June 21, 2016

TO: Sarah Mangelsdorf  
Provost

William Karpus  
Dean of the Graduate School

FROM: Richard J. Straub  
Senior Associate Dean

RE: Department of Biological Systems Engineering Program Review, 2015

The College of Agricultural and Life Sciences Academic Planning Council met on May 20, 2016. During this meeting they reviewed and unanimously approved the review of three programs offered by the Biological Systems Engineering Department – the Bachelor of Science Biological Systems Engineering, and an MS and PhD in Biological Systems Engineering. The self-study was completed in the fall of 2014, the review team’s report was submitted in the fall of 2015, and the departmental response was complete by mid-Spring 2016. Copies of the latter two documents are attached.

The review team found the BSE department to be “high-functioning … with a clear vision for its current and future activities…. high quality research and [is] meeting stakeholder needs.” The undergraduate program is notable in particular for its dramatic growth in recent years and the review team noted the department seems to have reached its maximum capacity given the current instructional and advising resources. The graduate program has remained more stable in size and seems to be appropriate to support both student interest and faculty needs. A discussion of several key recommendations from the review committee follows.

Seek More Unified Facilities
As noted in the review report, BSE is challenged by being spread across four buildings, plus facilities at the West Madison Agricultural Research Station. The college recognizes this challenge and understands that this is a development priority for the department. In the meantime, the college will continue to work with the department to maintain and upgrade existing facilities as funds permit.

Develop Action Plan for Increasing Diversity of Student Body
The review report notes that there is a lack of gender diversity as well as racial and ethnic diversity, particularly in the student population. The college encourages the department to work with Assistant Dean Tom Browne and others on campus to develop a plan to further diversify the student body and to enhance the ability of department faculty and staff to ensure a welcoming environment for all students. Given the department’s commitment to students and the robust interest of students in the program, the department seems well poised to make progress in this area.
Seek Strategic Hires for Instruction & Coordinate with CoE

The rapid expansion of the undergraduate BSE program enrollment, along with a stable-to-shrinking number of faculty presents a challenge for the department, as noted by the review committee. The solutions to this challenge are likely to be multifaceted. The college supports recent efforts by the department to streamline the undergraduate curriculum and to raise the entrance requirements for admission to the bachelor’s degree program. Exploring strategic hiring and coordinating with the College of Engineering on course offerings (as suggested by the review committee) should help as well. CALS efforts to support additional hiring are hampered by the growth that has taken place across most majors in the college, resulting in growing instructional needs college-wide in a time of reduced budgets. In addition, we note that effective communication from the College of Engineering regarding Direct Admission plans and notification timelines for students who do not meet the new “Progression Requirements” will help support BSE, given the frequent migration of students from CoE to BSE.

We are proud of the BSE academic programs and associated student services and pleased to see the growing interest in them among students, along with continued strong interest from employers. The college will continue to work with the department to identify opportunities to support the demand for instruction, services, and facilities appropriate to a world-class university.

Please let me know if you need any further information.

cc: Kathryn VandenBosch Marty Gustafson  
    Jocelyn Milner Doug Reinemann
Introduction

In November 2014, the College of Agricultural and Life Sciences (CALS) appointed an ad hoc committee to conduct a program review of the Department of Biological Systems Engineering (BSE). The committee consisted of Steve Ventura (committee chair; Dept. of Soil Science), Ken Genskow (Dept. of Urban and Regional Planning), Pamela Ruegg (Dept. of Dairy Science), and Michael Graham (Graduate Faculty Executive Committee representative; Dept. of Chemical and Biological Engineering).

The charge to the committee from CALS included general questions about fulfilling its mission and six specific issues:

1. What is the standing of the department within its disciplinary base and within the University of Wisconsin? Is it in need of strengthening? If so, what can be done to improve its standing?
2. How well are its degree programs functioning? Are there a sufficient number of students in each program and are the students of high caliber? Is student advising functioning well?
3. Should the department be taking any steps to improve the quality of its educational programs? Are student learning objectives clear? How is learning evaluated and used for program improvement?
4. How effectively does the department satisfy its outreach and research missions and are these recognized strengths of the department? Are resources deployed in a way that satisfies its stakeholders?
5. Is the climate in the department one that encourages productivity and feelings of inclusiveness by staff, students, and faculty?
6. Are there issues concerning the department's functions or interactions within CALs that should be considered as part of the College's ongoing strategic planning process?

In addition, the Graduate Faculty Executive Committee had specific questions related to graduate education, conveyed through their representative.

The committee reviewed extant documents, particularly the Department of Biological Systems Engineering Ten-Year Review: Comprehensive Self-Study of Departmental Activities, interviewed faculty, staff, and both graduate and undergraduate students, and toured facilities during spring of 2015. The self study was a comprehensive and well-prepared document, including extensive descriptions of programs and facilities, faculty activities, responses to previous reviews, and self-identified goals and issues. It is the starting point for our report. We also used review documents from the 2003 review to understand changes in the department over the last decade and adjustments made in response to the previous review.
Based on our observations and interviews, we provide this report about the department, its undergraduate and graduate programs, research and outreach activities, facilities, and recommendations. While not organized to directly address the six issues in the CALS charge to the committee, we believe this report covers all aspects.

Department Overview

BSE is dedicated to “application of engineering principles to agricultural and biological systems.” It is the only engineering department within CALS, and maintains working relations with several College of Engineering (CoE) departments and centers, as well as other campus and federal centers. It is accredited by ABET, the national organization for accreditation in engineering (renewed in 2012 for seven years). The department identifies four broad areas of inquiry and instruction: sustainable production agriculture, bioenergy and bioproducts, rural environmental quality, and food production and bio-processing systems. Activities of the department contribute to all areas of the CALS “Growing the Future” strategic framework of 2014.

Major changes since the 2003 review include movement into new areas of inquiry such as bioenergy and a substantial increase the number of undergraduate majors. In most other respects, the department has been stable and meeting stakeholder interest in research, instruction, and outreach. The shift to biofuels and post-harvest processing of food is essentially a response to stakeholder and student interest, and perception of where jobs for graduates are likely to be.

Administrative structure and function

As of spring 2015, the department comprised a core faculty of 13 (nine professors, one associate professor, and three assistant professors). In addition, Richard Straub serves CALS as Senior Associate Dean and Awad Hanna (primary appointment in Civil and Environmental Engineering) has a 25% appointment in the department. Five other UW professors are affiliate faculty and the department lists five adjunct professors from other (non-UW) organizations. The faculty are supported by an administrative staff of four, three technical staff helping with the machine shop and information technology, and several scientists and research associates.

The department has standing committees for undergraduate and graduate instruction, and committees to support student activities and department social events. Faculty and staff meet twice a month, once for routine department business and second for “issues.” The latter may sometimes be just faculty or executive committee.

Staffing needs and plans are discussed in strategic planning documents developed in summer 2014. Specific faculty needs are identified annually in response to the College’s call for positions. In broad terms, the rapid growth of undergraduate enrollment has put considerable strain on instructional resources, including faculty instructors, advisors, and facilities.
Department climate

Our review team spoke with most of the faculty and a subset of the support staff and researchers. With the exception of almost universal comment about facilities, we encountered very few negative comments. Of course, everyone would like additional resources from the College to support a variety of needs, including workshop equipment and supplies, classroom upgrades, and faculty/staff positions. The department appears to function together very well, with a high degree of collegiality and respect for others activities.

We interviewed small groups of senior faculty and all of the assistant professors individually. Aside from almost universal recognition of facility challenges, as a whole, the faculty have no consistent problems with the structure or function of the department. Additional comments are contained in subsequent sections on instruction, research, and outreach, particularly the challenges associated with significantly expanded undergraduate majors and offering service courses for College of Engineering students. A few did mention ambiguity in the procedure for election of the department chair. This should be reviewed and clarified in writing as needed.

All three pre-tenure faculty are generally satisfied with their circumstances and prospects of successful promotion. A couple mentioned the need for greater clarity in department policies and procedures; these seem to be conveyed primarily by word of mouth rather than through easily searched written documentation. All feel supported by senior faculty, with a good mentoring structure in place.

The administrative staff in the department is uniformly appreciated and respected. Students, other staff, and faculty all complimented them on their abilities and friendly atmosphere they help create in the department. Technical support staff are similarly well liked. However, the time and effort required to maintain equipment and supervise students in the Agricultural Engineering Laboratory was noted as an issue. Some faculty felt this was serious enough to constitute a safety concern. The department is pursuing one potential solution through collaboration with the Department of Soil Science.

The department has no explicit effort to increase diversity within employees or student bodies. As with most STEM fields, it is predominantly white and male. Given campus-wide interest and effort to improve diversity, this is an area for future consideration. The women faculty and staff we interviewed did not feel that there were significant issues of gender-based bias or discrimination, though the circumstances of obtaining this information were quite limiting.

Campus partnerships

The BSE department is tightly interconnected with a variety of activities and entities on campus. BSE faculty have affiliations with the departments of food science and dairy science within CALS, with the civil and environmental engineering department within CoE and with the Wisconsin Energy Institute. The department also has relationships with the USDA Dairy Forage Research Center and Forest Products Laboratory. Several faculty hold joint appointments with the Gaylord Nelson Institute for Environmental Studies. BSE faculty also provide instructional support for courses offered through Engineering Professional Development. EPD director Phil
O’Leary’s tenure home is BSE. Finally, several BSE faculty have an extension component to their appointments.

**External standing**
The BSE department at UW-Madison has substantially fewer faculty (15) than many of its peer departments at land-grant institutions. For example, Iowa, Illinois, Minnesota, Michigan and Purdue have, respectively, 38, 22, 20, 20 and 28 faculty members. Nevertheless, on a per faculty basis, the department is outperforming all but one or two of these departments in publications and citations and is competitive for funding.

**Undergraduate Programs**
The BSE undergraduate program is a significant strength of the Department. In recent years, enrollments have nearly tripled from just over 60 in Fall 2007 to nearly 160 in Spring 2015. Faculty are confident the program could attract even more students, but they feel that current enrollments are straining existing resources. Students completing BSE requirements receive a BS in Biological Systems Engineering, which is an ABET accredited engineering degree. The Department has strong ties to industry and program alumni, and taking advantage of career counseling and job placement support from CALS and from the College of Engineering, all students graduating from the program are finding well-paying jobs in the profession.

**Curricula Overview**
The Department offers students four specialization areas within the BS-BSE, along with the option of customizing their own option area. The four developed specializations are: 1) Machinery Systems Engineering, 2) Natural Resources and Environmental Engineering, 3) Food and Bioprocess Engineering, and 4) Structural Systems Engineering. Similar to degrees granted through the College of Engineering, the BS-BSE degree requires advanced coursework in math, physics, chemistry, thermodynamics, statistics, and applied problem solving. BSE requirements differ from other engineering fields in their additional emphasis on biological sciences and processes. All students complete a two-semester capstone experience, typically a project with design, construction, and evaluation components.

Among current students, approximately one-third pursue Machinery Systems, one-third Natural Resources and Environmental, and one-third Food and Bioprocess Engineering, and a relatively small number are studying Structural Systems.

The Department maintains an updated and easy-to-follow Undergraduate Student Handbook. The Handbook clearly describes the program and desired educational outcomes along with information about each area of specialization, including road maps for completing each specialization within four years. The Handbook also provides helpful information about student life and activities, Department faculty and staff, scholarships and financial aid, and tools for tracking individual progress. A copy of the Handbook is available through the BSE website [http://bse.wisc.edu/Current-Undergraduate-Undergraduate_Student_Handbook.htm].
**Student Evaluation**

As required by ABET, the undergraduate program follows a rigorous assessment process outlined in the Department’s Undergraduate Program Assessment Manual. The manual includes assessment forms, rubrics for measuring learning outcomes from student coursework and projects, alumni survey forms, and more. Assessment results are summarized in the Department’s 2012 ABET accreditation Self Study Report.

Based on student outcome assessment conducted for the Department’s 2012 ABET accreditation Self Study Report, BSE students are generally meeting or exceeding target performance benchmarks. Highlights include excellence in national student competitions, 3&5-year alumni survey responses indicating achievement of educational outcomes, and high-levels of performance in courses and exams based on instructor evaluations and rubric assessments. In recent years, BSE also increases its admission standards and also changed the curriculum to provide students earlier exposure to engineering design concepts. Both are intended to further improve the quality of student experiences.

**Strengths and Weaknesses**

Overall, the undergraduate program is an important asset to the Department and CALS, and it comprises a vibrant core of the BSE community. The Department’s undergraduate program benefits from a highly committed faculty and staff, close association with the College of Engineering, a strong sense of camaraderie and community among undergraduate students, and close connections to alumni and industry. Faculty connect well with students and pursue regular program assessment activities to identify opportunities for further improvement. With additional resources, the Department has the potential to grow an even larger undergraduate program, complementary to other CALS programs.

The growth of the undergraduate program over the past decade has also strained the diminishing resources of the Department. With faculty feeling over-extended by teaching needs, some draw upon gift funds to support lab assistants, graders, and additional helpers for managing instructional roles. Faculty also expressed concerns about undergraduate specializations being overly dependent on individual faculty members. They anticipate possible future challenges for specializations due to difficulties replacing faculty who leave the Department or retire. The Department continues to have a faculty advisor for every student, and this will ultimately constrain numbers, though some of the day-to-day information comes from student services staff.

A few faculty noted that they are not well integrated with the College of Engineering. Although BSE and CoE, particularly Civil and Environmental Engineering, rely on each other for pieces of curricula, coordination is informal. A concern was also noted that if CoE raises the GPA in coursework of pre-engineering undergraduates required for admittance to their engineering programs, it may push some marginal students into BSE.
**Student Satisfaction**

Students interviewed for the review seem to genuinely appreciate the personal experience found in BSE. Several commented on the positive environment toward students, the approachability and accessibility of faculty, and the supportive attitude of staff. The Department has an active student ASABE chapter, and Food Services club. Student cohorts are perceived as small and tight-knit and experience a high degree of interaction with Department faculty, whom they hold in high regard. Most undergraduate students are involved in research projects beyond their classroom requirements.

Students were complimentary of the advising and hands-on instruction provided by the Department. They also appreciate the Student Handbook and its clear details about requirements and course options. Students take advantage of their cross-college situation to access career services, computer resources, and shop and lab facilities in BSE and in the College of Engineering.

Student surveys and exit interviews conducted as part of regular assessment activities are positive toward the Department. Students are complimentary toward the quality of teaching overall, and they feel instructors are student focused, and also mentioned the excellent student services support staff. They feel prepared for work in their degree field upon graduation and are aware of high demand and job placement rates for BSE graduates.

**Opportunities and Recommendations**

The Department is very aware of their resources, limitations, and opportunities associated with the undergraduate program. As part of their Ten Year Review, following their recent ABET re-accreditation process, BSE identified three priority areas:

1. “Improve the quality of students through attracting best students not most.”
2. “Consider fewer specialty area in the BSE undergraduate program.”
3. “Increase the controls/electronics side of the curriculum.”

The Department has taken steps toward each of these areas.

The review team generally recommends that the college provide instructional resources to support the expanded undergraduate enrollments and support the Department’s efforts to improve their instructional and research facilities.

**Graduate Programs**

**Overview**

The BSE graduate program has about 45 students, about 60% PhD and 40% MS. The Ph.D. program has seen steady growth for the past decade. Applications to the program are evaluated by a subcommittee of the GRIC (Graduate Research and Instruction Committee) as well as by individual faculty who are seeking graduate students – the students are admitted to the program to work with a particular professor. The program gets about 50 applicants per year with about a 30% acceptance rate and a high (~70%) yield resulting in about 10-15
students entering the program per year. The department attributes the high yield in part to the one-to-one faculty-student matchup. The department’s major competitors for grad students include Iowa State U., U. of Illinois Urbana-Champaign, Ohio State U., U. California-Davis, Michigan State U. and Texas A&M U.

The growth in applicants and attendees is attributed to increased research activity in the department, especially in energy and biochemical areas. The department is working to improve its graduate student recruiting process, hoping to attract more high quality students who would be competitive for NSF and other prestigious graduate fellowships. Recruitment is through professional conferences, web resources, and word of mouth, and done primarily by individuals within the department.

**Curriculum, evaluation and student support**

The graduate program has a number of divisions – natural resources (soil and water), farm machinery and structures, energy and power, and food processing systems. Because of this diversity, there is not a set of core courses that all BSE grad students must take aside from a 1 credit seminar BSE 900 that all new students take, which is an introduction to doing research, ethics and presentation skills, and a capstone, BSE 901, in which students give a research presentation to the entire department.

Graduate students are admitted at the MS or PhD level, including students that matriculate with the intention of only completing an MS degree. MS students have two options – a thesis and non-thesis track. Very few have chosen the non-thesis option in recent years. Students intending to continue for a PhD are strongly encouraged to complete a thesis. Applicants are expected to have an undergraduate degree in engineering or closely related field. If the latter, they may be required to complete additional coursework to make up deficiencies.

Whether a student needs to take a PhD qualifying exam is up to the advisor. The preliminary exam is a research proposal that the student must write and defend; this occurs in the third or fourth semester after the student is done with their course requirements. There are very few failures, as students have the opportunity to retake the exam if their performance is poor the first time.

Students are primarily supported on RAs – there is no TA support to speak of for the department. There are a few self-funded students, generally supported by foreign governments or other institutions. Residence time for the PhD is about 5.3 years and for the MS about 2.2 years.

Anecdotally, about 50% of the PhD graduates go to academia and 50% to industry; these numbers come from reporting by advisors. The department just recently began performing an exit interview for the students and has also established a LinkedIn page.

Challenges that Professor Gunasekharan (graduate program chair) has identified with regard to the graduate program include:
• The USDA has a national needs fellowship program, but the fellowships do not cover the entire cost of tuition and stipend, obligating faculty to make up the difference from other sources or support the student at a lower rate. This affects domestic student recruiting and competitiveness with other institutions.
• The graduate student population has much less gender diversity than the undergraduate population and very little diversity with regard to underserved minority populations. The department receives very few applications from this population.
• The department would like to provide graduate students with more international opportunities, specifically mentioning a desire for more resources to enable participation in international technical meetings.

Student experience
The review committee met with five students from several different departmental divisions. Their overall level of satisfaction with the department was high. A number of topics came up in discussion including the following:
• **Career services.** The students were satisfied with the career opportunities available to them. They mentioned a number of resources, including the Engineering Career Services office, career publicity distributed by the Nelson Institute, departmental industry contacts via departmental faculty, and The Writing Center’s walk-in resume clinic.
• **Admissions and funding.** Students have a contract with advisors, renewed every year with an annual appointment letter. Many students are co-advised; more generally the students feel that the faculty seem to get along and they are comfortable talking with faculty other than their advisor(s). The students feel that the faculty are strongly invested in their success.
• **Advising resources.** The students are very happy with graduate advising, commenting that they are happy with the graduate student handbook and with the departmental staff.
• **Department social and intellectual environment.** There is an active student group that holds a monthly lunch meeting at which students give presentations on their research. There is not formal representation of graduate students at faculty meetings. There is also not a regularly scheduled departmental seminar series. Most of the graduate courses that students take are in other departments such as Mechanical Engineering. Most of the BSE courses are at the undergraduate level. Finally, the students noted that the graduate student population is not very diverse though they seemed to recognize some improvement in diversity.

Recommendations
The graduate program in BSE is very healthy. It has stable enrollments and the students are satisfied with their education and with the career opportunities that it affords. Nevertheless, opportunities exist for improvements so the following recommendations are made:
• Build on current marketing efforts to improve both the quality and diversity of the graduate applicant pool.
• Work with CALS and perhaps with other departments within CALS to remove barriers to obtaining important federal grants such as the “National Needs” fellowships mentioned above.
• Invite the graduate student group to send a representative to the open sessions of faculty meetings, as a further mechanism to facilitate communication between faculty and students.
• Consider how it can further enrich the intellectual opportunities available to students through seminars and graduate course offerings.

Research
The research program in the Department of BSE is focused on applied research that is directed toward solving problems relevant to producing and processing food and fiber and to design and implement renewable energy sources. Research projects are often cross-disciplinary and integrate the fields of engineering, agriculture, and biology. Faculty members in this department collaborate with peers in many other departments on campus and successfully contribute to the overall research mission of CALS.

Strengths of the research program
While the overall number of faculty FTE has remained constant since the previous review (2003), the number of research FTE has increased from 5.22 to 6.25. This investment in research faculty has been rewarded by excellent productivity. While the number of faculty in the BSE department is ranked in the bottom half of peer departments, research productivity is excellent and typically ranks in the top quartile. Based on academic analytics, the BSE department is ranked 7th of 33 departments in both publications and citations per faculty member.

Research is funded by a variety of agencies and private companies and is generally aligned with the mission of the department. The department should be commended for the evolution in research priorities that have allowed it to remain relevant and a leader in their discipline. During interviews with faculty members, they expressed enthusiasm and optimism about their individual research efforts and appeared supportive of research conducted by peers.

Weaknesses of the research program
Relative to peer institutions, faculty in the Dept. of BSE have received less grant dollars per faculty member. This issue is likely related to the increased number of students enrolled in the BSE program and the subsequent increase in teaching load, resulting in less time for faculty to spend preparing grant applications. This issue is somewhat minimized by the excellent research productivity of the group. However, the most pressing issue relative to research needs is the inadequate facilities for laboratories of faculty members. Faculty members and their labs are scattered across five buildings and this issue presents problems with departmental cohesiveness, intradepartmental collaboration and recruitment of new faculty members.
**Resources and Needs**
All faculty members as well as technical staff who participated in interviews expressed concerns about the lack of a suitable facility that includes appropriate space for faculty and graduate student offices and for research laboratories. In some instances, faculty are working in outdated laboratories that do not meet current research needs. The previous review in 2003 included recommendations for locating all faculty offices, laboratories and teaching spaces in a single building. However, since that time, the Phase II building plan for the Agriculture Engineering Laboratory Building has been dropped, as it inadequate to meet all current needs. No fund-raising strategy is currently being pursued, though old and/or inadequate equipment within the facility is being upgraded opportunistically.

Faculty suggest a completely new building is necessary to meet the need. Addressing this issue is a critical need to ensure that the research infrastructure for the department is aligned with current research. Although faculty have adapted to use of facilities in several buildings, this reduces collegiality and collaboration, impedes interaction of faculty and student researchers, and wastes time and energy. It will be difficult for the Department to retain and recruit top faculty and graduate students without addressing this issue.

**Recommendations**
Consolidation and upgrading of facilities is the biggest need to support research in BSE. The lack of supervision, the condition of aging equipment, and the lack of adequate air circulation and cooling in the Laboratory present a potential safety hazard. These issues in the Laboratory building should be addressed as soon as possible. A long-term plan for a consolidated building should be developed, including a fund-raising strategy, as the campus’s standard operating procedure for new buildings now entails raising at least half the needed funding.

**Outreach/Extension**
Outreach efforts in BSE are met through a combination of faculty participation in University of Wisconsin Extension as state specialists, and through outreach programs that are primarily delivered by academic staff. Extension and outreach programs are aligned with faculty interests and research efforts. Academic staff with outreach/extension responsibilities are specialized into delivering programs related to farm safety and health, watershed and nutrient management, and energy conservation. Stakeholders include a number of state and federal agencies and professional organizations that address food, fiber and energy needs within the state, national and international audiences. Delivery of outreach/extension programs vary among faculty and include a combination of traditional farm visits, development of websites, presentation at conferences and meetings, development of short courses, and use of distance education modalities.

**Strengths of outreach/extension programs**
Despite increased student numbers and declining extension headcount, outreach and extension programs remain a priority in the department. The department focuses on performing applied research that is relevant to their stakeholders and facilitating the delivery of effective
outreach/extension programs. These efforts seem to be appreciated by stakeholders, including county extension personnel. Faculty members have been creative in use of distance education and in development of fee based programming.

**Weaknesses of outreach/extension programs**
Through retirements of faculty who had large extension appointments, 4BSE has experienced a considerable reduction in faculty FTE who have extension appointments. In 2003, of 13.65 faculty FTE, there were 4.54 FTE (almost 40%) of faculty who had extension appointments. Currently of 13.4 faculty FTE, there are 2.49 (less than 20%) faculty FTE with formal extension appointments. This reduction of two FTEs, about 50% in extension capacity, has resulted in a narrowing of outreach/extension activities. This will be exacerbated with future retirements of specific faculty members, including areas of specific interest to stakeholders such as farm structures and machinery. Extension needs are also addressed through use of academic staff, however, all of the academic staff who are funded by UWEX also teach or support courses, and the balance of teaching relative to extension/outreach programming needs to be reviewed.

**Resources and Needs**
The greatest need is to maintain sufficient faculty capacity to deliver effective extension/outreach programs that are aligned with the research programs and needs of departmental stakeholders. This issue will grow as more senior faculty with extension appointments contemplate retirement. A plan for how to address future extension/outreach needs while balancing growing teaching needs should be developed.

**Facilities and Infrastructure**
The Department’s research, administration, and instructional activities are spread across five buildings, and challenges associated with facilities and infrastructure were identified in every conversation conducted for this review. All faculty, staff, and students expressed a desire for improved and consolidated facilities. Several noted that the lack of a single common space reduced opportunities for interaction and synergy within the Department and took away from the Department’s overall sense of community. In addition, specific concerns were identified related to comfort and student safety in the Agricultural Engineering Laboratory Building.

Most BSE Departmental activities take place in two Buildings:

- **Agricultural Engineering Building**—460 Henry Mall—serves as the Department’s primary home for administrative and faculty offices. This building also includes instructional spaces, student offices and lounge spaces, and conference rooms. Instructional spaces include two 40-seat classrooms (B25, 101) and the Student Engineering Design Center, connected to the Computer Aided Engineering system in the College of Engineering.

- **Agricultural Engineering Laboratory Building**—540 Elm Drive—houses multiple laboratory, workshop, computer, and instructional spaces. Originally intended to support additional
floors as the need expanded, the building is now considered dated and unable to support the vertical building space once envisioned. The building includes instructional space and five main laboratory spaces:

- Soil and Water Lab
- Milking Research and Instruction Lab
- Machinery Lab
- Environmental Quality Lab
- Machine Shop

Faculty and research activities are also centered in the Enzyme Research Institute, the Wisconsin Energy Institute, and part of the West Madison Agricultural Station. BSE students also have access to computer, lab, and shop facilities in the College of Engineering.

Although BSE facilities are generally well maintained and have benefitted from remodeling grants (e.g., asbestos removal, new cabinets, new roof venting) the primary lab spaces are aging and in need of investment. Needs are most obvious in the Agricultural Engineering Laboratory Building, where multiple faculty, staff, and students commented on the lack of air conditioning and need for wet lab space and various types of updated equipment. Staff are also concerned about their ability to maintain facilities and equipment in the Department.

Importantly, the Department is concerned about a potential student safety risk associated with un-monitored and unapproved after-hours access to the Machine Shop by non-BSE undergraduate students. Without adequate building access monitoring and security protection, students without proper safety training may have access dangerous shop equipment. This problem has been noticed during periods of intensive project deadlines for Engineering and related courses. This issue in particular needs immediate attention from the College.

Overall, BSE faculty, staff, students all feel the quality of the facilities must improve to match the quality of the Department, and to ensure the quality into the future. Although they recognize the ongoing constrained resource environment, the Department believes that a new building would meet most of their current and future needs.

**Recommendations**

Overall, BSE is a high-functioning department with a clear vision for its current and future activities. It is providing high quality research and meeting stakeholder needs. The undergraduate program has grown rapidly in recent years and appears to have reached the limits of instructional and advising capacity within the department. The graduate program is appropriate in size and scope to support student interest and research needs of faculty. This section reiterates a few of the most cogent recommendations noted in previous sections.
The greatest need, consistently expressed by faculty, staff, and students is to resolve the facilities-related challenges. The Department should work with CALS and UW Foundation on a fund-raising strategy that can result in more unified facilities.

BSE does not have active efforts at improving diversity within the department, though individuals recognize this as an issue and put in personal effort. Given campus-level resources and initiatives, the Department should develop an action plan for increasing the numbers of women and under-represented minorities in its student body. Most people consider the department climate to be quite positive, so this is an asset that could be leveraged to advantage in a diversity plan.

BSE has experienced rapid growth in undergraduate advising and instruction in recent years. Particularly with potential retirements on the horizon, continuing this level of instruction will strain staff and faculty resources, a situation not dissimilar to departments throughout the university. Nevertheless, BSE should seek strategic hires to bolster and/or replace instructional capacity. They will also benefit from effective coordination with the College of Engineering on pre-engineering and undergraduate courses.

The graduate program in BSE if functioning quite effectively, though attention to student-faculty intellectual and governance interactions are recommended. We also note a need to resolve a structural funding issue related to USDA “National Needs Fellowships.”
Response of the Biological Systems Engineering Department to the 2015 Program Review

BSE submitted its 10-year program self-study in October of 2014 and the review team issued its report in November of 2015. We are grateful to the review team for their thoughtful and comprehensive review of our self-study and our program and their constructive suggestions.

The review committee affirmed the direction and goals for the department as established by our faculty. We appreciate that they judged the department as a high-functioning department with a clear vision for its current and future activities and a high degree of collegiality and respect among faculty and staff. The review team suggested that the procedures for electing the department chair be reviewed and clarified. Our executive committee will undertake this task in the coming year.

**Undergraduate Program**

The committee reported that the undergraduate program is an important asset to the Department and CALS, comprises a vibrant core of the BSE community with a positive environment toward students, approachability and accessibility of faculty, and the supportive attitude of student services staff. Students are complimentary toward the quality of teaching faculty and feel that the faculty are strongly invested in their success. BSE students are generally meeting or exceeding target ABET performance benchmarks and fell well prepared for their career choices.

The committee concurred with our assessment that the growth in our undergraduate student population has put considerable strain on our instructional resources and that with additional resources, the Department has the potential to grow an even larger undergraduate program, complementary to other CALS programs. We have 172 undergraduates enrolled in the program as of the Spring 2016 Semester (60 Machinery Systems, 36 Food & Bioprocess, 32 General or undeclared, 24 Natural Resource and Environment, 20 Structural Systems). This number under-represents the true total, as there are typically a large number of undeclared COE students that transfer into our program. Issues concerning constrains related to faculty advising have been addressed through reassignment of much of the freshman and sophomore pre-advising to our new Student Services Coordinator.

One of the primary recommendations was that **BSE should seek strategic hires to bolster and/or replace instructional capacity**. The review team recommends that the college provide instructional resources to support the expanded undergraduate enrollments and support the Department’s efforts to improve their instructional and research facilities. We have addressed this with a 2016 faculty position request in the Machinery Systems area (currently at 60 students in this option). Our second priority is for additional faculty to support our food engineering area (currently at 36 students).
The committee also recommended that **BSE will benefit from effective coordination with the College of Engineering on pre-engineering and undergraduate courses.** We are in constant communication with COE on developments in their curriculum and course offerings that present challenges and opportunities as part of the continuous review and evolution of our curriculum. Of particular note are changes in the technical writing offerings and introductory engineering courses (questionable future status of InterEgr 102 and InterEgr 397, redesign of InterEgr 160 to InterEgr 110 and InterEgr 170).

**Graduate Instruction and Research**

The review team indicated that the graduate program in BSE is very healthy and is functioning quite effectively with stable enrollments, and that students are satisfied with their education and career opportunities. Our research program was judged to be of high quality, meeting stakeholder needs, highly collaborative with other departments and successfully contributing to the overall research mission of CALS. The review team noted that BSE faculty receive less grant dollars per faculty member than some of our peer departments; likely related to the high teaching load, an issue that is somewhat minimized by the excellent research productivity of the group. The department was commended for the evolution in research priorities that have allowed it to remain relevant and a leader in their discipline. The most pressing issue relative to research needs was identifies as inadequate facilities for laboratories of faculty members.

The review team recommended increased **Attention to student/faculty intellectual and governance interactions**, with specific suggestions for further enriching the intellectual opportunities available to students through seminars and graduate course offerings and invite the graduate student group to send a representative to the open sessions of faculty meetings. BSE requires all graduate students to take two seminar classes: BSE 900 and BSE 901. BSE 900 seminar class introduces students various resources available on campus for their intellectual and research pursuits (e.g., CALS Statistical Consulting service, DELTA program, Writing Center, etc.). In BSE 901 graduating students present their research. To their seminars presentations all students, staff and faculty re invited. This has provided a good forum for graduate students to interact and intellectually engage with the rest of the department. We have a provision to include a graduate student representative to serves on the BSE Graduate Instruction and Research Committee.

The review committee recommended that **the Department should develop an action plan for increasing the numbers of women and under-represented minorities in its student body.** We recognize this common need in all of our sister departments and are in discussion with our peers to identify best practices for recruiting and retaining women and minorities into STEM fields. The percentage of female graduate students has been steadily increasing to the current 32%. Our undergraduate population is 27% female and 12% minority: We will implement the suggestion to build on our current marketing efforts to improve both the quality and diversity of the graduate applicant pool.

**Outreach/Extension Programs**

BSE has experienced a considerable reduction in faculty FTE who have extension appointments (2.49), has resulted in a narrowing of outreach/extension activities. The review team noted that all of the academic staff who are funded by UWEX also teach or support courses and that the balance of teaching, relative to extension/outreach programming should be reviewed. The
Academic Staff in BSE funded by UWEX include:

- John Panuska (%100 Extension Funding) teaches a 2 credit course BSE 201 Land Surveying fundamentals;
- Scott Sanford (25% UWEX funding) has previously taught a 2 credit short course on Energy Management,
- Cheryl Skjolaas (100% UWEX Center for Ag Safety and Health funding) teaches a 1 credit short course on Agricultural Safety and Health.

Of the faculty with extension appointments:

- David Kammel (80% UWEX 20% Research) teaches a 2 credit short course in Dairy Livestock Housing,
- Brian Luck (70% UWEX 30% research) does not teach or assist in any courses,
- Douglas Reinemann (51% UWEX, 24% teaching, 25% research) teaches a 3 credit course in renewable Energy systems,
- Rebecca Larson (50% Extension, 40% Research, 10% Teaching) teaches approximately 1/3 of a 3 credit course in nutrient management.

The greatest need identified was to maintain sufficient faculty capacity to deliver effective extension/outreach programs that are aligned with the research programs and needs of departmental stakeholders. The review team recommended a plan to address future extension/outreach needs, while balancing growing teaching needs, should be developed.

The short course offerings have traditionally been considered part of the Extension mission. The surveying course is primarily a service course with the majority of students from degree programs other than BSE. (We are considering discontinuing this course?) We have respected the T/R/E splits of our faculty and intend to do so in the future. We look forward to guidance from CALS and UWEX regarding the appropriate teaching activities for faculty with extension appointments, how 101 teaching and research percentages should be handled, and new policies regarding short course instruction. The realities of future Extension budgets for Specialists makes it particularly difficult to maintain, much less regain, faculty specialist positions. We have managed to fund a number of extension/outreach program staff from soft funds generated by gifts and grants and program revenue. We will continue to explore these opportunities as well as other creative responses to restructuring of the UWEX network in response to budget challenges.

Facilities

The review team reinforced our facilities concerns about facilities and noted that consolidation and upgrading of facilities is the biggest need to support research in BSE. Faculty members and their labs are scattered across five buildings and this presents problems with departmental cohesiveness, intradepartmental collaboration and retention and recruitment of top faculty and graduate students. Needs are most obvious in the Agricultural Engineering Laboratory Building with needs for additional wet lab space and updated research equipment were identified. Importantly, the Department is concerned about a potential student safety risk associated with use of the outdated Machine Shop for instructional purposes. The lack of adequate supervision, the condition of aging equipment, and the lack of adequate air circulation and cooling in the
Laboratory present a potential safety hazard. Without adequate building access monitoring and security protection, students without proper safety training may have access to dangerous equipment. This issue in particular needs immediate attention from the College and should be addressed as soon as possible. The review team indicated that a long-term plan for a consolidated building should be developed, and recommended that the Department should work with CALS and UW Foundation on a fund-raising strategy that can result in more unified facilities.

The major impediment to the effort to unify facilities is the projected cost of a new building ($90M) and the requirement of a 50% contribution from private sources. In addition, the footprint of a building to meet our needs is unlikely to fit on the current footprint making location of a new building challenging. We continue to explore creative options for addressing our space needs. The shop/lab facility and staff at our sister departments provide a vital and valuable contribution to both the teaching and research mission. Our near-term goals are to address the immediate safety concerns in our lab building and to improve this instructional space to keep pace with our peer departments.

We have identified several industrial stakeholders that are ready and willing to facilitate fundraising activities. This effort is being coordinated with a position refill (shop manager retirement in January 2015) and redefinition of this position to meet the future needs of the department. We have developed a PD and hope to fill this position by the summer of 2016. We would like to involve this new staff person in the development of ideas for space and facilities upgrades and anticipate launching our development campaign in the Fall of 2016. We have concerns about the type and level of support that is available from our current Foundation officer to facilitate this process.
Applicants, Admits and New Enrollments

This visualization was created by the Graduate School. Questions should be directed to Peter Kinsley, peter.kinsley@wisc.edu.
This visualization was created by the Graduate School. Questions should be directed to Peter Kinsley, peter.kinsley@wisc.edu.
Students with an Appointment of 33% or Higher

This visualization was created by the Graduate School. Questions should be directed to Peter Kinsley, peter.kinsley@wisc.edu.
PhD Time-to-Degree Metrics, Peer Comparison

This visualization was created by Academic Planning and Institutional Research (APIR), Office of the Provost, UW-Madison. Questions should be directed to Sara Lazenby, sara.lazenby@wisc.edu.
Distribution of Elapsed Years to Degree (Fall 2006 - Fall 2016)

- **Degree Level:** Doctorate
  - Less than 5 years: 68.2%
  - 5-5 years: 18.2%
  - 6-7 years: 9.1%
  - 8-9 years: 4.5%

Division: All
School/College: All
Academic Major: Biological Systems Engineering
Gender: All
Diversity: All
Race/Ethnicity: All
Country of Citizenship: All

This visualization was created by the Graduate School. Questions should be directed to Peter Kinsley, peter.kinsley@wisc.edu.
PhD Retention/Completion Rates, Peer Comparison

Dashboard will populate the retention/completion rates for the UW-Madison program (top graph) and the retention/completion rates for comparable peer programs at other AAU institutions (bottom graph).

Select UW-Madison Program
Biological Systems Engineering

UW-Madison Retention/Completion Rates (Biological Systems Engineering)

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<th>Number of years since PhD entrance cohort entered program</th>
<th>Percent of Entrance Cohort</th>
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<td>1%</td>
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<td>80.0%</td>
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Association of American Universities Peer Program Retention/Completion Rates (Biological Systems Engineering)

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<th>Number of years since PhD entrance cohort entered program</th>
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Student Status
- % Not Enrolled
- % Completed
- % Enrolled

This visualization was created by Academic Planning and Institutional Research (APIR), Office of the Provost, UW-Madison. Questions should be directed to Sara Lazenby, sara.lazenby@wisc.edu.