School of Chemical, Biological and Materials Engineering (CBME)  
Strategic Plan for 2015-2019  
Mission, Goals, and Values

The mission of the University of Oklahoma is to provide the best possible educational experience for our students through excellence in teaching, research and creative activity, and service to the state and society.

Consistent with the university mission statement, we in CBME seek to foster creativity, innovation, and professionalism through dynamic learning experiences.

We will realize our mission by achieving key goals:

• Provide our students with competitive advantages in pursuing future careers.
• Empower students, faculty, and staff through professional development opportunities.
• Deliver high-impact research and technology development.

Our mission and goals are built around the core values of leadership through integrity and service to society.

Our planning and future achievements are founded on a strong century-long tradition of excellence.

Goals

1) Grow high-impact research and development
We will build on existing and planned strategic investments to bolster our leadership within the College of Engineering in high-impact R&D areas of importance to our state and nation, including: Energy, Materials and Water and will support college efforts in Biomedical and Transportation.

2) Lead nationally in experiential learning
We will build on our strong emphasis on experiential learning, including supporting a new engineering leadership program, having a strong emphasis on undergraduate research, having undergraduates participating in national contests and continuing an innovative mentoring program.

Initiatives

1) Expand diversity, inclusion and capacity to enhance success of students, faculty and staff
In addition to expanding the size of our student body, faculty and staff, we will accomplish our goals most effectively within an inclusive environment where ideas from a diverse community are valued.

2) Expand CBME communication via social media and other outlets
Executing our communication plan will help us strengthen our CBME brand and its consistency among a broad spectrum of internal and external stakeholders.

3) **Enhance Academic Facilities**
Achieving our strategic goals will require enhancements to facilities, particularly laboratory facilities necessary to foster dynamic learning, innovation and professionalism.

4) **Support Formation of School of Biomedical Engineering**
A strong School of Biomedical Engineering (BME) will have significant synergies with CBME, and we support a strong BME program to complement our currently strong CBME program.

**Goal 1: Grow high-impact research and development**
The College of Engineering has identified 6 different growth areas: Biomedical, Energy, Materials, Radar, Transportation and Water. Within the College of Engineering, CBME leads in Energy and Materials, is one of two co-leaders in Water and Biomedical, and has contributions in Transportation. Each of the five areas will be considered in turn.

**Energy**
Long a recognized leader in research related to oil and gas recovery and processing, CBME will continue to lead in fossil energy R&D, while making cutting-edge contributions in a variety of other energy-related areas. Research on catalytic conversion of lignocellulosic biomass to gasoline and diesel fuel has gained national recognition over the last five years. Recent chemical flooding research shows promise to economically recover billions of barrels of trapped oil. Opportunities exist for development of sensors and strategies to deploy sensor networks, nonintrusive diagnostic tools, and multiphase flow modeling. Downstream issues in refineries such as crude pretreatment and fractionation, more efficient energy usage and alternative separation strategies for petrochemicals and downstream gas are of interest. The partnership with MPGE in the Mewbourne College of Earth and Energy in the development of unconventional oil and gas recovery technologies will continue to be a strategic focus for CBME. Our well-known expertise in nanotechnology will continue to be applied to the Energy area.

**Materials**
We will develop materials-by-design using computational materials engineering, coupled with innovative mechanics-based modeling and experimental characterization. Focus areas include advanced multifunctional composites, nanoparticles at interfaces and biomaterials. Develop multifunctional, high-performance, lightweight composites with unique thermo-mechanical properties using both theoretical modeling and innovative experimental techniques. Such advanced multifunctional composites are particularly needed for applications such as deep-water drilling, pipeline insulation and high-speed aircraft. Biomaterials applications include design and synthesis catalytic nanoparticles to enable biomass conversion with dramatically improved carbon capture, to improve mobility of trapped oil in reservoirs and to facilitate capture of contaminants from aqueous systems ranging from fracking water to large scale potable water technologies. Whether it be the surface of an artificial biomaterial or the native
extracellular matrix, the chemical composition and topography of the surfaces that a cell encounters in its local microenvironment will control its behavior. Thus, understanding and designing materials that control the cell-surface interface have important implications in the design of implanted medical devices, scaffolds for tissue regeneration and nanoparticle drug delivery systems.

Water
Water utilization and quality are of increasing importance due to the growth of the unconventional energy sector, and because of this issue; CBME is one of the co-leaders within COE in this area. Under such conditions, new approaches to managing water are needed in order to sustain the natural and built environment. Targeted areas include formulation with high salinity brines for unconventional oil recovery, development of materials and strategies for separation of oil and water mixtures, nanomembranes for nanofiltration of water, use of interfacial catalysts for chemical reactions, planning of the re-design and retrofit of water systems in process plants and water supply chains in order to better recycle water with aiming at zero-liquid discharge cycles, and water supply chains. Many of these areas also involve nanotechnology at interfaces; the small length scale in one direction associated with the oil-water interface makes nanotechnology an important part of any efforts in this area.

Biomedical
Currently, CBME is one of the leaders in biomedical research in COE. As a new biomedical engineering department is formed, we expect to cede this leadership to BME. However, we still expect important contributions to this area. The original group of faculty in this area which were able to garner a Whitaker Foundation grant was led by CBME faculty. Current major research thrusts relevant to CBME include biomedical applications of carbon nanotubes; biomaterials for tissue engineering and protein purification strategies.

Transportation
CBME expertise is currently being used to investigate roadway materials. Of particular interest is the behavior of the asphalt-rock interface and its relationship to roadway performance initially and after various weather changes.

Goal 2: Lead nationally in experiential learning
The College of Engineering has identified 3 different areas: Experiential learning, Engineering leadership program and On-line Master’s degree and certificate in data sciences and analytics. Within the College of Engineering, the latter is not relevant to CBME and the former is relevant in the sense that CBME would be very receptive to implementing a Leadership Option to complement the existing three options: Standard, Biomed/Premed and Biotechnology.

There are four places where we can be leaders in experiential learning. The first is in undergraduate research; we encourage CBME undergraduates to spend time in a Professor’s lab doing research and historically about 50% of our undergraduates have had some research experience. Second is in national competitions; we typically send two teams to both the regional and national competition for the Chem E
car, sponsored by the American Institute of Chemical Engineers. Third, is in having a two-semester Chemical Engineering laboratory experience. The laboratory experience, in addition to our Capstone class, is the crux of what we teach in our classrooms. The fourth is that we typically have 15-20 juniors and seniors mentor sophomores and is sponsored by the Chevron-Phillips Chemical Company. Not only do the juniors and seniors help the sophomores with their homework, they also sponsor social events etc. to help integrate the sophomores into Chemical Engineering. The experiential part of this activity is probably more for the mentors than it is for the students!

**Initiative 1: Expand diversity, inclusion and capacity to enhance success of students, faculty and staff**

Our undergraduate student population is ~38% female and ~20% underrepresented minorities. Of particular interest will be to increase the number of female faculty so as to provide role models for both male and female undergraduates.

Summer Bridge programs are an excellent way to increase diversity in the student body. CBME currently participates in both the BP Camp and the DEVAs camp, and we fully support continuation of, and expansion, of those college-based efforts. We will seek opportunities to expand this type of outreach program through major funding programs such as NSF Science & Technology Centers and Engineering Research Centers.

Expanding capacity of our program is a key issue, since enrollments in CBME are at an all-time high and we expect this situation to not change over the next five years. We plan to add tenure-track faculty who are both research active and teach well in the classroom in order to maintain the quality educational experience for each individual as well as to maintain our high level of research activity.

We will nurture, reward and invest in career and professional development activities. Workshops, seminars, discussion groups and other initiatives will be provided to create awareness and understanding of inclusive culture, innovative classroom technologies and to enhance success of research proposals submitted by faculty. We will leverage existing resources across campus (such as the Center for Teaching Excellence, the Center for Research Program Development and Enrichment, the Sooner Engineering Education Center and Human Resources) in order to achieve these goals.

**Initiative 2: Expand CBME communication via social media and other outlets**

For students, our primary mode of communication is e-mail and will continue for the five-year period of this plan. For alumni, the power of social media to allow us to more effectively communicate with our alumni cannot be overstated. Our primary tools will be Facebook and LinkedIn. One step in this process is to develop a list of Facebook and LinkedIn contacts with as many alumni as possible. We are piloting a program where we take old student lists and try to find the students on Facebook and/or LinkedIn. Another step will be to be sure to make regular posts to these outlets.
On a less regular basis, we will be sending out e-newsletters to our list of e-mail contacts (which will grow as well ideally during our efforts to identify alums via social media). We will send this newsletter once a semester, while in the summer we will send the newsletter that also links to OKCHE Magazine, which will have more in-depth features. This tiered communication strategy we believe strikes the right balance of good communication without being overbearing.

**Initiative 3: Enhance Academic Facilities**
During the last five years, we have converted office space to a team room for undergraduate students which also includes a conference room with A/V equipment ideally suited for group work from class. We also have updated another team room, and have funding to build a graduate lounge and a Chevron-Phillips mentor room for tutoring. Besides completing these two projects in the next ~2 years, we also plan a complete refurbishing of our Unit Operations lab, via funding from a corporate sponsor. The Unit Operations laboratory is significantly out-of-date and needs updating; plus money is requested to better maintain the new laboratory. The department is expected to be intimately involved in both recruiting the sponsor and determining how best to redo the Unit Ops lab.

**Initiative 4: Support Formation of School of Biomedical Engineering**
Having a separate School of Biomedical Engineering is critical to help both COE and the University go forward. With sufficient resources, we believe that BME could become a strong and well-recognized department. BME would be the next step in a process that began primarily with CBME faculty with the establishment of Bioengineering graduate degrees. The process must be done carefully and correctly to ensure that BME as well as the rest of COE and the University are strengthened by a new BME department. Such a department would have a number of overlapping features with CBME in both research and teaching. We are very excited to welcome new colleagues to the COE family.

**Summary**
The ultimate goal of these efforts is to produce graduates that are highly sought after as well as faculty and staff that are happy with their jobs and are growing professionally. In support of our philosophy for continuous improvement including recent changes to our curriculum, we fully have an expectation that in 2017 we will receive a six-year no action required report from ABET. Students, faculty, staff and alumni can and should be proud of the School of Chemical, Biological and Materials Engineering at the University of Oklahoma.