Introduction

Founded in 1852 as the School of Arts, Mines and Manufacture at the University of Pennsylvania, Penn Engineering today continues to fulfill the original vision of Benjamin Franklin, our School’s founder and our country’s first engineer. It is a vibrant place where both “the useful and the ornamental” thrive. Undergraduate students receive an education that is both professional and inclusive, drawing from the resources of the entire University, and they graduate well-prepared for rewarding technology-based careers. Our faculty perform leading-edge research in state-of-the-art laboratories while being highly engaged in the School’s educational mission. Penn Engineering’s professional master’s and research-based doctoral programs are among the finest in the nation. Complementary to our mission, technology is also taking center stage in society, and is emerging as the new “liberal arts” of education in the 21st century. After faculty hiring and infrastructure expansions in the areas of information technology, biotechnology and nanotechnology, Penn Engineering is poised for significant growth and a rise to an even higher standard of excellence.

Penn Engineering 2020 is a strategic plan that will guide investments in the School of Engineering and Applied Science over the next five years. This plan is strongly interdisciplinary and aligned with the Penn Compact 2020. It is anchored on the three themes of Inclusion, Innovation and Impact, and emphasizes the integration of knowledge with the other 11 schools at Penn.

Our Mission

Penn Engineering seeks an optimal balance between the creation and integration of knowledge through scholarly research, entrepreneurship and innovation in translating the products of our research into practice, and the dissemination of knowledge to our students on the Penn campus and beyond. Accordingly our mission has two facets:

- The creation, integration and dissemination of knowledge in both the fundamentals and their application in order to be an international center of engineering excellence and a catalyst for technological innovation; and
- The design and delivery of an engineering education known for its rigor, breadth and relevance to prepare students to become global leaders in technology-based fields.

The Goals of Penn Engineering

1. Excellence

   The primary goal of Penn Engineering is to be internationally known for our scholarly research and our exceptionally trained students, and to be ranked with the top engineering schools.

2. Innovation and Impact

   Technology is central to confronting all of the grand challenges faced by human civilization. Penn Engineering will become a catalyst for innovation by addressing these challenges in areas as diverse as human health, urban infrastructure, climate and energy, and education.
3. Growth

As technology emerges as “the new liberal arts”, Penn Engineering will expand its footprint to educate and train students across campus and beyond, reaching out to a diverse student population.

Central to all three goals is the hiring and development of exceptional and diverse faculty, recognized as among the finest in the nation, and the recruitment of top students who will emerge as leaders in the field of technology and related areas.

**Priorities for Investment and Growth**

Penn Engineering has strong intellectual ties to a large number of departments and schools within the University. It must capitalize on its own special strengths and leverage the complementary strengths of the other 11 schools on campus.

Over the last decade Penn Engineering has developed expertise in important interdisciplinary areas, including: bioinformatics, cognitive science, computational science, embedded software systems, formal methods, molecular and cellular engineering, soft materials, micro- and nanoscale fabrication and characterization, network science, neuroengineering, programming languages, robotics, and systems theory. This has led to a steady climb in rankings at the departmental and school levels. The health schools are internationally known for their leadership in the large and aggressively growing fields of medicine and healthcare. Engineering science and technology are quickly emerging as the disciplines with the enabling tools for this growth, and healthcare continues to present new opportunities for Penn Engineering in particular. The emergence of new technology for micro- and nanofabrication and the improved understanding of biological, chemical and physical phenomena at small time and length scales point to a paradigm shift in engineering that will range from novel materials and techniques to new devices and applications. The emphasis on innovation across campus and our close ties to Penn Medicine, the Wharton School and the School of Arts and Sciences offer a unique synergy that is available on very few campuses.

Penn Engineering will strategically target opportunities that will differentiate our position among (typically larger) top-ranked peer institutions, while further strengthening core departmental needs. Our priorities lie within the following five thrusts involving faculty from all six academic departments and from other schools across campus.

**Engineering human health**

New and complex systems that bridge and advance both engineering and the health sciences include implantable devices, data-driven diagnostics, detection and drug delivery with wearables, precision biomedicine, robotics for surgery and hospital operation, autonomous and synthetic biology, cognitive systems, assistive technologies and neuroengineering. There are unprecedented opportunities for fundamental research and for catalyzing the translation of that research from the realm of discovery to the development of technologies at the interface of engineering and health. These opportunities can lead to the creation of an entirely new dimension at this interface, while also creating a new economic development opportunity to build on the health/information technology valley in the Greater Philadelphia region.
Data science and computation
While technological innovation and new algorithms continue to advance computational science, data science is now revolutionizing the scientific discovery process, going well beyond the now conventional experimental, analytical and computational techniques. Data science is impacting medicine, drug discovery, marketing, synthesis of novel materials, climate research, policy-making and social science, and it will transform the way our students learn and conduct research across all 12 schools. Opportunities for Penn Engineering include neuroengineering, computational biology, the materials genome, applied mathematics and statistics, and cognitive science. Penn Engineering will also lead the development of a curriculum in data science for all Penn students.

Nanoscale engineering, devices and systems
Penn Engineering will build on our existing strengths in materials, micro-electro-mechanical systems, microfluidics and nanofabrication. Our state-of-the-art facilities in nanotechnology have positioned us to become a hub for excellence in the industry-rich mid-Atlantic region and provide a nano “maker-space” for the greater Philadelphia area. There are new and exciting opportunities in nanomaterials, including characterization, microscopy and scalable approaches to synthesis, and in nanodevices, including the design and integration of nanosystems with applications to information technology, healthcare, robotics and manufacturing.

Energy science and technology
Developing the science and technology to provide sustainable energy solutions is an important area for Penn Engineering, exploiting our strengths and programs spanning fundamental to translational materials, devices and systems. We capitalize on our intellectual and physical proximity to the School of Arts and Sciences, the School of Design, and the Kleinman Center. Penn engineering will develop technologies to harvest and convert energy into useful forms, creating renewable and energy-efficient devices, and to manage energy utilization, building intelligent systems, all to insure a more sustainable future.

Security, resilience and sustainability
Our urban infrastructure integrates both the cyber world with its communication networks and computational nodes and the physical world with sensors, machines and people. It is essential to be able to understand the interdependencies between the physical, cyber, geographical and logical networks and design feedback loops that allow communities to be resilient in the face of natural disasters and emergencies, while being robust to cyber and physical attacks. We must also address questions of privacy and security that will require close collaborations between engineers, legal scholars and policy-makers. Penn Engineering will build on our unique ability to nurture and sustain cross-disciplinary interactions across schools to make investments that build towards a secure, sustainable and resilient urban infrastructure.

Acknowledgements
While this draft was prepared by the leadership of Penn Engineering, it incorporates ideas from over 200 faculty members, including many from other schools at Penn. Substantial contributions to this draft came from planning workshops led by Ritesh Agarwal, Mark Allen, Igor Bargatin, Danielle Bassett, Russell Composto, Kostas Daniilidis, Susan Davidson, Cherie Kagan, Michael Kearns, Katherine Kuchenbecker, Boon Thau Loo, Rahul Mangharam, Ravi Radhakrishnan, Aaron Roth, Jonathan Smith, David Srolovitz, Andrew Tsourkas, Kevin Turner, Jan Van der Spiegel, John Vohs, Beth Winkelstein and Shu Yang.