Brown School of Engineering: Rebuilding the Foundations

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It is the best of times, it is the worst of times for engineering. This is a wonderful time nationally and internationally for engineering schools and departments in major research universities. STEM in general, and engineering in particular, are recognized as central to every aspect of modern life. Applications to engineering schools are increasing and many engineering schools are growing. A parallel development is an increasing demand by students who do not intend to major in engineering but nonetheless want to take engineering courses. Universities like Rice are properly embracing this added demand by non-majors for engineering classes. It is fully consistent with the educational mission of a world-class university and recognizes the increased importance of technology in every intellectual endeavor. This added demand has created challenges for engineering schools and departments across the nation. A larger faculty is required to provide undergraduate and graduate students the quality education that a major research university should provide, while maintaining research excellence. Attracting and retaining a larger excellent faculty requires committing significant financial resources. The required resources include office, laboratory, and classroom spaces that are sufficient in both quality and quantity.

Rice faces all these challenges. As pointed out in a December 2015 report by the School's Advancement Committee (this proposal borrows much from that report), the current faculty size is inadequate to meet the students' demand for engineering classes while maintaining research excellence. The last decade has seen a significant increase in the number and percentage of Rice students choosing engineering as a major and in the number of non-majors taking engineering classes. During this time, faculty size has grown only minimally. The School is committed to protecting Rice's core values, particularly small class sizes and close faculty-student relationships. These relationships allow faculty to build research groups and to include undergraduates in state-of-the-art research. This commitment to both students and research is a distinctive feature of Rice and essential for the School to remain within the top twenty-five ranking.

Numbers alone cannot tell the story, but they must be considered. Rice's Vision for the Second Century includes the statement that student-body growth will mean a student-faculty ratio of 7:1 rather than 6:1. In the School of Engineering, where in 2004 the ratio was 8:1, the ratio currently is 12:1 on average, but is much higher in certain departments, such as Computer Science and Mechanical Engineering Department. Undergraduate student numbers in the School has grown from by about 100 percent from 2004 to 2016 (40% of Rice students currently major in Engineering). Partly in response to that, Rice announced in September 2015 that it is preparing to invest over $150 million in strategic initiatives aimed at increasing its research competitiveness, establishing a world-renowned program in data sciences and bolstering its position as one of the leading centers for molecular nanotechnology research. Yet, engineering faculty size at the start

of academic year 2018, after aggressive hiring in the current academic year, is expected to be at around 130, yielding a student-faculty ratio of 11.5.

Information from peer institutions is again useful to consider. Vanderbilt University and Washington University report heavy investments in engineering and are rising in the rankings. Washington University has a recently self-stated student-faculty ratio of 11:1; Vanderbilt University's is at 14:1, and MIT is at 8:1. Rice's historically distinctive advantage appears to be eroding. Research competitors also report investing heavily in faculty research and growth. For example, Texas A&M University has promised 25,000 graduating engineers by 2025, the University of Pennsylvania has announced an increase in its engineering faculty size by 33%, Harvard has announced a new $400 million gift to increase the engineering faculty, and Duke University reports a 20% increase in faculty size. These investments could threaten Rice's standing in the research community.

The underinvestment in engineering faculty has been accompanied by an underinvestment in the physical infrastructure. With the exception of the Oshman Engineering Design Kitchen (OEDK), which opened in 2009 (see discussion below), the Bioscience Research Collaborative, which opened in 2010 and houses the Bioengineering Department, and a few labs in Brockman Hall, which opened in 2011, no new Engineering space has been built at Rice for the past 20 years. Duncan Hall, which houses the computational-engineering departments opened in 1996, and is now full to capacity. The Mechanical Engineering Building, which opened in 1985, houses wet labs, something it was not designed for. The Ryon Engineering Lab opened in 1965, while Abercrombie Hall was opened in 1948, and is now literally crumbling. The Mechanical Lab Building was the second building on the Rice campus, when it opened in 1912. As infrastructure for a top-25 engineering school, the Engineering Quad is not merely inadequate, it is actually embarrassing. While OEDK is great space for senior design projects, other Engineering teaching labs have also suffered from underinvestment, and are crying for major modernization and sustainable maintenance.

It would not be unfair to characterize the Brown School of Engineering at Rice as "running on empty". Past reputation can only carry the School, which often has been called the "crown jewel of Rice", so far. Without a major investment, bringing the School back to where it was 20 years ago, slow decline in excellence and reputation is inevitable. This investment is necessary in order for the School to maintain its excellence, reputation, and ranking in research and education. Rebuilding the Foundation of Rice Engineering must be a *major* part of the first campaign of Rice's second century. We envision three components to this initiative:

1. **Improve the student-faculty ratio**: The historical ratio for Engineering was 8:1. Raising the size of the (tenure-line) faculty to 180, would result in a ratio of 8.3:1, assuming no further growth in the current Engineering study body of 1500. The growth in faculty should be accompanied by a concomitant growth in staff size to offer adequate administrative support.
2. **Modernize undergraduate labs**: Engineering should undertake a modernization initiative to modernize its teaching labs and make them state of the art. In addition, a maintenance endowment is needed to ensure that these labs are refreshed and upgraded on a regular schedule.
3. **Modernize the Engineering Quad**: The Mechanical Engineering Lab Building should be maintained as a historical building (but should be remodeled), but the two other old building in the Engineering Quad: Abercrombie Hall and Ryon Lab, should be

completely rebuilt, the former as a lab building, and the latter as an office building, to provide adequate space for the growing Engineering faculty and for research and teaching labs.

Details: Rebuilding the Foundations of Engineering would require an investment of $500M.

1. **Personnel**: Creating 35 junior faculty positions, 15 senior faculty positions, and 25 staff positions (for a 2:1 ration of faculty to staff) would require endowment of about $300M.
2. **Office Space**: Assuming also the addition of 300 graduate students resulting from the growth in faculty size would require about 230K GSF, at a cost of about $60M.
3. **Research Labs**: Assuming a 50:50 breakdown between theoreticians and experimentalists for the new faculty members, and also a 50:50 breakdown between "dry" experimentalists and "wet" experimentalists, would require 135K GSF in lab space, at a cost of about $120M
4. **Teaching Labs**: An investment of $20M in teaching labs is required to mount a major engineering-lab modernization initiative and create an endowment that would enable such labs to be maintained, and periodically refreshed on a sustainable basis.