Historical Strengths

The Hajim School of Engineering & Applied Sciences provides a comprehensive and balanced approach to undergraduate and graduate education in an environment recognized for the latest in scientific and technological research. Our education stresses mastery of fundamentals but with a clear vision of applications and impact in real-world settings. We strive to provide students with opportunities to engage in research experiences and other projects where they can develop close relationships with faculty members. We welcome students from diverse backgrounds to identify, develop, and refine their skills as engineers and scientists. We recognize our educational obligation extends beyond the classroom and the lab. Through mentoring programs, social outreach, community building and professional preparation, we strive to educate the whole person and suffuse a culture of success and educational ownership by setting high expectations and helping students achieve them. Our curriculum offers students the flexibility to explore other interests, including those in the humanities or social sciences, or participate in interdisciplinary work, translational activities, and entrepreneurship that is characteristic of Rochester’s strengths. Our research resources are prominent as demonstrated in comparison to peers through data collected by the American Society of Engineering Education and U.S. News & World Report, where we rank third in research expenditures by faculty. Our research programs include several nationally recognized programs, including unique programs in optics, imaging, and energy, and many faculty within the Hajim School are recognized leaders in their disciplines.

Highlights of Present Challenges

The past four years (2010–13) have seen the number of students with declared majors in the Hajim School grow by 52 percent.* The biomedical engineering department experienced the largest increase in numbers of majors* over this period at 57 students (56 percent gain). The mechanical engineering department experienced the largest percentage gain in majors at 80 percent (51 students). (See Figure 1)

Looking at the broader student population from freshmen to seniors within the Hajim School, we have seen a 50 percent increase from fall 2008 to 2012 versus growth of 13 percent from fall 2004 to 2008; furthermore, we estimate an additional 13 percent growth in this population for the fall of 2013. This growth has strained our faculty and staff to continue to provide the highest quality of engagement with our students. The growth presents unique challenges to our teaching labs and design experiences since these programs cannot easily add sections to accommodate the additional students. Although there are no goals to further grow the undergraduate population, the enrollment practices of the University do not manage the distribution of majors. Therefore, additional growth is possible. (See Figure 2)

A majority of research performed within the Hajim School is supported by federal agencies. While the research expenditures within the Hajim budget have grown from $82.6 million to $92.9 million from fiscal year 2008 to 2012, the growth has been concentrated at the Laboratory for Laser Energetics (LLE). Hajim School research expenditures without the LLE have dropped from $25.2 million to $23.3 million over the same period. The outlook for expansion in federal research expenditures remains uncertain. (See Figure 3)

Conclusions and Highlights of Recommendations

As part of initiatives undertaken over the past four years, the Hajim School of Engineering & Applied Sciences is experiencing both a period of large growth in student population that is significantly larger than the 10 percent average growth of peer institutions and uncertainty of research funding from federal agencies while operating within an outmoded infrastructure and administrative foundation. Against this backdrop of our historic strengths and current challenges, the following strategic priorities have been defined in the areas of education, research, and administration:

- Construct a new building to house an institute dedicated to the field of Data Science and to formalize a Science and Engineering Quad on the River Campus
- Renovate existing facilities to meet the growing needs of our school

* Growth calculated using three-year moving averages.
• Aspire to a target school size of 1,200 undergraduates, 400 master’s degree students, 400 doctoral candidates, and 100 faculty members to best position our strengths among respected peer institutions

• Maintain the quality of our education in an environment of increased enrollment

• Continue to strengthen the diversity of our school through targeted recruiting of students and faculty, and by enhancing support of under-represented and first-generation students through our STEM Gems program

• Support initiatives to improve the educational experience of our students through renovation and strengthening of laboratory and design experiences and by expanding offerings and pedagogical approaches through proven educational practices and promising innovations

• Support and enhance initiatives in mentoring, networking, community engagement and professional development that prepare our students for success in the dynamic and competitive engineering and applied science profession

• Expand and diversify our research programs by providing institutional support for interdisciplinary research in strategic emerging areas capitalizing on core institutional strengths

• Continue to encourage initiatives of individuals and small groups of investigators to pursue new research opportunities

• Enhance administrative efficiency and increase staff engagement in our core mission

Overall, this report summarizes areas of opportunity and challenge to align our community but does not intend to outline specific goals or plans to address these priorities. Using these shared priorities, specific operational goals and plans will be developed consistently both within individual departments and centrally within the school.

These priorities and the operational goals and plans developed to address them, individually and collectively, will strengthen the Hajim School in its mission to provide a full spectrum education through innovative curricular and research initiatives for all who pursue knowledge in engineering and applied sciences on our campus.
Section 2: Education

Charge
To identify and draft a set of priorities in the domain of curricular development, expanded resources, and career/support services, etc., needed to attract and retain the best possible undergraduate and graduate students.

Summary
The committee distilled the University’s mission statement, “Learn, Discover, Heal, Create—And Make the World Ever Better,” to a guiding principle for the educational mission of the Hajim School: “Education of the highest quality.” To realize this principle, the committee and department chairs recommend executing on six strategic aims:

<table>
<thead>
<tr>
<th>Education Strategic Aims</th>
<th>Recommended Actions</th>
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| 1 Re-establish and maintain the high quality of interaction between students and faculty | • Adjust faculty size as needed to optimize student/faculty ratio in the areas of required courses, advising, and faculty leaves  
• Review the availability of teaching assistance to support the increased student population  
• Increase undergraduate research opportunities through enhancements in funding and infrastructure  
• Consider opportunities for multiple sections of key courses |
| 2 Maintain high quality of laboratory and design experiences | • Update and expand educational laboratory and design facilities  
• Recognize needs for increased staffing to manage laboratory and design experiences consistent with growing student enrollment  
• Provide support to faculty and staff to develop, implement, and maintain modern approaches |
| 3 Adopt innovative and proven teaching practices and techniques that result in improved learning | • Provide release time to adopt and institute new teaching techniques  
• Recognize efforts to improve student outcomes in promotion, tenure, and compensation deliberations |

Chemical engineering students inside the newly renovated instructional lab in Gavett Hall (Photo by Brandon Vick)
Above: **Center for Medical Technology and Innovation** (CMTI) is a collaboration of the Hajim School and the School of Medicine and Dentistry to develop technological solutions to clinical problems.

Left: **The Audio and Music Engineering (AME)** major combines studies in engineering and applied sciences with music and audio production to give students a technically rigorous, design-based education in the field of audio, music, and sonic engineering.

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<th>Education Strategic Aims</th>
<th>Recommended Actions</th>
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<tr>
<td><strong>4</strong> Enhance both distance and residential learning opportunities</td>
<td>• Support faculty to develop and experiment with technology to expand offerings and pedagogical approaches</td>
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</table>
| **5** Ensure that students are prepared and able to succeed in our programs and provide sufficient flexibility to allow for diverse entry points and paths through programs | • Identify and address a student’s ability to use foundational math skills critical for our curriculum  
• Coordinate between departments to offer fundamental courses in alternate semesters or summers without increasing class size  
• Identify options to provide discipline-specific materials to fundamental courses  
• Offer basic science service courses in multiple semesters (similar to the flexibility in the math sequence)  
• Accommodate study abroad and industry practicum opportunities |
| **6** Enhance opportunities for graduate students to participate in the translation of research and innovation | • Address needs for professional development, networking, and career planning by graduate students  
• Develop coursework on intellectual property, regulatory pathways, or other translational topics  
• Consider partnerships among professional MS programs, PhD programs, and other advanced degree programs |
Opportunities and Challenges
The size of the University and the Hajim School is both a strength, as it allows flexibility and interdisciplinary activities, and a weakness, given the limits of our infrastructure, resources, and faculty size compared to peers. We have outstanding opportunities for interdisciplinary collaboration with unique crossover programs, and we have unique opportunities for collaboration with other parts of the University. We also have a very strong entrepreneurial spirit both from the community and the University with much success in intellectual property development and management. We have seen increased interest from international students and continue to reach out to underrepresented groups. We recognize that the Internet offers wide opportunities to broaden our reach. We have unique combinations of expertise that should be fully leveraged.

We are challenged by the uncontrolled growth in some disciplines that strain the ability of faculty and staff to maintain the interactions with students that are central to our self-image. The substantial growth affects advising, availability of research opportunities, and access to class and lab facilities, many of which are aging with limited capacity. Our faculty often have limited experience with new teaching and instructional models and theories as we face fluctuating enrollment in various disciplines and rapid changes in the learning styles and expectations of our constituents. To face the challenge of increased enrollment while maintaining the strength of our student-faculty interaction we recommend strategic initiatives to improve the educational experience of our students through renovation and strengthening of laboratory and design experiences and by expanding offerings and pedagogical approaches through proven educational practices and promising innovations. Through these initiatives our school can continue to provide an excellent education as our environment and student population evolve.

Ronald Rettner Hall for Media Arts and Innovation (Photo by J. Adam Fenster)
**Section 3: Research**

**Charge**
To identify and draft a set of priorities that addresses the growing need for interdepartmental methods of recruiting faculty for the purpose of research and teaching that spans multiple disciplines; to make suggestions on key priority areas that transcend departments and our school in leveraging strengths at the University of Rochester that differentiate us from peers; to make suggestions on resources/training necessary to make us more competitive in the laboratory and in the classroom, possibly extending to new educational trends in higher education, etc.

**Summary**
The committee and department chairs have identified four areas of interdisciplinary research with strong societal impact and that leverage existing strengths in the Hajim School and the University. Additionally, these areas are believed to offer particularly promising opportunities for technological innovation and research funding.

<table>
<thead>
<tr>
<th>Research Areas</th>
<th>Rationale</th>
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<tr>
<td>1. Generating energy for sustainable development</td>
<td>• To improve our ability to generate and utilize energy resources in an environmentally sound and sustainable manner</td>
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<tr>
<td>2. Engineering a healthy society</td>
<td>• To bridge the gap between medicine and engineering, allowing individuals to improve their health, independence, and life expectancy with the assistance of technology</td>
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<tr>
<td>3. Transforming society through extreme-scale computation</td>
<td>• To advance discipline-specific tools and underlying algorithms and computing technology that have the potential to dramatically enhance the speed, scope, reliability, and cost-effectiveness of innovation across every branch of engineering and technology with emphasis on data science</td>
</tr>
<tr>
<td>4. Enhancing human capability and productivity</td>
<td>• To create human-machine interfaces and systems that enhance human interactions with sound, images, data, and physical objects. This is a pervasive theme across all fields of engineering, and continuing advances in this area will have far-reaching impacts in domains such as advanced manufacturing, communications, health care, and entertainment.</td>
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</table>

**Opportunity and Challenges**
These four priority areas in interdisciplinary research have been chosen for their potential to leverage signature University of Rochester strengths and to build bridges between departments. To realize this potential, it is recommended that the University become more ambitious in its pursuit of center-level funding and that the University invest in the center-planning process, including seed money for students, postdoctoral fellows, and faculty release time. Furthermore, the Hajim School needs to remain committed to maintaining core strengths within each department in order to provide a strong foundation for the interdisciplinary initiatives. The outcome of this will be to expand and diversify our research programs while capitalizing on core institutional strengths.
Section 4: Administration

Charge
To propose opportunities to maximize administrative efficiencies and strategies to engage staff in support of the school’s educational and research mission.

Summary
The committee’s review of the existing administrative environment indicates that a majority of the school’s operations involve processes and budget models that have not kept pace with evolving educational and research needs. Many ad-hoc enhancements have created a “patch-work” to effectively keep overall operations functioning; however, these enhancements are not sustainable or efficient and require a comprehensive review for system-wide modifications. The recommendation is to adopt lean knowledge management principles that place a high value on staff time and expertise. This involves actions that create efficient processes to optimize staff work time and investments in skill development.

Administrative Efficiencies
A “working smarter, not harder” approach to reduce or streamline tasks performed by department staff can relieve staff of time-intensive tasks and provide more bandwidth in departments to support new initiatives. The committee has identified certain tasks as good candidates to either (1) centralize with a single individual to complete the task for all departments, or (2) implement technology enhancements to dramatically reduce time and frustration. The table below lists the key findings of this review.

<table>
<thead>
<tr>
<th>Task for ‘Central’ Staffing</th>
<th>Tasks for Technology Enhancement</th>
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<tr>
<td>HR activities related to recruitment, job descriptions, appointments, paperwork, etc.</td>
<td>Migrate paper forms and data collection to electronic solutions</td>
</tr>
<tr>
<td>Data reporting to University or dean offices for assessment surveys</td>
<td>Utilize databases to eliminate manual data entry and record keeping</td>
</tr>
<tr>
<td>Content management of external communications of web and print materials</td>
<td>Create budgets that match actual department operations and allow administrators to accurately forecast expenses</td>
</tr>
<tr>
<td>Specialized support for graphics, writing, etc., on multi-PI award proposals and management</td>
<td>Enhance web-based systems that provide knowledge sharing among staff</td>
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</table>

Staff Engagement
The recent naming of the Hajim School has given an “identity” to the school’s culture and brought a common sense of purpose to the staff. However, the changing external environment has brought new challenges of rising student enrollments and growing complexities in pre/post research award program requirements. The committee has recognized a need for relevant staff development and recognition strategies that will retain staff as they acquire skills to successfully meet these new challenges. Recommended actions for skill development include budgets for staff to experience professional development from national resources (conferences, webinars, etc.) and creating internal resources either on the ASEIntranet or through face-to-face collaboration among staff. To foster retention and recognition within the organization, the committee suggests developing a formal mentoring program, defining career paths, and creating standard functional job descriptions with use of functional titles.
Section 5: Acknowledgements

We offer thanks to the committees that prepared the recommendations contained in this summary.

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