2013–2018
Arts, Sciences & Engineering
STRATEGIC PLAN
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SUMMARY

Our 2008 strategic plan foresaw growth of 25 percent from 2006 through 2016, taking our faculty from about 320 to 400 and our undergraduate body from 3,980 to 5,000, with commensurate growth in graduate programs. The plan also projected faculty investments in new research initiatives and the introduction of new undergraduate majors.

Despite the recession, and a $10 million reduction in annual income from endowment, we have made good progress in most areas. In undergraduate education, we have introduced 15 new majors and have exceeded all our targets for increases in numbers and quality. In graduate education, we have introduced five new master’s degree programs and seen a threefold growth in enrollments. The one area in which we have fallen short of our goal is faculty growth. In the next planning period, our paramount goal is to strengthen the faculty, both through growth, because our faculty size has not kept up with the increase in student numbers, and through investments to boost our competitiveness in research. We want particularly to invest in data science (“Big Data”), a key emergent domain in which we have the opportunity for distinction.

The external context in which we pursue our goals is more complex and more adverse than in early 2008. Research funds are diminished. Changed expectations of students and their families, together with reduced capacity and willingness to pay the full cost of an undergraduate education, will require from us initiatives that ensure a compelling undergraduate experience and consequently strong tuition revenue. Our currently strong enrollment profile has encouraged us to plan for modest growth to 5,125 undergraduates.

PLANNING CONTEXT FOR 2013–2018

The General Environment for Research Universities

The environment in which we plan for the next five years is more complex, more uncertain, and potentially much more adverse than when we established our current plan five years ago. Among the key challenges are:

- Restraints on federal spending will lead to low growth, or decline, in research expenditures.
- The recession has left fewer families able to afford the full cost of a private education of the kind we provide.
- Among families who can afford to pay, there is increasing reluctance to pay the full price, and many more students expect financial inducements to enroll.
- Increased public sensitivity to the cost of higher education is likely to restrain, to lower levels than in the past, the rate at which universities increase tuition.
- Concern about cost and about universities’ perceived inefficiency is driving demands for technology-rich alternatives (e.g., online courses).
• Students and their families are more concerned than in the past about the career prospects of graduates and about the benefits of a high-cost education, particularly a liberal education of the kind that is typical of places like Rochester.
• We need to limit endowment draw rate to levels lower than in the past.

The confluence of these pressures has already caused severe stress at major public research universities and at liberal arts colleges. Private research universities have so far fared better, but they too must adapt.

The pressure on research funds is significant (federal research expenditures in constant dollars have declined slightly over the last decade) and may increase. Universities like ours cannot function as they currently do without access to substantial federal research funds. Our strategy for research has to be focused on ensuring that our faculty secure a larger slice of a shrinking pie and become better able to establish partnerships with industry. A later section describes steps to achieve this.

The largest constellation of pressures bears on the cost and value-for-money of undergraduate education. The AS&E deans have reviewed the prospects for lowering our costs and have concluded that, although there are opportunities for us to become more efficient and to limit the rate of increase in costs, we cannot offer a lower-cost education without fundamentally changing what we do. The question then is whether our inherently high-cost model (of which the key elements are a rich residential experience in a research context) will continue to be attractive and affordable to enough students. The AS&E deans think that it will and that many families will continue to be able and willing to pay for an exceptional undergraduate experience. Major research universities offer students something unique: an immersive residential experience among very bright peers and great breadth and depth of intellectual opportunity. No other institutions can do this. The best liberal arts colleges can provide the residential experience, but they cannot match research universities for the breadth and depth of disciplinary coverage and intellectual opportunity nor provide rich access to professional schools. All this suggests that the research universities that offer an exceptional undergraduate experience will be well placed.

To establish ourselves firmly in the group of universities that will thrive, we must make ourselves more attractive to highly qualified undergraduates. Our currently strong enrollment trajectory (expressed in substantial year-to-year increases in applications and quality of enrolled applicants) encourages confidence that we can do this, but in pursuing this path we have to redouble our efforts to secure scholarship support that will be increasingly important in maintaining our commitment to affordability and diversity.
Additional Issues Facing AS&E

Our recent investments in faculty, although significant, still leave us with one of the smallest faculties of any major research university. Moreover, faculty growth has not kept up with the growth in undergraduate and master’s enrollments. Except for our investment in East Asian studies, we have lacked the resources to hire faculty in important new areas, such as data science. The deans and faculty are concerned about maintaining and enlarging our research strengths. Investments that strengthen the faculty must be our top priority.

Our research space is in some places outstanding (e.g., Goergen Hall) but in other places poor (e.g., Gavett). Investments in additional faculty positions will exacerbate our space problems: we can accommodate modest growth in the sciences and engineering, but significant growth will require additional space. Some of our teaching space is outstanding, but too much of it (particularly labs) is not up to the standard we would wish. This reduces our competitiveness in attracting the most talented undergraduates.

Progress on faculty and infrastructure will depend on us generating significant additional revenue and/or trimming costs. Absent initiatives to strengthen our revenues and/or reduce costs, we are currently projecting budget deficits in the range of 1 to 2 percent in the years through 2018.

KEY OBJECTIVES

Our overall objective is to increase the distinction and impact of AS&E as the heart of a major research university.

1. We must strengthen our faculty by investing in new positions in key domains where we have an opportunity to build distinction and by increasing our faculty’s competitiveness in securing grant support.
2. We must continue to strengthen our position in undergraduate education. This is both an end in itself and a means (via tuition) to provide for investment in faculty.
3. We must secure our financial stability. This will require us to reduce our endowment draw and will depend substantially on continued strengthening of our enrollment, especially in undergraduate education.
ACADEMIC INITIATIVES

Strengthening Faculty and Research Programs

The faculty is our most precious asset. In recent years we have invested substantially to ensure that our searches are maximally inclusive and attract and secure the most talented and diverse faculty. We have encouraged departments to pursue special hiring opportunities. We have increased our attentiveness to early career development, we have invested in resources to strengthen teaching, and we have launched programs to seed promising new research. These efforts will continue.

We must also strengthen our faculty through growth in both core and emergent fields. Given our constrained resources, a stretch target would be to increase the faculty by up to 30 beyond our current size (approximately 350) over five years. In identifying investment opportunities, we began with proposals from departments. These proposals were reviewed by four divisional faculty committees (humanities, social sciences, sciences, engineering) that recommended priorities to the deans.

Our provisional investment priorities, informed by the faculty committees, are summarized below. Fifteen to 20 of our growth lines would be directed to these areas, with the remainder deployed to provide for smaller initiatives, including meeting the needs of individual departments and pursuing special hiring opportunities.

Data Science—Program and Institute

Our most important research priority, endorsed by all the faculty review groups, is to establish a strong research presence in data science. Although the importance of data science is now widely recognized, few universities have yet established major initiatives, and we still have an opportunity to be in the forefront. We are well placed to do so, because we have a nucleus of outstanding researchers (notably in computer science) dealing with data science problems, and we already have great strength in some of the key disciplinary fields in which it will have the most transformative impact. Data science is all about discerning patterns in and making predictions from enormous data sets, for example, producing accurate weather forecasts from data on the atmosphere and oceans or predicting how individuals vote from the way they search on the web. Problems that until recently were intractably complex are increasingly accessible because rapid reductions in the cost of computer storage have led to the accumulation of vast databases, and rapid increases in processing power have made analysis possible.

We need to build strength both in the fundamental science and in its applications. In the fundamental fields we have provisional priorities that will be refined through discussion with faculty:

- Machine Learning—a field concerned with computer systems that learn from data
- Data Management—data-intensive computing with large databases
- Network Science—the analysis of information flow in complex networks
- Statistics

In the application domains, there are many areas of opportunity—and a few where we think building on our current strengths could be distinctive:

- Biological Imaging—machine analysis of the content of images
- Computational Linguistics—machine recognition of speech, etc.
- Computational Social Sciences—analysis of political systems and behavior
- Computational Neuroscience

Our initiative could be stand-alone, but since other schools (notably the School of Medicine and Dentistry and Simon Business School) also see major opportunities in data science, we believe that we will generate the greatest benefit through partnership in the University-wide Institute for Data Science. AS&E expects to contribute significantly to the University-wide initiative, contributing perhaps as many as eight growth hires.

The program will require investments in space (detailed later).

Environmental Change, Energy and Resource Sustainability

This is a broad domain of central importance to society and increasingly to students. In several departments, we have faculty talents on which we can build. It is synergistic with the initiative in data science (many of the important challenges, such as understanding changes in ecosystems or analyzing satellite data, depend on data science as an enabling technology). It is also a domain to which constrained federal funding is increasingly directed. Our best opportunities lie in alternative (clean) energy (capitalizing on strengths in the technologies of inertial confinement fusion, photovoltaic devices, fuel cells) and climate systems (capitalizing on strengths in atmosphere and ocean science).
International
The increasing economic interdependence of countries, their increasing interconnectedness through easy flow of information, and the need to solve major global problems (e.g., environmental change, terrorism, disease) through cooperation give many of our most important scientific and scholarly problems an international dimension. We have already invested in fields such as international relations, East Asian studies, and Africa and the African diaspora. Further opportunities include such areas as factors affecting economic development and evolution of international trade; the connection of concepts of justice, law, and ethics to the structuring of political and economic systems; cultural and environmental impact of urbanism; global issues relating to human well-being, including health care and climate change.

Other Initiatives to Bolster Research
Since 2006, AS&E–sponsored research expenditures have increased from $57 million to $62 million. This represents an approximately constant share of federal research expenditures and has taken place during a period in which competition for grants has increased greatly and the overall success rate (fraction of submitted proposals that succeed) at NIH and NSF has declined substantially. This means that faculty spend more time applying for grants and have less time to spend on research.

Our faculty’s achievement in maintaining stable funding is creditable, but given the unfavorable outlook for federal funding, we need to find ways to do even better. Beyond the investments we have already made in strengthened administrative support, we have launched a new program “PumpPrimer” that responds to two important funding trends.

First, federal agencies are increasingly moving to award mechanisms that bring together experts with complementary skills to address grand challenges. We want faculty to take on such large-scale initiatives because they potentially benefit multiple AS&E faculty, increase the quality and stability of our research infrastructure, and (especially) increase our national and international visibility. Preparing proposals and managing grants of this type require a large investment of faculty time, so the deans’ office will provide substantial support (administrative assistance, travel funds for multi-institutional partners, possibly teaching relief) to encourage them.

Second, the increasingly competitive environment for funding lessens the chance that high-risk proposals will be supported and increases the need for proof of concept and/or pilot data. To help faculty with strong records of research productivity...
move in bold new research directions, the deans’ office will allocate $200,000, possibly more, to provide up to $50,000 for pilot projects lasting up to one year. These funds can be given extra leverage by being deployed in conjunction with the University’s revised Multidisciplinary Fund. We hope that our new program, which will recognize our strongest and most innovative research, could be made an Advancement opportunity.

We must also find ways of partnering with corporations to expand our research funding and further facilitate translation and commercialization. The consolidation of our URMC and AS&E Offices of Technology Transfer and the recent appointment of a new director charged with developing corporate opportunities for our faculty will help this.

Through generous support from President Seligman, we will expand and extend the scope of the Humanities Fund from $150,000 to $250,000 per year.

The decline in federal support for research comes at a time when other countries, notably in Asia, are investing heavily in university research. Many Asian universities are eager for international partnerships that enable their researchers to collaborate with researchers in the United States. The Institute of Optics has had several approaches of this kind. There are potentially large opportunities for us to strengthen our own research enterprise by establishing judicious partnerships with universities abroad.

**Strengthening Undergraduate Education**

Our greatest asset in dealing with the value-for-money challenge in higher education is the richness of the residential experience within a major research university. We are among a relatively small number of universities that can offer this kind of experience, and, to thrive, we must do it exceptionally well. To strengthen our position and attract ever more talented students will require continued expansion of our curricular offerings and further investment in the academically effective hands-on learning that today’s students seek.

**Curricular Expansion**

The introduction of 15 new majors and five minors has been key to the College’s recent success in enrolling and retaining strong students. Majors in areas such as digital media, public health–related fields, business, and international relations have attracted new applicants and have helped to retain students who moved away from the majors they initially intended.

Additional programs are on the way, including recently approved majors in audio and music engineering and in East Asian studies. We are exploring the potential for a new major associated with the data science initiative.

In partnership with the Simon School we will enlarge the scope of our undergraduate business programs. A new BS major, for which we will seek AACSB accreditation, will offer several tracks (corporate finance/accounting, marketing, general management). The existing BA, enhanced with addition of more courses from Simon, will be available to students as a double major. At maturity, we expect this expanded set of majors to attract about 1,500 additional applicants, allowing us greater selectivity in admissions.

Beyond the foregoing, we think two categories of program will best strengthen our profile.

*Educating Global Citizens.* We will continue work to deepen students’ understanding of the world beyond the United States and prepare them for engagement with people from diverse cultures in a global economy. Among initiatives under consideration:

- A new major in Latin American studies. We currently have a minor in this area, but the recent addition of broader faculty expertise makes a major feasible.
- We will expand the teaching of foreign languages, with five initial candidates: Portuguese, Hindi, Swahili, Korean, Turkish.
- With the addition of suitable faculty expertise, we can consider adding a major in Global Health to the existing set of public health–related majors that we offer in partnership with the SMD.
- Including or expanding international study components in existing majors, such as economics, anthropology, history, religion, and other disciplines, and potentially adding interdepartmental programs focusing on globalization.
- Continued enlargement of study abroad opportunities, with special emphasis on science and engineering majors who will need global skills but have more limited opportunities to study off campus. More emphasis will be placed on exchange programs that not only enable our students to study at partner universities around the world but also bring to campus students from those universities. Our initial work is focused on exchange programs with partner universities in Australia, New Zealand, Hong Kong, South Africa, and the United Kingdom.
• Increased investment in campus programs, such as the Inter-
cultural Center, that foster interaction among students from
the United States and abroad. Among the universities we
compete with we have the largest enrollment of international
undergraduates (19 percent of our 2013 freshman class will be
from abroad), and our campus is now richly diverse.

Bridging the Sciences/Engineering and the Humanities. Rochester is particularly well equipped to establish programs that
bridge the sciences/engineering and the humanities. Examples
include recently established majors such as digital media stud-
ies; audio and music engineering; and archeology, technology,
and historical structures. These are distinctive, possibly unique,
and we will add more of them, such as:
• Research and internship opportunities growing out of our en-
larged partnership with George Eastman House International
Museum of Photography and Film. For example, one of the
first-ever NSF-funded projects in the newly formed SCIART
(Science and Art) division involved the use of nanotechnolo-
gies for the preservation and conservation of daguerreotypes.
• Continued development of humanities labs, in which faculty
introduce students to the use of technology in the service
of humanities scholarship. Students in humanities labs have
developed interactive websites to illustrate and investigate
the development of different forms of media, and they have
worked with faculty on research to collect and analyze large
data sets concerned with how time is represented on tele-
vision. A newly awarded $1 million grant from the Mellon
Foundation will help underpin programs and graduate train-
ing in these rapidly evolving fields.

Curricular Innovation: Learning by Doing

Last fall, we established two faculty committees and asked
them to recommend how we might best deploy technology to
advance undergraduate education, and how we might develop
our curriculum to take maximal advantage of our faculty ex-
pertise and the residential experience. The College has a strong
history of curricular innovation (e.g., Rochester Curriculum,
Workshops, WebWorks for Math) on which the committees’
recommendations build. The overriding conclusion of both
committees is that we should invest more to promote “experien-
tial learning” or “learning by doing.” All indications are that this
kind of active learning is academically effective and appealing to
talented students and strengthens skills that will be important
in the workplace. Rochester is well positioned to exploit its
advantages in this area.

These reports have far-reaching implications for our ap-
proach to undergraduate education, and we will need thorough
discussion of their recommendations and how to implement
them, but some initial themes are already clear:
• Embedding experiential learning components in otherwise
traditional courses. This is a key priority and could include
further expansion to a broader range of disciplines of the
extremely successful workshop program in which peer leaders
work with small groups of students in problem-solving
sessions; more active use of technology (such as recorded
lectures, developing more effective online resources to assist
students in entry-level courses) to free class time for active
discussions and problem solving.
• Enlarging research opportunities. Most students engage
in independent research, and many others work under the
supervision of faculty members throughout the University.
Our program of Research and Innovation Grants attracts
outstanding freshman enrollments (147 in fall 2013). We
are increasing these opportunities by offering similar grants to
talented continuing students, by encouraging greater faculty
participation in supervision of undergraduates, by creating
better systems to match students with faculty members with
shared research interests, and by celebrating and making more
visible the accomplishments of student researchers and their
faculty mentors. We also want to develop ways to include
more graduate and postdoctoral students in the mentoring of
undergraduate researchers.
• Connecting courses to projects, activities, and enterprises
in the local community and beyond. Many students engage
in academically valuable activities out of the classroom, on
campus, in the region, through internships nationwide, and
in study abroad programs. Students often describe these “real
world” activities as being among their most valuable learning
experiences. They gain leadership and communication skills,
acquire insight into political or cultural issues, learn a great
deal about themselves and their interests, and gain an un-
derstanding of the communities with which they engage. By
connecting these nonclassroom experiences to faculty expert-
tise in related areas, we can turn them into novel and effective
learning experiences.

These initiatives will place new time demands on our faculty,
and our planning must include assessing whether and how some
of the burdens can be borne by professors of the practice and/
or professional staff who have the requisite talents. There will be
new costs associated with this, for which we will have to develop
firm estimates.
Career Preparation
It will be increasingly important for us to demonstrate that a Rochester education provides outstanding career preparation as well as preparation for graduate school. All that we do is founded on the belief that a liberal education—and especially a liberal education that is as distinctive as the one we provide—develops flexible and critical thinkers who are ethically and culturally sensitive and well equipped to master the intellectual and human challenges of today’s professions.

We believe that we do a good job, but we need to do more, and we need to demonstrate that we’re doing a good job. Initiatives now under way or to be implemented include:

• incorporating more explicit career-relevant skills into the curriculum
• increasing the opportunities for “learning by doing” (above)
• introducing “portfolios” that capture a comprehensive picture of a student’s activities and achievements
• expanding the Gwen M. Greene Career and Internship Center’s outreach to undergraduates, particularly in the freshman year
• improving our tracking of long-term outcomes through Alumni Relations and vehicles such as the COFHE alumni surveys

Additional Initiatives
Master’s Programs
We foresee further growth in master’s programs, where our enrollment profile is now strong. We aim to add 100 to 150 enrollments over a period of 3 to 4 years, taking us from our current 350 enrollments to enrollments of 450 to 500.

This growth will come from enlargement of existing programs (TEAM, optics, possibly also computer science) and the addition of new ones, such as photographic preservation and collection management (developed in conjunction with George Eastman House and recently approved by New York State) and data science, which we expect to develop during the next year. Our postbaccalaureate premed program (designed for students who have decided on a career in medicine but as undergraduates did not take the premed curriculum) also has some room for growth.
Summer Programs

These represent an unrealized opportunity, given the available infrastructure and the summer weather in Rochester. We have a successful and still growing summer program for high school students (about 400 enrollments). Two years ago we made major changes to our traditional summer programs for undergraduates to offer a better core set of courses on a more reliable schedule. This has stabilized enrollments but has not led to a consequential increase. Given what we have learned of summer enrollments elsewhere, we are not confident that there is much opportunity for growth in the traditional programs.

We have begun looking elsewhere for growth, particularly the possibility of residential programs that would provide an opportunity for students from abroad to develop English language skills in concert with an academic program. Additionally, we will launch programs in the following areas:

- a three-week summer program in engineering, based upon hands-on activities in the domains of optics, audio and music engineering, and biomedical engineering
- precollege and for-credit courses taking advantage of Rettner Hall’s facilities, especially in the areas of digital media studies
- a 16mm film production course for both precollege and college students.

Last fall, we brought in an outside consultant to advise us on these and related opportunities. His recommendations were that we consider summer and intersession distance learning programs; have all summer courses taught by tenure-line faculty; grow our precollege programs; and develop alumni programs, especially study-tours in parts of the world people are unlikely to venture on their own.

English Language Immersion Program

We are considering introducing an English Language Immersion Program that would provide intensive training for students who are deficient in English but are otherwise well qualified for admission to a U.S. university as undergraduates or as master’s students. Such a program would allow us to enroll students from parts of the world underrepresented in our undergraduate body (e.g., the Middle East). There is substantial demand for such training, which could be organized as a summer and/or academic year program. The value to us is as a path to enrollment of otherwise well-qualified international students who might be granted conditional admission, subject to achieving proficiency in English. Because of the limits imposed by available housing, we would need to consider the viability of housing students off campus or of increasing the diversity of our international student body while holding the number of admitted students constant. We are studying whether the revenues and increased quality and diversity of students associated with establishing an English language program would offset the costs.

SPACE

We need also to deal with a shortage of suitable space for cocurricular activities. Our planning must recognize that the distinction between the space needs of student life and academic life are becoming increasingly blurred, and it must ultimately take account of the library’s space master plan, now in development. To maximize the value of the residential experience, we must assure that students have ample opportunity to hold leadership positions in student organizations, to engage in meaningful ways with the Rochester community, and to interact with fellow students from around the world. We need to ensure that we invest sufficiently in support for activities of these kinds.

To help us define our space needs and priorities more precisely, we hired consultants to help us undertake a comprehensive review of

- the capacity, quality, suitability for purpose, and efficiency of use of faculty research space
- the capacity, quality, and suitability for purpose of our teaching space
- the capacity, quality, and suitability for purpose of student life space

The work is now complete and provides clear guidance about areas for action.

Research Space

We gauge the appropriate amount of space using two metrics: the average research space allocated per faculty member compared with disciplinary norms and the grant revenue per square feet compared with disciplinary norms. By these standards, we have enough research space to meet the needs of our current faculty and space to spare. However, the quality of some of that space falls far short of the standard required for first-rate research. Our consultant’s preliminary assessment is that our portfolio of science and engineering space is on par with other major research universities: about 35 percent of it is very good to outstanding (Goergen Hall, Meliora Hall), about 45 percent of it is good but may not be optimal (Hutchison Hall), and about 30 percent of it is adequate to poor (Hopeman Hall,
Bausch & Lomb Hall, Gavett Hall). Our consultant flagged Gavett Hall (approximately 10,000 assignable square feet) as seriously deficient, unsuitable for modern research, and a high priority for replacement.

Putting the need to replace research space in Gavett together with the projected needs of our new research initiatives points to coordinated investments centered around a new building that would be the primary home of the data science initiative. In summary:

- Construct a new research building of about 50,000 gross square feet ($25 million), to accommodate faculty involved with the data science initiative (including all computer science faculty) and closely associated faculty in the energy and environment initiative.
- Consolidate faculty from the Department of Electrical and Computer Engineering (currently split between Hopeman Hall and Computer Studies Building) in the Computer Studies Building.
- Renovate Hopeman as new home for the Department of Earth and Environmental Sciences, releasing EES space in Hutchison Hall. Since some EES faculty will be in the new data science building, it should be connected to Hopeman.
- Move the Department of Chemical Engineering out of Gavett into Hutchison Hall, closer to the Department of Chemistry.
- Renovate Gavett as teaching space. This could be done piecemeal.

**Teaching Space**

We are not short of teaching space overall, but our space is not well deployed (an unusually large fraction is managed directly by departments and is not used efficiently), and we have too few classrooms with 80 to 100 seats. Our consultants noted that our classroom technology is better than at peer institutions, though the overall condition of our classrooms is poorer. We will be taking steps to deploy classrooms more efficiently through better scheduling and greater use of departmental teaching space.

**Student Life Space**

Our preliminary assessment, based both on benchmarking and on questionnaire responses, is that we are not seriously short of space, but that the space we have is not well adapted to the needs of students. Wilson Commons in particular has a lot of space that is ill suited to the needs of students and not well used: a surfeit of large spaces and too few smaller spaces for informal gatherings and group activities. Overall, there is a serious shortage of dedicated space for student groups, resulting in heavy use of classrooms (sometimes competing with academic uses) and greater-than-desirable dispersion of student activities across campus. We must create more of the right kind of space for student activities, probably through renovation.
SUMMARY OF PRIORITIES

1. We will invest in strengthening the faculty, both through growth and through help to improve competitiveness in research.
2. We will continue to strengthen our undergraduate programs to secure greater enrollment of the ablest students.
3. We will improve our infrastructure for research (notably in the sciences and engineering) and teaching (particularly undergraduate labs and spaces for hands-on learning) and will better align our student life space with current needs.