of their aspirations to follow in the footsteps of the giants of industry and technology who have preceded them here. Those accolades are indicative of our interviews with students, which indicate that all is well at SEAS and that we are operating from a strong base. However, in order to maintain that position in a rapidly changing technological and competitive educational environment, SEAS must continue its strong focus on constantly improving courses and services offered to undergraduates in order to maintain that high level of satisfaction.

Graduating "Non-Engineers"

Some SEAS graduates have voiced their concerns that SEAS is becoming an engineering school for non-engineers. They fear for the decline of traditional engineering disciplines and ask whether admitted first-years are already on the road to non-engineering careers, or if Columbia's Engineering education, environment, and recruiting opportunities change their career plans? These questions are critical to the establishment of a long range plan for the school and deserve to be aired and examined.

SEAS Dean Morton B. Friedman has said that "Engineering is the liberal arts of the 21st century." His sentiment is perhaps best illustrated by China, where the President, Vice President, and two Vice Premiers were all trained as engineers. This is not a chance occurrence—in the last administration, two-thirds of China's Politburo were trained in engineering and natural sciences.¹ These leaders increasingly are coming, not from Peking University, but from Tsinghua University, known as the "MIT of China."

We recommend that SEAS recognize its outstanding ability to offer a superior education to those not pursuing a technical track beyond the

¹ Foreign Affairs, December 2001, Lucien Pye

undergraduate level. It should continue to build on the excellent reputation of its financial engineering courses and graduates, and expand the programs it offers with Columbia Business School as well as other schools at Columbia.

With Wall Street just a short ride away, SEAS has long been a source of financial professionals. It should continue to build on the excellent reputation of its financial engineering courses and graduates, and expand the programs it offers with Columbia Business School, including a joint BS/MBA degree. At the same time, it may want to examine opportunities for collaboration with other parts of Columbia. These programs should not be viewed as replacements for an engineering education, but rather as a supplement to it.

The challenge to SEAS is to be able to train engineers who seek careers in non-engineering professions without sacrificing its reputation for research and engineering education and without losing its core competencies in traditional areas. In an era when policy makers in business and government are asked to understand complex technologies, Columbia's Engineering graduates are particularly well prepared to pair their technical undergraduate education with graduate training and careers in non-technical areas.

SEAS as an International Institution

SEAS is among the most international of all of Columbia's colleges. This is evidenced not only by its student body, but also by its faculty and administration. There are both threats and opportunities in this international capability.

Several members of this Committee have questioned how international SEAS should be in the future. Should there be a limit on the percentage of non-US students or faculty? Will the current surplus of international candidates for teaching and graduate student positions continue?

Nearly all engineering schools seem to have a doctoral student body containing more than 50% non-U.S. students. That being said, the difficulty

of obtaining visas post 9/11 and the rise of alternative schools in Asia may continue to erode the available pool of non-US candidates for both teaching and post-graduate positions.

As SEAS grows in size and reputation, it must continue to maintain its existing balance of teaching Americans and foreign students of the highest caliber. That balance is a hallmark of a great global University.

New Globalization Initiative

The Committee discovered that SEAS has international activities underway today in more than 20 countries. All these projects were created and sponsored by individual professors; few resulted from departmental connections and *none* had any affiliation or sponsorship at the University level.

We proceeded to examine the international efforts of other universities, of which there were many. International programs included joint research, combined degrees, semesters abroad, distance learning, and satellite colleges. They were funded by foreign governments, international corporations, international grants, individual scholarships, and university grants.

There were many benefits to these foreign programs. Students with international experience are highly coveted by employers, the sponsoring school's reputation is often enhanced, and these international exposures provided access to exceptional new foreign students and faculty.

However, these foreign programs also carry with them challenges, from housing and funding, to reciprocity of credits for courses taken, to government restrictions on classified research and subsequent problems with sharing patent and royalty income. Perhaps the biggest problem (one that has ended many foreign initiatives we studied) was the need to relocate faculty for extensive periods of time. Once the original sponsors of these programs returned home, the projects they facilitated often atrophied.

One of the recommendations the Committee felt most strongly about was that, over the next 15 years, SEAS should create a strategy for globalizing its brand by creating a greater presence abroad.

In reviewing the various existing foreign initiatives, the Committee felt that **opening extensions of the SEAS Tech Centers abroad** would be the fastest and least risky way to expand the Columbia SEAS brand. These should be reciprocal arrangements where each foreign partner would also establish a tech center at SEAS. To aid in this effort, we established a **Globalization Development Task Force**, led by several faculty members who will prioritize countries and projects. Each of these programs requires a faculty "champion" who will not only establish the international effort, but also oversee its staffing, curriculum, funding, and other requirements. The results of this Task Force's work will be reported to the Dean later this year. The University's help in promulgating and implementing such international efforts and integrating them with the efforts of other Columbia schools is both needed and welcome.

Unlike Columbia College students, very few SEAS undergraduates spend a semester abroad. This is not due to a lack of interest but rather to the scheduling of classes, especially those in a sequence. **The Committee recommends that SEAS explore options for undergraduates to take a semester abroad at schools where credits can be earned.** SEAS should also explore and sponsor a reciprocal foreign summer program for its students. One way to implement a foreign studies program would be to establish a new five-year, joint degree program. SEAS's current 3/2 program with Columbia College and more than 100 other liberal arts schools could be a model for such a program.

Other Recommendations

The Committee became aware of several other issues that are perhaps more tactical than strategic, but were nonetheless considered to be important. These varied from specific suggestions, such as the offering of biology as a science option to first-year students, to expanding the Columbia Video Network ("CVN").

Using Technology in the Classroom

By its very nature, SEAS is at the forefront of understanding, developing and promoting the use of technology in every aspect of modern life. One essential aspect is teaching and learning. SEAS already has rewired many of its classrooms and has added new audiovisual and computer facilities. The next step is to find new ways to "teach the teachers" on how to best use these new technologies. Although it is a source of technological innovation, SEAS has not itself adopted the latest technologies for teaching its own courses.

Continuing Education Programs

Columbia's Business School has begun an effort to identify the lifetime benefit of a Columbia MBA degree. A similar effort could identify the need for continuing education for SEAS graduates. As the rate of technological progress continues to increase, so too does the need for lifelong learning. These needs can be met for SEAS graduates through the formation of new "short" courses intended to refresh and update knowledge in particular disciplines. Such courses can take the form already in use by several business schools for intermediate degree programs. It also is possible that such courses can be taught using the Columbia Video Network ("CVN"), the School's award-winning on-line distance learning program. These refresher courses, open to any engineering graduate, could generate significant demand from non-SEAS graduates as well and could be very profitable.

Joint efforts with other engineering school faculties, under SEAS's auspices, could share the teaching burden, with SEAS acting as the marketer and distributor of continuing education (under its own label). The School also could undertake these refresher courses in collaboration with industrial laboratories and research facilities that could help subsidize the programs, define the most important new skills to teach, and provide teaching assistance. From the viewpoint of faculty, participation in the creation and execution of such programs should be considered on a par with research and classroom teaching. We believe that expanding CVN can drive revenue growth while improving the School's reputation.

The SEAS Environment

Under Dean Zvi Galil's leadership, SEAS has seen a significant increase in the quality of undergraduate student life. Nonetheless, about half the school's population is comprised of graduate students. Greater effort needs to be expended to improve the quality of their lives, from social interactions to better housing to improved job placements. **The need for better academic and career advisement are perennial complaints heard from SEAS students at every level.** These concerns should be addressed immediately.

School spirit also appears to be much stronger at the undergraduate level than among graduate students. Since school spirit leads directly to greater involvement in SEAS after graduation and to greater donation and recruiting levels, it must be improved. The School already has stepped up its efforts to remain in communication with alumni. Those efforts should continue at or above the current level.

Physical Space Requirements

The Manhattanville expansion will alleviate some of the significant space constraints that have prevented departmental growth in the past. Some departments are split apart and others have separated labs from classrooms and offices. SEAS should undertake a fresh review of physical space availability and layout once the new plan is in place and growth patterns for the future are clearer.

A preliminary estimate forecasts that an additional 220,000 square feet of space will be needed, primarily for graduate students and for research. An expanding undergraduate student body also would require additional dormitory space. The exact space requirements must await the completion of the SEAS facilities plan, which is now underway and should be completed by year-end.

In the near future, the Core Curriculum and joint housing will continue to anchor SEAS undergrads to the main campus. Expansion to Manhattanville may therefore initially involve mostly graduate students and research

facilities. However, as Columbia College develops its own plans for Manhattanville, SEAS should track and cooperate with those plans in order to best serve its undergraduates.

Funding the Long Range Plan

A New Campaign

The implementation of this Long Range Plan will require new funding commitments. In addition to the current \$125 million campaign, we propose establishing a new fundraising effort, entitled "A 2020 Vision for SEAS," to help support and implement the Plan. This program can incorporate many of the specific plans outlined in this report, each of which can become a "fundable" project. We are still working on the total funding requirements on this plan, which requires completion of the real estate plan and further examination of undergraduate expansion options.

The 2020 Fund should be open throughout the 15-year period it addresses. It should target current and future graduates at both the undergraduate and graduate levels, helping to expose them to the idea of fund raising while they are still students at SEAS. New SEAS graduates will, in the course of 15 years, become productive members of society who can afford to fund the repositioning of their alma mater. Other donors, including corporations, are also likely to find this an important project, worthy of their support.

Support from Columbia University

This is a Long Range Plan for The Fu Foundation School of Engineering and Applied Science—but it can not be achieved in a vacuum. SEAS needs total "buy-in" from the Columbia University Administration to support this Plan's goals, recommendations and implementation. The University should publicly express that support and include SEAS's plans in its own planning efforts. SEAS needs to become an integral part of Columbia's overall campaign in the U.S. and abroad. The continuing ascendancy of SEAS, forecast in the Plan, will accrue to Columbia University's benefit in many ways and is worthy of full-hearted support.

The fifteen year goals outlined in this plan will be achieved incrementally over the Plan period. There will be many interim requirements along that path, including space and funding. To accommodate SEAS's growth, interim space will have to be found, perhaps in the Northwest Science Building, perhaps elsewhere. The University will demonstrate its commitment to a strong engineering and applied science school by showing its willingness to partner with SEAS throughout this Plan period.

The SEAS Development Office Should be Substantially Expanded

Money spent on expanding the SEAS Development Office is more than recouped by its productivity in bringing in new funding. Additional efforts should be made to help SEAS faculty identify and obtain outside grants.

It has been suggested that perhaps SEAS does not derive full benefit from its New York City location. **The Committee recommends that SEAS attempt to improve its access to State and local funding.** SEAS also must strengthen ties to companies and institutions in the greater New York region that can be conduits for further funding. The School should approach Wall Street firms that employ so many of its financial engineering graduates about sponsoring related educational efforts. Finally, the globalization efforts cited elsewhere in this report should be accompanied by a dedicated effort to solicit funding from international corporations that can sponsor specific efforts in their home countries as well as general efforts in Morningside Heights. Z.Y. Fu's impressive gift to SEAS may be a forerunner of other non-U.S. sponsorships that could be available, if sought out.

Declining Government Support for Research

Many sources we consulted lament that federal government support for American universities may have already peaked. If this is true, SEAS will need to rely increasingly on corporate sponsorships, alumni contributions, and other sources of funding. SEAS professors have asked for more help from the central University administration in pursuing grants, patents, and licenses than is available today. The revenues from such efforts would more than offset their associated costs.

Relying more on corporate funding for research implies more work on short-term technical problem-solving rather than on theoretical research. Historically, a school's reputation has been heavily influenced by its fundamental research work, most of which was government funded. This shift to corporate-sponsored research creates a dilemma of theoretical versus applied research, which also must be addressed. In addition, some of SEAS legacy corporate relationships (Bell Labs, IBM) are declining as sponsors. They will have to be replaced by new relationships with the likes of Yahoo and Google and the investment banks, all of whom increasingly employ SEAS graduates.

New York City is an expensive place in which to operate a great University (see Appendix D-8). Nowhere is this felt more acutely than in the engineering school, where lab space is at a premium and significant cost-of-living disadvantages make it difficult to win federal contracts and recruit faculty. The costs and benefits of reducing the overheads charged to Columbia grant applications should be examined.

The Strategic Planning Process

Since Strategic Planning already exists at SEAS, we do not have to "invent" or "sell" it. Nevertheless, the quality of that planning at the departmental level ranges from superb to mediocre. The Dean's Five-Year Plan is an excellent example of an objective set of goals against which performance can be—and is—measured. The Board of Visitors should establish a permanent Planning Committee, whose job would be to monitor progress on implementing this Plan and modifying it as circumstances change.

SEAS should mandate that best practices in planning be adopted by all departments on a standardized basis. Plans should continue to contain specific objectives and measurable goals, and each department should undertake a long range planning process every three to five years, perhaps coinciding with the rotation of department chairs. All plans should fit into the broader vision outlined in this report. The Dean may wish to provide centralized professional resources to help each department prepare and monitor its plan.

The School should uniformly adopt the practice of inviting visiting experts, including SEAS alumni, to evaluate and recommend departmental practices and goals. Annual retreats by faculty members to review departmental goals and policies also should be encouraged.

Engineering school reputations depend primarily on a school's faculty and its ability to teach and conduct research. These factors of excellence are often in conflict as time spent teaching is time away from research. This is further exacerbated by the fact that funding for research typically comes from sources outside the University, while teaching is funded internally. Options to balance teaching/research loads with internal/external funding (such as the Computer Science Department's option to "buy out" of teaching loads) represent a complex, but attractive way to voluntarily have faculty both manage and fund their own workloads.

The SEAS Communications Office Should be Substantially Expanded

There is some sentiment that SEAS should have a greater voice in public forums dealing with the technology issues of our society. Greater public exposure for the Dean and key faculty members should help to raise the school's reputation and perception and is likely to attract new funding as well. To this end, SEAS should develop, fund, and implement an enhanced communications and public relations effort to "get the word out" to peers and recruiters (two groups who do not currently rate SEAS as highly as we feel we deserve) about the School's achievements and goals for the future. The "Career Fair" that SEAS hosts appears to have had a very favorable impact on the technology company recruiters who came to Columbia. Other such programs to increase awareness and improve our reputation should be undertaken as soon as possible. We found, for example, that simply providing better accommodations and coffee for recruiters, and ensuring that interviewees arrive on time, can have significant effects on our ratings. Other programs to increase recruiter and peer awareness and reputation should be undertaken as soon as possible.

Conclusion

Based upon the very impressive improvements at SEAS during the past decade and its current momentum, there is every reason to believe that a top-10 ranking is attainable within the next 15 years. SEAS is in good shape and has most of the attributes required to maintain its preeminence, expand its brand globally, and become a world-class institution.

In preparing this report, the Planning Committee has spent two years gathering information, interviewing participants at SEAS, and consulting with outside experts. The process not only has resulted in a document of recommendations, but also has raised awareness of the importance of long term planning at SEAS. The Committee has formed two Teams to pursue specific recommendations: The first is the Academic Development Team, which has been tasked with reviewing emerging technologies, developing new curricula, managing change at SEAS, and assessing space requirements. The second is the Globalization Development Team, which will evaluate specific ways in which SEAS can extend its brand overseas. This Team's work already has identified specific countries and foreign universities where existing relationships can be converted into major programs. With the participation of SEAS "champions," these projects can result in a stronger international presence for the School.

To complete these planning tasks and to monitor their post-approval implementation, we recommend that the Board of Visitors establish a permanent Long Range Planning Committee. This Committee should continue to work with the Dean of SEAS and to report to the Dean and the Board of Visitors on a regular (semi-annual) basis. The first task of this Committee will be to implement Stage 2 of the planning effort, where specific requirements and action plans required to attain the goals of this Plan will be identified. As an independent and impartial group of interested alumni, with independent resources to pursue its work, the Long Range Planning Committee of the SEAS Board of Visitors represents an appropriate body to help oversee the refinement and implementation of this important long-term vision for the school.

The members of this Committee would like to thank the many participants who helped in its efforts. We excitedly and optimistically await the outcome and implementation of our recommendations.

This project was begun at the request of Dean Galil, who has been extraordinarily supportive throughout our efforts. Unfortunately, this report coincides with Dean Galil's departure from Columbia. SEAS now needs to recruit a new Dean who will embrace the objectives cited here, putting his or her own stamp on them, and lead us forward to new heights.

APPENDIX A

Project Participants

Andrew Gaspar - Chair	David Seader	Tom Fazio
Jim Li	Dan Libby	John Kender
Armen Avanessians	Sanjiv Ahuja	Alex Whitworth
Dana Vlcek	Ted Tsung	Christian Aucoin
Frank Zovko	Anna Longobardo	David Novick
James Down	Hie Jae Kim	Garud Iyengar
Alan Silberstein	Steve Tai	Michael Bykhovsky
Bruce Lister	Jennifer Johnson	Bradley Bloch
Allan Cytryn	Greg Gonsalves	Morton Friedman
Josh Hauser	Ron Mangione	Gerry Navratil

APPENDIX B

SEAS's Accomplishments Over Past Decade

• FACULTY	<u>1995</u>	<u>2005</u>
- Members	92	151
- Academic Departments	7	9
- Annual Research Spending	\$22.1 M	\$74.9 M
- Annual Fund	\$660 K	\$2.5 M
• UNDERGRADUATE STUDENTS		
- Enrollment	974	1,400
- Applicants	1,334	2,332
- Average SAT Scores	1318	1454
- Selectivity	49%	27%
• GRADUATE STUDENTS		
- Applicants	1,673	3,148
- Selectivity	37%	38%
- Yield	36%	38%
• COLUMBIA VIDEO NETWORK (CVN)		
Forbes' "Best of Web" award for 3 years		
- Enrollment	322	1017
- Programs	7	31
• SPACE	575,000 sq. ft.	575,000 sq. ft.
• NSF-NIH FUNDED INTERDISCIPLINARY CENTERS		
- Columbia Center of Excellence in Genomic Science		\$21 M
- Columbia Center for Electron Transport in Molecular Nanostructures		\$22 M
- Materials Research Science and Engineering Center		\$15 M
- Environment Molecular Sciences Institute		\$ 5 M
• MARCONI INTERNATIONAL FELLOWSHIP FOUNDATION		
• ENGINEERING AS A LIBERAL ART:		
- Required first-year course includes service learning component		
- SEAS students working with 30 non-profit entities on over 70 local community projects		
• SEAS Participation in local Science Fairs, etc. is working to build The Columbia "Brand"		

APPENDIX C

SEAS - SWOT ANALYSIS

STRENGTHS

- New York City Location
- Leadership (Dean Galil)
- Prominence of Selective Departments
- High and Rising Global Stature
- Columbia name (brand) and access to other Columbia schools
- Excellent combination of liberal arts and technical education
- A well functioning system that can be built upon

OPPORTUNITIES

- Manhattanville (new space)
- Faculty has strong international ties
- Global/Asian Expansion for SEAS where “Brand” is known
- Closer links to Columbia College, Medical, Business and other schools
- World-class leadership in emerging areas of technology
- Commercialization of research/IP royalty income
- CVN Expansion into new roles

WEAKNESSES

- Size
- Space Constraints
- National Ranking
- Alumni Involvement

THREATS

- Shift of students, faculty, technology, jobs to Asia
- Large number of engineers being trained in Asia; will compete for jobs and funding
- Larger schools with more resources are targeting the same strategy, students and funding sources
- Declining funding available for some traditional engineering disciplines