Proposed new unit: School of Biological and Biomedical Engineering (SBBE or similar name)

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Current units impacted:
Agricultural and Biosystems Engineering (CALS) – Academic Programs to be reorganized: BS-Biosystems Engineering. No consolidation of MS and Ph.D. programs in Agricultural and Biosystems Engineering nor the BS – Agricultural Systems Management degree program in Yuma.

Biomedical Engineering (ARL, CoE, CoM, Graduate College) – No consolidation of MS and Ph.D. programs in Biomedical Engineering GIDP. Change in ARL Division of BME faculty appointments.

Date: October 9, 2008
Background

The current Transformation Plan creates an opportunity to assess strengths in bioengineering at the University of Arizona, and to create new organizational and academic program structures that will capitalize on these assets while streamlining administration. Strong bioengineering will help UA achieve its goal of becoming a top-10 public research university, and enable it to serve the needs of the state’s emerging biosciences sector. Examination of USN&WR rankings reveals a strong correlation between highly ranked bio(medical)engineering programs and high overall university ranking. In Arizona, the importance of bioengineering is already well understood- bioengineering has been identified as a thrust area in the Arizona Bioscience Roadmap, and several UA colleges have bio-areas among their priorities, e.g. Medicine: bioimaging, Engineering: biomedical engineering, Agriculture and Life Sciences: biosystems engineering.

Current structure

Today, interdisciplinary research in the broad area of bioengineering draws together faculty from most of the colleges at UA. Bioengineering-related coursework is found in the departments of Aerospace and Mechanical Eng; Agricultural and Biosystems Eng (ABE); Chemical and Environmental Eng; Electrical and Computer Eng; Materials Science Eng; Optical Sciences; Pharmacology; Speech, Language, and Hearing Sciences; Systems and Industrial Eng; Physics, Physiology; Plant Sciences; and the Biomedical Engineering Graduate Interdisciplinary Program (BME GIDP); among others.

Academic degrees conferred span a similar breadth of programs. The CALS unit of ABE administers the undergraduate degree in Biosystems Engineering as a joint effort of CoE and CALS. Students earn engineering degrees which are accredited through ABET as are most CoE undergraduate programs. Graduate degrees in Biomedical Engineering are provided through the BME GIDP, which relies on the teaching and mentoring of faculty from over 25 departments and the ARL division of BME. Graduate degrees in Agricultural and Biosystems Engineering are offered by ABE. Education in bioengineering is strongly supported by NSF, NIH, USDA, and DOE with the BME GIDP being the principle or partner program for two NIH T32 training grants.

Requested action

Clearly, there is a broad base of support for, and interest in, bioengineering at the UA. While it would be neither practical nor productive to consolidate all bioengineering activities on campus, we propose to develop a School of Biological and Biomedical Engineering (SBBE) which would enhance bioengineering education and stimulate further interdisciplinary research while reducing the number of administrative units. UA is uniquely positioned with excellent and co-located Colleges of Agriculture and Life Sciences, Engineering, Optical Sciences, and Medicine. The proposed School of Biological and Biomedical Engineering would require cross college cooperation to provide the necessary faculty and staff resources needed to tackle the grand challenges of biological systems ranging from microbes and plants to animals and humans.

It is proposed that the School of Biological and Biomedical Engineering jointly report to CoE and CALS. Faculty in this school would be drawn from the ABE department (18 faculty), the ARL division of BME (5 faculty), and other CoE, CALS, and CoM faculty with strong bioengineering interests who wished to affiliate. ABE faculty would retain their current appointments in CALS. BME faculty would move their appointments from ARL to CoE. Faculty with primary appointments in CoM are critical to the research and teaching missions of BME and will be encouraged to affiliate with the school.

Timeline

Implementation should be performed in stages.

Jan 2009 – Establishment of the school and its management structure.
Spring 2009 – Assessment of faculty roles, develop plans for program modifications.
Fall 2009 – Request ABOR approval of program modifications.
Aug 2010 - Initiate academic program modifications. This timing is required to synchronize with the ABET accreditation sequence for UA engineering programs with backward-looking, 6 year review to be held spring 2010.

Impact on affected research, instruction, and outreach programs.

Impact on instruction

Undergraduate: A major outcome of this new structure would be the establishment of an undergraduate program or track in Biomedical Engineering. It is expected that this program would attract top students, many of them women, who currently attend ASU or other universities because of the lack of such a degree at the UA. Requiring only a few changes, the current Biosystems Engineering curriculum could be modified to create an ABET accredited program in Biomedical Engineering. Existing courses will be modified to the greatest extent possible with consultation of the affected departments to minimize the creation of new courses. The two programs could either be separate degrees or a single degree (possibly named Bioengineering) with two separate, ABET accredited tracks (Biosystems and Biomedical Engineering). Such an approach is not uncommon at other US institutions which have successful integrations of undergraduate programs in biomedical engineering with biosystems engineering under one administrative umbrella.

The proposed reorganization is anticipated to have a substantial positive impact on the overall enrollment with expected student numbers to increase from the current 82 students (roughly 15 graduates/year) in Biosystems Engineering to 200 enrolled students (targeting 50 graduates/year) in this new BS program. These students will be well-prepared to enter bioindustry or graduate / professional programs in engineering, sciences, or health professions (e.g. medical school). The current biosystems engineering program is scheduled to undergo accreditation in early 2010. This provides an excellent opportunity to put forth a proposed new BME or combined BME/BE program for accreditation that builds on the existing BE program.

Graduate: The BME GIDP is already highly collaborative and efficient. It serves as a nexus for bioengineering interests across campus and relies on a large cross-section of faculty for student mentoring and teaching. Therefore it is recommended that the GIDP remain the program for graduate biomedical engineering education. The BME GIDP currently has about 20 students. To grow to its optimum size of about 40, aggressive efforts are being made in recruiting and identification of first-year student funds. An accelerated master’s program (AMP) is being developed in cooperation with undergraduate programs in CoE. It is expected that the formation of an undergraduate program in Biomedical Engineering will have a substantial positive effect on the graduate program, e.g. in student pipeline development and availability of teaching assistantships based on large enrollment in the undergraduate program. To emphasize its world-class focus in bioimaging, consideration should be given to a name change of the MS/PhD program to Biomedical Engineering and Imaging GIDP.

Similarly, the current graduate degrees in Agricultural and Biosystems Engineering would be retained without major modifications. This program has averaged 36 students over the past 10 years with a large proportion of students from under-represented groups (49% of the graduate students from under-represented groups (Hispanic, African American)). Approximately 1/3 seek MS degrees while 2/3 are in the PhD program. Student research areas cover a broad range of topics across the nexus of water (quality and quantity), energy (primarily bio-energy), and health related (e.g., biosensors for food safety, transport of microbes in water systems, drinking water impact on health). Graduates of the program currently serve as faculty in Universities both in the US and abroad; as research scientists in US government research centers; or as practicing engineers in private firms or local, state or national
government agencies. Synergies in graduate level teaching will develop which may reduce the number of necessary graduate level classes.

Impact on research, outreach, and extension

Research programs would benefit from synergies between related applications across program areas. The major research thrust of BME currently is biomedical imaging. The major research areas of ABE currently are: bioenergy, biosensors, controlled environment agriculture, and water resources engineering. All of the ABE areas have a commonality of interaction with living systems. No major changes in organization are anticipated; however closer cooperation is likely to lead to cross-fertilization of research directions.

Currently eight of the eighteen faculty members in the ABE Department have partial appointments in the Cooperative Extension Program and are engaged in translational research and outreach involving irrigation, water quality, controlled environment systems, precision agriculture and specialty crop mechanization. These programs compliment the nexus of water, energy and health found in the research and instruction programs in ABE and will continue to play an important role in the new school. Synergies may develop upon integration; however, there are no apparent negatives for extension through this re-organization as long as extension programs continue down their current paths. In the long term, extension and outreach programs may benefit from the closer interaction between ABE and BME faculty especially as the AZ bioindustry continues to grow and future needs of industry advances.

Impact on UA reputation

The UA is unusual in having colleges of Engineering, Medicine, Agriculture, but no undergraduate degree program in biomedical engineering. Developing such a program will certainly increase the profile and reputation of bioengineering at the UA. Similarly, a strong tie between ABE and BME will also have a positive impact on the reputation of ABE and would reflect well on CoE and CALS.

Development of the School of Biological and Biosystems Engineering strongly supports the UA Strategic Directions of:
1) World-Class Research themes in Biosciences, Biotechnology, and Biomedicine,
2) Engage and Graduate Students Who Can Contribute to the State, Nation, and World,
3) Partner With and Serve the People of Arizona.

Process for developing this white paper

Many faculty, staff, and students have been involved in the development of this white paper from the beginning of the process. Initial discussions began with the four faculty listed on the cover page. Slack brought an initial plan to the ABE faculty and staff meeting on 9/12/08 and again on 9/26/08 with participation from nearly all ABE faculty and staff including Barton who has a joint appointment in ABE. Barton held discussions with BME division faculty and then later held a round table discussion open to and attended by a broad cross section of BME -GIDP faculty, staff, and graduate students. At all of these meetings, response has been highly supportive. Slack and Barton presented this plan to the appropriate deans and administrators (CALS – Sander, COE – Peterson, and ARL – Cusanovich). Slack presented this plan to BE undergraduate seniors who were highly supportive. The plan was also presented to BE undergraduate sophomores who indicated interest in and no objection to the transformation. The total number of students present at these two discussions was 46 (total program enrollment is 82). In addition, the plan was presented to the ABE graduate students on October 6 and they were generally in favor so long as the MS and Ph.D. programs in ABE would continue. This rearrangement is the preferred path of transformation supported by a majority of ABE faculty.
Budget Impact

1) Centralization of administration of programs eliminates 1 unit head. New synergies can enable existing program coordinators to handle increased student load. Net savings are difficult to assess at this point because it appears that it would be difficult, if not impossible, to co-locate faculty and facilities for the two programs.

2) Undergraduate enrollment will increase by 2.5x. Some of the students may come from other UA programs; however the BME degree is highly desirable and attracts top high school students (including about twice the average percentage of women in other engineering programs) and would be a net gain in enrollment. Graduate enrollment will also increase, including AMP students who primarily will be self-supporting. No new faculty will be needed, but existing faculty positions will need to be assigned to the SBBE. Participating faculty will need to be credited for teaching in the UG program.

3) New course development and expansion of a current laboratory will be required to meet ABET requirements for BME programs.

4) One time costs for staff training, consolidation of administration, letterhead, etc.