

Kansas State University
Summary Assessment & Institutional Recommendations Reports
Program Review Year 2019

College of Agriculture

Horticulture and Natural Resources: Bachelor, Masters, Doctorate – CIP Code – 01.1103

Wildlife and Outdoor Enterprise Management: Bachelor – CIP Code – 03.0201

Park Management and Conservation: Bachelor – CIP Code – 31.0301

These programs request a one-year delay for the BOR review. The department is in the middle of a major transition. In spring of 2018 the teaching coordinator resigned; and then in the summer the department head resigned. In addition, during the summer and fall three of the faculty either retired or moved to other schools. The remaining faculty, three of which are assistant professors, have been working to cover the additional responsibilities and earn tenure. The department will complete the BOR reviews for all three programs in next year's review cycle. All programs are exceeding minimum enrollment requirements for the BOR review. This postponement will provide the faculty and department the opportunity to focus on serving the students and completing the leadership transition.

Computer Science: Bachelor, Masters, Doctorate – CIP Code – 11.0101

Software Engineering: Masters - CIP Code – 11.0201

1. *Mission, Centrality, Uniqueness*

Our teaching mission is to offer high-quality degree programs that prepares graduates to be successful in high tech industries and advanced degree programs. Our research mission is to conduct world-class research that produces high-quality PhD graduates, contributes to computer science knowledge, and provides solutions for the technological needs of government, business, and industry. Our outreach mission is to deliver basic computer science education to high schools, community colleges, and undergraduate students and to provide online masters programs to professionals working in the field. Personal computers, smart phones, cyber-physical systems, and other computing devices are pervasive in our society. The state of Kansas has increasing needs for computing professionals capable of harnessing the power of these computing devices. The Computer Science Department, with its B.S. Degree in Computer Science (CS), educates students to fill these needs. The Computer Science Department has four main research strengths to set it apart from other similarly named departments across the country: Cybersecurity; High Assurance Software; Cyber-physical Systems; and Data Science. The Master of Software Engineering (MSE) degree program covers the application of engineering principles to the building of computer software.

2. *Strengths, productivity, and qualifications of the Faculty*

The faculty consists of 16 tenure track members, all with terminal Ph.D. Degrees. In addition, the department has 3 teaching professors and 3 instructors. The average class size for the UG program is 39.9. Graduate classes are relatively small (generally 10-25 students), enabling students an opportunity to engage in much one-on-one discussion. The program has been moving to an instructional model that uses lab classes, particularly in the first two years. In these classes, students complete a programming assignment completed during lab time. Graduate teaching assistants (GTAs) and undergraduate teaching assistants (UTAs) help the class instructor answer students' questions. On average, including all instructors, GTAs, and UTAs, we have achieved a ratio of one instructor for every 13.8 students in these lab classes. The faculty's 5-year average extramural research expenditures is \$3,287,991. Looking at the past five years, there is an annual average of 46 refereed publications and 35 grant proposals with an annual average of 20 funded.

Faculty service and extension/outreach activities include NSF GK-12 STEM Fellowship Program: INSIGHT (Infusing System Design and Sensor Technology in Education), which is a recent partnership between Kansas State University, Kansas schools, and the National Science Foundation (NSF) working to

Kansas State University
Summary Assessment & Institutional Recommendations Reports
Program Review Year 2019

instill the use of current sensor technologies into regular classroom learning. Seven faculty members have received prestigious NSF Career Awards. Research and academic funding is from several federal agencies: NSF, USDA, DoD, U.S. Army Research Office, AFOSR, DHS, etc., national research laboratories: Sandia, Lawrence Livermore, etc., and industry. Prestigious NSF awards have been received to fund both research and outreach activities from K-12 through the graduate level. The department is designated as a National Center of Academic Excellence for Research in CyberSecurity by NSA and DHS. Faculty members have received numerous teaching and research awards and six endowed chair positions in the college.

3. *Quality of Curriculum and Impact on Students*

The average ACT composite score for the incoming freshman class is 27.5. The annual average of Junior/Seniors over five years is 238 for Computer Science Bachelor degree. The current number of 550 undergraduate majors represents a 38.5% increase over the past 4 years. For the Computer Science program the five-year annual average enrollment is 32 for the masters program with an average graduation rate of 18 and the Ph.D. has an average enrollment of 39 with an average graduation rate of five computed over the past 5 years. Enrollment among doctoral students is steadily increasing. For the Master of Software Engineering, the 5-year average enrollment is 13 with an average graduation rate of 3 degrees conferred. External interest in the K-State MS in Software Engineering has changed in recent years with availability and reduced cost of online program offerings from other U.S. colleges. The department is currently assessing their program to determine if they can provide a more cost competitive program or if they should phase the current program out and place focus on other degree programs (which have been growing). At the same time, there has been a steady demand from online students for the MSE Degree Program. In the curriculum students specialize in Cybersecurity, High Assurance Software, Cyber-physical Systems, or Data Science. As a part of the program accreditation process, they regularly assess Student Outcomes (SOs) using rubrics applied to specific activities in specific courses. The program assesses most SOs annually; but some are on a 3-year sequence. Specific curricular improvements recently initiated as a result of outcomes analysis include requiring CIS 505, Introduction to Programming Languages; the proposed addition of a new required course, CIS 400, Object-Oriented Design, Implementation, and Testing; and two proposed Options – an Entrepreneurship Option and a Cybersecurity Option. Every six years, the Computer Science B.S. degree program undergoes an accreditation review by the Computing Accreditation Commission of ABET. The program was reviewed in the 2017/18 academic year and their accreditation was continued.

Student awards and recognitions in the program include: Maria De La Torre - University Award for Distinguished Undergraduate Student in Research, 2018. Other students and teams have won 9 awards in various competitions over the past 5 years.

4. *External Demand – Demonstrated student need and employer demand for the program*

The placement rate of graduates from this program is 97% (85% employed, 12% furthering education) (FY 2017 graduates). The types of employers include Technology, Manufacturing, University, and Defense with positions as Software Developer, Software Engineer, Analyst, Tech Support, Data Scientist, and Web Developer. Graduates are employed throughout the United States, with more in areas with higher IT demand. Many of our graduates are involved in start-ups here on the “Silicon Prairie” -- Ames, Des Moines, Omaha, Lincoln, Kansas City, and Manhattan. The industry advisory board indicates that demand for graduates will remain strong with placement, and external indicators also hint at continued demand. The average starting salary is approx. \$70,000 (FY 2017 graduates). Each year an Advisory Board consisting of alumni reviews the program with a consistently positive response about the direction of the program, while offering some specific suggestions for continued improvement. The graduate program plans to emphasize the on-line MSE Degree Program offered through K-State’s Global Campus, and to build off the program’s recognition as one of the Best Online Graduate Programs in Software Engineering in the 2017 U.S. News and World Report Ranking.

Kansas State University
Summary Assessment & Institutional Recommendations Reports
Program Review Year 2019

5. *The service to the discipline, the university, and beyond*

The department's contributions to general education include four introductory support courses: CIS 101 Introduction to Computing Systems, CIS 102 Introduction to Spreadsheet Applications, CIS 103 Introduction to Database Applications, and CIS 104 Introduction to Word Processing Applications. Service courses provided for other majors include: CIS 111, Introduction to Computer Programming (used by programs in Statistics, Mathematics, Biology, Agricultural Economics, Education, and Kinesiology), and CIS 209, C Programming for Engineers (used by programs in Statistics, Mathematics, Industrial Engineering, Electrical and Computer Engineering, and Civil Engineering). The program provides consulting services and resources as exemplified by eight faculty members serving on conference program committees or panels; four serving as conference chairs or organizers; and two serving on journal editorial boards.

6. *Cost Effectiveness and program needs*

In respect to program size and quality of the degree program relative to its costs, the undergraduate program generated about 7500 SCH per year (5-year average) from 14.7 FTE of faculty which yields over \$3,000,000 in tuition and fees (considering in-state tuition). Instructional expenditures equals \$2.6M per year (5-year average). Research expenditures equals \$3.3M per year (5-year average). State of Kansas support is \$2.0M per year. Faculty time required to offer CS major courses is 10.7 FTE (50% per TTF, 90% per teaching faculty). Support and equipment required for students is \$374K (IT staff, advisors, equipment fee expenditures). Infrastructure required for high quality degree include 4 computer labs equipped with thin clients or 64-bit desktops with state-of-the art software and classrooms/labs with audio/video equipment including data projectors and video recording capabilities

Architectural Engineering and Construction Science and Management:

CIP Code 140401 Bachelor of Science in Architectural Engineering

CIP Code 140401 Master of Science in Architectural Engineering

CIP Code 151001 Bachelor of Science in Construction Science and Management

1. *Mission, Centrality, Uniqueness*

The mission is to provide a learning environment of value to students, and of benefit to industry, the academic community and society as a whole. The department is committed to focusing individual attention and resources to achieve the highest standard of excellence in undergraduate education for architectural engineers and constructors. They promote excellence in faculty and student performance related to instruction, research, and service." Both the Architectural Engineering (ARE) and Construction Science & Management (CNSM) programs are central to the university, college of engineering and the state because of the critical role graduates play in their professional careers in society. The construction industry is crucial to a healthy US economy and the need for competent professionals is more critical than ever. ARE and CNSM programs are unique because the application based focus degrees and close involvement with the engineering and construction industry in Kansas, as well as nationally and internationally. Both programs at Kansas State are considered among the best in the nation.

2. *Strengths, Productivity, and Qualifications of the Faculty – Entire Department*

The department has an annual average over the past 5 years of 16 faculty FTE for the bachelor degrees and 12 faculty FTE all with appropriate terminal degree. All faculty have a minimum of 5 years related industry experience. Nine faculty members are registered professional engineers, two are registered Architects and four have additional certifications related to design and construction. Class sizes for both programs range from 12-60, depending on the course type and semester offered. Teaching responsibilities of

Kansas State University
Summary Assessment & Institutional Recommendations Reports
Program Review Year 2019

the faculty consist of teaching approximately 60 total classes each semester with 16 full time faculty dedicated to nearly 600 students in two programs within the department (Student-Faculty ratio of 37 to 1). Faculty increased engagement in research with \$667,730 awarded in grants and contracts over the past 5 years. Faculty are also involved in mentoring undergraduate students through research projects. Over the past 3-1/2 years approximately 50 different projects involved nearly 100 students. Nine faculty teaching awards are presented by the department each year. Faculty have earned four college, university, regional, and national teaching and service awards during the past school year. Among the graduate faculty, one is a fellow of American Concrete Institute and one is a fellow of American Society of Heating, Refrigeration, and Air-Conditioning Engineers which are honors given to about 1% of society members based on valuable contributions to the field. Graduate faculty distinguish themselves through educational outreach activities, service on professional societies and peer-review activities for scholarly journals and proposals, as well as editorial service on national and international journals.

3. *Quality of Curriculum and Impact on Students*

The annual average ACT score for ARE students is 26.9 and for CNSM students is 23.2 computed over the past five-years. The pass rate for ARE students taking the Fundamentals of Engineering exam is at 91%, higher than the national average. Departmentally, approximately 31% of the students enrolled are women and minorities. The trends for enrollment in the ARE program are an annual average of 303 students in bachelor's program and 11 students in graduate program. For the CNSM program, the annual average of 296 students in bachelor's program. The Architectural Engineering bachelor program graduates an annual average of 50 students, 7 masters graduates, and Construction Science & Management bachelor program an annual average of 65 graduates. Each semester the program gathers direct and indirect assessment data from students, faculty, alumni and industry partners to determine the effectiveness of the courses and competence of the students. This process involves the entire faculty with results reviewed by the program coordinators, program assessment teams and Advisory Councils. Findings lead to improvements in course topics, assessment measures, and course additions. ARE and CNSM students participate in several design and construction regional, national and international competitions each year. They placed, and sometimes won, in every event. Many ARE and CNSM students routinely receive award grants and scholarships from professional societies affiliated with student organizations.

The Architectural Engineering program is accredited by the Engineering Accreditation Commission of ABET every 6 years, the last accreditation during the 2017-2018 academic year receiving continued accreditation. The next accreditation visit will be in the 2023-2024 AY. The Construction Science & Management program is accredited by the American Council for Construction Education (ACCE) occurring each 6 years, the last accreditation review in the 2015-2016 AY. That was one of the "Pilot Visits" for revised accreditation standards. Re-accreditation was granted with weaknesses and concerns primarily regarding assessment input at the course/instructor levels. Those have been corrected and the next accreditation review will occur in the fall of 2021-2022 academic year.

4. *External Demand*

Industry demand for ARE and CNSM graduates is very high because of the strong construction market and shortage of competent professionals. Every semester virtually 100% of the department's graduates are employed prior to graduation or continue to graduate school. Graduates of the ARE & CNSM programs are employed with engineering firms and construction companies throughout the entire country. Recruitment of these graduates is not purely regional. Average starting salaries range from \$58,000-\$60,000 per year, for both degrees. Industry participates in the assessment of the programs via surveys. They provide feedback on the effectiveness of the programs and performance of our graduates.

5. *Service to the Discipline, University and Beyond*

Kansas State University
Summary Assessment & Institutional Recommendations Reports
Program Review Year 2019

The major instructional service responsibilities of the department consist of teaching approximately 60 courses per year. Programs offer one course as a service course for other students on campus. Scholarship responsibilities include working with students and industry to advance the understanding of engineering and construction aspects of buildings and building systems. The department has eight active student organizations that align with national professional societies. Faculty in the department routinely participate in conferences, provide service to the university and community, and participate in professional development. They continue to be actively involved and well represented in local and national professional and educational societies. Many of these instances involves committee work that furthers the societies and directly puts Kansas State in front of the engineering and construction industry. Service responsibilities of the faculty have included supervision of eight different department student organizations and many volunteer hours for local and state causes, benefitting the State of Kansas.

6. *Cost Effectiveness and Program Needs*

The student credit hour production was 9,373 for fiscal year 2018, which is 15% of the College of Engineering total. In FY2018 the department generated \$2,929,063 in tuition (based only on in-state tuition) and another \$927,927 in college fees. FY17 budgeted department support was \$2,036,220. The department's course-student head count for on-campus courses was 5,199 and the course-credit hour production was 9,239 for FY2018, with 5-year averages of 4,779 and 8,086 respectively, accounting for 16.17% of the college of engineering's BS and MS head count and 15.04% of the college of engineering's BS and MS student credit hour production. The General Use Base funding for FY 2018 was approximately \$2.01 M while the tuition revenue generated by the department exceeded \$3.0 M. The department generates substantially more funds than it costs to operate, reflecting a cost-effective operation and good return on investment when viewed as a profit center within the College and the University. Faculty in the department teach 3 to 4 courses per semester, as part of their full time contract. Past unfilled positions have reinforced the need for each faculty position in the department to adequately support the required coursework for the two-degree programs. Computer hardware/software and network connectivity are essential for the ARE and CNSM students. Software used for design, analysis, computation, and building modeling are the basis of many courses and the need to maintain and implement them into the degrees is paramount.

Chemical Engineering: Bachelor, Masters, Doctorate – CIP Code – 14.0701

1. *Mission, Centrality, Uniqueness*

The mission is to produce graduates who strive to better the human condition throughout the world by application of their technical knowledge and professional skill. The instructional priority for the department is to prepare students for a career in chemical engineering, whether that career begins in industry or with professional school. Graduates work in many different areas, including fuels, chemicals, biotechnology, microelectronics, advanced materials, nanotechnology, food and consumer products, and environmental engineering, demonstrating its centrality and mission of K-State. This is further demonstrated by faculty collaborations with other engineering programs and colleges: Civil Engineering, Biological and Agricultural Engineering, Computer Science, Electrical Engineering, and Mechanical Engineering, as well as with Chemistry, Physics, Biochemistry, and Grain Science. Chemical engineering is the only department within the College of Engineering with the background to address engineering products and processes based upon chemical technology. It is unique from chemistry; chemical engineering moves chemical technology out of the laboratory and into production. Of the Regents' institutions, only Kansas State University and the University of Kansas provide B.S. degrees in chemical engineering. The departments have very different emphases with KSU having demonstrated expertise in materials science and engineering, and bioprocessing.

2. *Strengths, productivity, and qualifications of the Faculty*

Kansas State University
Summary Assessment & Institutional Recommendations Reports
Program Review Year 2019

The department has a 5-year annual average of 13 faculty FTE with appropriate terminal degrees from highly regarded internationally eminent universities. Chemical engineering faculty have won a number of important College of Engineering and university awards for high quality teaching and research. These include the J. L. Hollis Memorial Award (Anthony), the Frankenhoff Outstanding Research Award (Hohn), the Coffman Chair for Undergraduate Teaching Scholar (Hohn), and the Steve Hsu Keystone research faculty scholar (Hanson). Edgar is a University Distinguished Professor and the second recipient of the College of Engineering Distinguished Researcher Award. Placidus Amama recently received a prestigious NSF Career Award (2017). Research is an important component of the chemical engineering program, and most faculty attract extramural funding via grants and contracts to support their research programs. In FY2017 the department spent \$3.5 M on research (\$2.2 M in chemical engineering and \$1.3 M from the Center for Hazardous Substance Research, housed within the Department of Chemical Engineering), most coming from extramural sources. Research areas include materials science, catalysis and reaction engineering, nanotechnology, gas delivery for biomedical applications, biological interfaces, and semiconductor processing. Funding comes from a variety of sources, including the National Science Foundation (NSF), the Department of Defense, and industry. In the past five years, ChE faculty have co-authored over 170 publications that have been cited over 1,000 times, attesting to their productivity and to the high regard for their research by their national and international peers. While chemical engineering faculty do not have extension appointments, several have served as consultants to companies within the state and beyond. The faculty contribute in a variety of ways to their professional organizations.

3. *Quality of Curriculum and Impact on Students*

The composite ACT score for incoming freshmen has averaged 28 over the past five years, significantly higher than the average for the university (24.9) or the College of Engineering (27.1). Our students received an Othmer National Scholarship, the A. McLaren White Award for taking 1st place in the AIChE national design competition, and an NSF Graduate Research Fellowship. Chemical Engineering has averaged annually 318.6 ChE majors and awarded an annual average of 48 BS degrees, computed over the most recent five-years. Enrollment spiked in 2015 and 2016 to 343 and 349 students, respectively, before dropping in the last two years to a more typical size of ~300 students. The ChE BS degree program is accredited by the Engineering Accreditation Commission of ABET. Graduate students are admitted on a competitive basis; typically less than 30% of applicants are admitted. Those admitted usually have an undergraduate GPA over 3.5 and GRE scores above 150 (verbal) and 160 (quantitative). Enrollment in both the MS and PhD programs has remained steady over the past eight years. The PhD and MS programs have averaged 20 and 10 students, respectively, over this time period. The department emphasizes graduating PhD students to align with K-State's strategic plan. Their students have been highly successful with the acceptance of their presentations and posters at professional meetings, and manuscripts for publication in high impact professional scientific and technological journals.

4. *External Demand – Demonstrated student need and employer demand for the program*

Chemical engineering graduates are employed in a variety of industries, including petroleum refining, chemical production, processing of agricultural products, materials, and consulting. Graduates are typically employed as process engineers, working in a manufacturing facility. The versatility of chemical engineers make this an attractive degree to many employers, now and in the future. From 2012-2017, only 14 of 167 graduates were still seeking employment at graduation. The average starting salary of our graduates during this time was \$68,602, one of the highest starting salaries on campus. Recent MS and Ph.D. graduates have taken positions at universities, national laboratories, and industry. In general, PhD graduates pursue positions that involve research while MS students find positions in process engineering or management. Examples of employers include 3M, Fluor, Air Liquide, Intel, Argonne National Laboratory, and Lawrence Livermore National Laboratory. Overall demand for chemical engineers is expected to be steady.

Kansas State University
Summary Assessment & Institutional Recommendations Reports
Program Review Year 2019

5. *The service to the discipline, the university, and beyond*

The impact of the Department and its graduates on state priorities includes current initiatives related to bioenergy, bio-based resources, biomedical applications, and sustainability. The department historically has performed research in areas related to important business sectors in the state such as agriculture, animal and human health, engineering design, energy, and advanced manufacturing industries. Within their discipline, the faculty sit on a number of editorial boards, serve on NSF review panels, review articles and textbooks, and assist national organizations by serving as officers, organizing workshops and symposia, and in other ways. Dr. Schlup serves as a program evaluator for the Engineering Accreditation Commission of ABET. Dr. Hohn serves as the Editor-in-Chief of Catalysts, an open-source journal in the field of catalysis, and is the founding president of the Great Plains Catalysis Society, a regional society focused on research in catalysis. At the university level, Dr. Erickson leads the Hazardous Substance Research Center. The faculty members are actively involved in committees both within the College of Engineering and across the University. Our faculty regularly serve on the thesis committees for students in other departments.

The number of ChE student credit hours taken by non-majors was 29.9% (five-year average). The department teaches service courses on Materials Science and Engineering to a combined enrollment of 476 students per year. The ChE graduate courses are frequently taken by students outside of the department. The faculty are also actively involved with economic development in the state through both their research and their consulting for a variety of companies in Kansas and elsewhere.

6. *Cost Effectiveness and program needs*

The Department has a 5-year average annual instructional budget of \$1.6M and generated 4,500 SCH annually in 2016 and 2017 (an average of 346 SCH/FTE/FY). All lectures, recitation sections, and laboratories are taught by faculty. Only \$12,915 of the entire general use budget is allocated for OOE. Operations are largely subsidized by corporate and individual sponsors, and the average annual amount spent in support of undergraduate instruction from these sources was \$62,600. Note that at the current in-state tuition rate, the 4,500 SCH generated represents \$2.1 M. The ratio of the average annual starting salary to the in-state student's investment in tuition to complete their degree is 1.7.

Civil Engineering: Bachelor, Masters, Doctorate – CIP Code – 14.0801

1. *Mission, Centrality, Uniqueness*

The mission is to provide: Excellence in classroom instruction, and an educational environment that prepares students for a professional career in civil engineering; Enrichment of the academic and professional experience of students and faculty; Outreach to the engineering community; and Advancements in civil infrastructure development and preservation. The undergraduate and graduate programs (B.S., M.S., and Ph.D.) conduct extensive research and creative activities, and offer outreach and continuing education programs. The undergraduate degree program in CE requires 128 credit hours of courses and is fully accredited by the Engineering Accreditation Commission of ABET. The Department also has established graduate education and sponsored research programs in structural analysis and design, geotechnical engineering, water resources engineering, environmental engineering, and transportation engineering and materials. There is also a vibrant distance education program (with about 20 students enrolled during the regular semester and three times as many in the summer), which is offered through the Global Campus and parallels the on-campus graduate and undergraduate programs. The department is committed to foster excellent teaching, research, and service that develop a highly skilled and educated citizenry necessary to foster the well-being of Kansas, the nation, and the international community. Graduates are in very high demand and work all over the United States. A majority of graduates serve the state by working for entities, such as, cities, counties or state (for example, the Kansas Department of Transportation, KDOT) or hold

Kansas State University
Summary Assessment & Institutional Recommendations Reports
Program Review Year 2019

prominent positions in industry, engineering consulting and architectural firms, and large construction companies. Many go on to work in local companies or own their own consulting firms.

2. *Strengths, Productivity, and Qualifications of the Faculty*

The department has an annual average of 12 tenured/tenure-track faculty members, computed over the most recent five-years. All faculty have terminal (PhD) degrees and are active in teaching, academic advising, extramural research, and/or professional activities. Several faculty are also licensed Professional Engineers. Four of the faculty members hold endowed positions. Over the last five years, the program faculty generated approximately \$2.67 million of extramural funding. Faculty authored/edited several books, book chapters, and numerous refereed articles in archival journals. Faculty members are professionally active and serve/served on the editorial boards of national/international journals, lead/led national technical committees, and organize symposia and conferences. At least one has recently won a national research award.

3. *Quality of Curriculum and Impact on Students*

The undergraduate enrollment in CE has steadily increases over the past several years going from 125 several years ago to well over 253 during the fall of 2018 after peaking at 306 in the fall of 2013. The average fall enrollment computed over the past five years is 303 with an annual average of 49 bachelor degrees and 22 doctoral degrees conferred over that period. The average ACT of incoming students for the last five years is 26.4. Ninety-eight percent of bachelor graduates gain employment within six months of graduation with an average annual starting salary is \$54,364, or enrolled in advanced studies. M.S. and Ph.D. graduates are employed in industry, public service, and in faculty positions at academic institutions. Results of program assessment metrics show that the percentage of graduating seniors passing the national Fundamental of Engineering (FE) examination is consistently greater than maximum of national average or 85%. The program recently had ABET accreditation review (2017/18) and renewed through AY 2023.

4. *External Demand*

The national need for the civil infrastructure preservation, improvement, and expansion is indicative of the demand for civil engineering graduates. As per the projection of the Bureau of Labor Statistics this demand will keep on increasing, which, in turn, will undoubtedly increase our student enrollment. Employers in the midwest and west are seeking K-State graduates who are well-known for their outstanding technical competencies as well as their high work and professional ethics. The competition for talent is so fierce that employers are looking for means of attracting the students as they enter the program by offering scholarships, summer internships, and part-time employment even to the underclassmen. Over the past several years graduating seniors (24 to 33 per semester) have received multiple job offers from employers, some well before their graduation dates. In addition to the traditional civil engineering employers such as government roles at all levels and consulting companies, a large variety of companies see graduates including oil and gas companies, power (transmission, alternative energies, etc.) companies, contractors, and construction companies. Based on the available responses, the average salary of MS graduates in CE is \$76,911. Most domestic students seek and find employment after completing the MS degree and international students continue with the doctoral program at KSU or other research universities. Doctoral CE graduates found positions as post-doctoral associates, instructors, or tenure-track faculty at national and international universities. Doctoral graduates are employed at research institutes, government agencies, and industry. The average salary of PhD graduates was \$66,500.

5. *Service Provided to the Discipline, the University and Beyond*

The department plays a key role in education, research and professional practice through its numerous activities at national and local levels. In addition to successful distance-learning program, the Department provides significant services beyond the University. Examples include the Annual Kansas Transportation Engineering Conference (500-600 participants, 100th meeting in 2018), the Annual Bridge Design

Kansas State University
Summary Assessment & Institutional Recommendations Reports
Program Review Year 2019

Workshop (about 80 participants, 24th year in 2017), Superpave Field Technician Certification Training (50-60 participants), Traffic Assistance Services for Kansas (providing training in highway safety since 1980), and a series of seminars and training courses on pavement preservation. KDOT continues to rely on K-State faculty expertise in large-scale infrastructure testing and research (e.g., the Civil Infrastructure Systems Laboratory, an off-campus facility). In addition to basic research that advances civil engineering practice worldwide, faculty continue to support state-level agencies. KDOT heavily interacts with faculty and actively seeks K-State graduates to serve the transportation needs in Kansas.

Although the department does not offer any course designated as K-State 8 (general education), nearly 47% of our departmental Student Credit Hours (SCH) are generated from teaching non-civil engineering student majors. This clearly demonstrates the department as heavily service oriented. Courses (CE 333, CE 522, CE 533, and CE 537) form the curricular backbone for the largest two departments in the college, (Mechanical and Nuclear Engineering (MNE) and Architectural Engineering, (ARE). CE 212 (surveying) is enrolled by many engineering and non-engineering (landscape architecture) students. CE 530 (statics/dynamics) is offered to Industrial and Manufacturing Systems Engineering (IMSE) and Electrical and Computer Engineering (ECE) students. CE 534 is taken by the ARE majors. Other service courses (CE 331 and CE 332) are offered to the students in Construction Science. For many years the BS/MS integrated program in ARE has been relying on CE graduate courses to support its program in Structural Engineering. Courses in water resources and environmental engineering are open to students in BAE and CHE.

6. *Cost Effectiveness and Program Needs*

Due to a steady increase in enrollment coupled with the loss of a number of faculty positions, the average Student Credit Hours (SCH) per Full Time Employment (FTE) has increased from 275 (as reported in the previous review cycle) to 535 in the fall of 2017; a 95% increase. The program needs additional FTE positions to continue to meet demand and provide quality education. The department offers three service courses that are exclusive to non-civil engineering majors and several undergraduate and graduate courses for both civil and non-civil engineering majors. The department's total instructional expenditure in FY '17 was around \$1.66 million, and the extramural funding generated by our faculty during the same year was about \$2.4 million.

Electrical and Computer Engineering: Bachelor, Masters, Doctorate – CIP Code – 14.1001

1. *Mission, Centrality, Uniqueness*

The mission is to provide: a) undergraduate and graduate students with the best possible education to prepare them for a professional career in biomedical, computer, or electrical engineering within the guidelines provided by the ABET; b) an environment which instills in students a sensitivity to the social and humanistic implications of technology and motivates them to make worthwhile contributions to the profession and to society in general while upholding the highest standards of professional ethics; c) the atmosphere to create new knowledge through scholarly research, which fosters faculty development, enhances the educational process, and contributes to the economic development of the region; and d) an effective outreach program including distance education courses, regular and short courses which benefit students outside the program and participation in professional society activities. Electrical Engineering was initially accredited in 1936 and has been continuously accredited since. The department of Electrical and Computer Engineering has approximately 440 undergraduate students and 80 graduate students. The department is housed in Engineering Hall and provides a variety of laboratories for teaching and research. Undergraduate programs are offered in Biomedical Engineering (BME), Electrical Engineering (EE) and Computer Engineering (CpE). The BME program just started in Fall 2018. Masters' and Ph.D. programs are offered in Electrical and

Kansas State University
Summary Assessment & Institutional Recommendations Reports
Program Review Year 2019

Computer Engineering. Two of the technical options of the M.S. program are offered to students via distance learning.

2. *Strengths, productivity, and qualifications of the Faculty*

The department currently has seven tenured Professors, seven tenured Associate Professors, and four tenure-track Assistant Professors, with an annual average of 19 with terminal degrees computed over a 5-year period. All have Ph.D.'s and are members of the graduate faculty and involved in teaching, research, and service. The department also has three non-tenure track faculty, two who have Ph.D's and one with an M.S. All faculty teach each semester, and class sizes range from approximately 150 students for freshmen classes to approximately 15 students for technical elective classes taken by seniors. Over half of the faculty are also involved in competitively funded research, with nearly \$3M in annual expenditures. Many faculty are involved in international professional organizations at various levels such as president, editor, advisory boards, conference program committees, and accreditation. For example, faculty serve in the associate editor positions for both the IEEE Transactions on Power Electronics and the IEEE Transactions on Network Science and Engineering. Another faculty is currently serving as a program director at the National Science Foundation. The faculty often receive various recognition for their efforts. Recent examples include: 1) a faculty member was named university distinguished professor in 2017; 2) Jefferson Science Fellow at the U.S. Department of State in 2014-15; and 3) Fulbright Specialist Award in 2017; 3). The research interests of the faculty cover several areas within the discipline. Three faculty are recognized for their contributions to the profession as Fellows of the IEEE.

3. *Quality of Curriculum and Impact on Students*

At the undergraduate level most of the students are U.S. citizens, except for approximately 14% of international students who are primarily from Saudi Arabia and China. About 16% are female and 13% are multicultural. The average ACT score is 27.1 computed over a 5-year period. Enrollment for computer engineering has a slight positive trend while electrical engineering has a slight negative trend. The five-year average enrollment is 255 for electrical engineering and 153 for computer engineering. The five-year average graduation rate is 51 for electrical engineering and 20 for computer engineering. Computer engineering does not offer sub-specialties, while electrical engineering has three sub-specialties: bioengineering, communications & electronics, and power systems. Over the past two years, both programs have developed a comprehensive two-semester capstone course for the senior year that gives students significant industry-related design experience. Both programs had successful ABET accreditation reviews in 2017-2018. Students in the programs have earned numerous recognitions, including receiving the outstanding chapter award to our honor society, HKN, for over the past 5 years. There have also been numerous individual student recognitions, and over 100 students are active in undergraduate research or creative inquiry each year. In the graduate program, an average of 30% are female and 70% are male. The percentages of applicants that were recommend for full admission was 30.6%, admitted with funding was 8.7%, admitted on probation was 2.6%, and denied admission was 58.1%. Enrollment trends for the past five years have seen an increase in Ph.D. students and a decrease in M.S. students due primarily to priorities in the program and the job market for B.S. graduates. The average graduation rate is 9 students. Besides the on-campus M.S. and Ph.D. programs, two distance education tracts for the M.S. degree are also offered in: 1) power systems; and 2) communications and networking. Graduate students received numerous recognitions and awards, including outstanding paper awards, programming competitions, entrepreneurial competitions, and graduate scholarships.

4. *External Demand*

Electrical and computer engineering graduates are sought by employers on a national and international basis. There is over 95% percent placement of graduates into full-time employment or a graduate program within a year after graduation. The demand for graduates at all levels exceeds the current number of

Kansas State University
Summary Assessment & Institutional Recommendations Reports
Program Review Year 2019

graduates, even in periods of lower economic activity. Many of the employers are located within or adjacent to the state of Kansas. These include Garmin, Cerner, Honeywell, Black & Veatch, Burns & McDonnell, Koch Industries, and Textron Aviation. Other graduates find employment with major defense contractors, federal laboratories, and major dot-com industries in the southwestern U.S and up through the Pacific Northwest. The average starting salary for 2016-17 electrical engineering graduates was \$61,886 and \$63,240 for computer engineering graduates. Employers of the graduates continually inquire about ways to increase the number of graduates for both degree programs to meet their employment needs. Graduate students take a variety of positions across the country with the vast majority are senior level research and design. Those that move into academic positions are typically either assistant professors or postdoctoral researchers. Post-graduate surveys identify that over 90% of graduates are gainfully employed in a job that corresponds to their degree.

5. *Service to the discipline, the university and beyond*

The department has a primary responsibility to offer quality courses in programs that are of value to employers who hire our graduates. Faculty appropriately balance their teaching with research to advance knowledge and service to advance the discipline. Many of the research efforts are collaborative in partnership with other K-State faculty and involve many undergraduate students. Several faculty have served as consultants to a variety of Kansas companies, which strengthen the companies with their expertise. Faculty are also often sought out as speakers at other universities, companies and conferences. The ECE department offers two courses that are required by other programs in the College of Engineering. This instructional service to other engineering departments amounts to approximately 1900 student credit hours (SCH) annually.

6. *Cost Effectiveness and program needs*

The 11.6 instructional FTEs in the department generated an average of 7351 student credit hours over the past five years. There were 5.48 FTEs devoted to research, and 2.20 FTEs devoted to service. This represents a significant increase in SCHs with a decrease in FTEs since the last general review. A significant concern that continued cuts in faculty will restrict the growth and quality of department programs, especially as the BME program is in its early stages. Likewise, a general lack of both teaching and research space for all three programs and the corresponding faculty is present.

Mechanical Engineering: Bachelor, Masters, Doctorate – CIP Code – 14.1901

Nuclear Engineering: Masters, Doctorate – CIP Code – 14.2301

1. *Mission, Centrality, Uniqueness*

The Mechanical and Nuclear Engineering (MNE) Department offers undergraduate degrees in Mechanical Engineering and Mechanical Engineering with a Nuclear Option and has separate graduate programs in Mechanical Engineering and Nuclear Engineering—both leading to M.S. and Ph.D. degrees. The mission of the Department of Mechanical and Nuclear Engineering is to (1) provide rigorous and challenging educational experiences at both the undergraduate and graduate levels to enable students to attain their full potential, (2) conduct scholarship that is of national and international repute to generate new knowledge and technology for the benefit of society, and (3) provide service through outreach programs to the profession, Kansas, the nation, and the world. The K-State MNE degree program is the largest among the six Kansas Board of Regents universities in terms of enrollment and faculty size and plays a critical role in meeting industry's needs for mechanical engineering graduates in the Midwest region and the nation. The degree program is the only one in the state and among only 26 nationwide to offer a Nuclear Engineering option or degree.

2. *Strengths, productivity, and qualifications of the Faculty*

Kansas State University
Summary Assessment & Institutional Recommendations Reports
Program Review Year 2019

The quality of the MNE faculty is evidenced by measurable accomplishments in teaching, scholarship, and service. Twenty-nine of the current members of the faculty hold the Ph.D. with appropriate specialization. The quality of teaching is evidenced by recent awards for excellence in teaching: the Bob and Lila Snell Distinguished Career Award for Excellence in Undergraduate Teaching, James L. Hollis Memorial Award for Excellence in Undergraduate Teaching Presidential Award for Excellence in Undergraduate Teaching, American Society of Engineering Education Midwest Section Outstanding Teaching Award and Commerce Bank Outstanding Undergraduate Teaching Awards have been awarded to faculty members in the department. One faculty member was recently awarded an ABET Fellow (a highly coveted award in the discipline). One faculty member was awarded the Rockwell Lifetime Achievement Award and another was awarded the Radiation Science and Technology Award, both from the American Nuclear Society. Another faculty member has received six R&D 100 awards in the last fifteen years (one is considered exemplary). Four others are Fellows of the American Society of Mechanical Engineers (ASME). One of the faculty members recently was recognized by ASME with the International Conference on Nanochannels, Microchannels, and Minichannels (ICNMM) Outstanding Early Career Award and three faculty members have received coveted CAREER awards from the National Science Foundation. The faculty have an outstanding record of external funding, with sponsored research expenditures reaching \$5.6M in FY 2017. In 2018, funding from successful grant proposals has already exceeded \$15M. Papers published in peer-reviewed scholarly journals has reached 3.2 per tenure-track faculty member. Over the past three years, the department has annually averaged 2.05 national awards. Increased research funding and productivity for the past several years has led to an increase in professional leadership and service opportunities. Members of the faculty serve in college and university leadership roles as well as a key point of contact between the university and industry. Nearly one third of the faculty are engaged in research that involves an industrial partner.

3. Quality of Curriculum and Impact on Students

The department aggressively recruits outstanding students into both undergraduate and graduate programs. Since 2010, the average ACT score of undergraduate students is 27.4. Undergraduate enrollment has exceeded 900 over the past four years after rising substantially since 2010 when 703 enrolled. Women account for 9.0% of MNE undergraduate students and 16.3% are underrepresented minorities. The program has averaged 164 graduates over the last five fiscal years. In fiscal year 2018, MNE graduated a record 185 undergraduate students. The doctoral student enrollment continues to grow. The fall 2018 graduate student enrollment reached 17 M.S. and 56 Ph.D. students, that included 23.3% women and 54.8% underrepresented students. The 5-year average per program is 22 students and 8 graduates for the masters in Mechanical Engineering and 24 students with 3 graduates in the Ph.D. program. For Nuclear Engineering the masters program has a 5-year average of 5 with 2 graduates and 13 students with 2 graduates for the Ph.D. program. Student creative inquiry teams are active with almost one out of every five undergraduate students participating. MNE students have earned college, university and national recognition for their achievements in creative inquiry team activities, papers/posters/presentations, as well as academic and leadership accomplishments.

In FY2017/18, the program completed a successful accreditation from ABET. This six-year, external major review of our program is in addition to annual internal assessments. Student learning achievement has remained steady over the past five years and showing growth in the area of ethical decision-making. The curriculum has been improved to require our students to take all core design courses at K-State. (Students may only transfer two ME/NE courses with core design courses not eligible for transfer.) Additionally, the program has modified its capstone senior design course sequence with one course covering essential lecture material and one course covering an industrial project. The shorter turnaround time (down from two semesters to one for project completion) is popular with industry sponsors. While the program has gone through a period of strong student enrollment growth over the past decade, successful faculty searches and a reorganization of some laboratory space has allowed the program to keep MNE only courses (not service courses) relatively steady in size. Laboratories have a 16:1 student-to-faculty ratio and most technical elective courses have enrollments under 50

Kansas State University
Summary Assessment & Institutional Recommendations Reports
Program Review Year 2019

students. Laboratory and classroom facilities are equipped with current technology/equipment for state-of-the-art instruction. In addition, MNE has hired two full-time professional advising staff to provide solid and consistent advising throughout the first two years of the program. Faculty members then advise junior and senior students as well as creative inquiry teams and professional organizations.

4. *External Demand – Demonstrated student need and employer demand for the program*

Demand for graduates from K-State with mechanical engineering undergraduate degrees as well as for M.S. and Ph.D. graduates in both mechanical and nuclear engineering is very high. Over the past few years common job titles for our graduates are project engineer, field engineer, and design engineer for companies in many industries including oil and gas, automotive and aviation, and control systems as well as government and government-support agencies. In the last four years of recorded data 49.5% of program graduates were employed in Kansas, 13.5% in Missouri, and 9% in Texas. The program's Industrial Advisory Council meets yearly to evaluate the program and to discuss current trends and outlook to help guide our program towards continued success.

5. *The service to the discipline, the university, and beyond*

All curriculum-required courses are offered in both fall and spring semesters. The MNE department teaches several large-section service courses (ME 212 Engineering Graphics, ME 512 Dynamics, ME 513 Thermodynamics I, ME 571 Fluid Mechanics) to MNE students as well as students in other programs. Of these courses, Dynamics, Thermodynamics I, and Fluid Mechanics are also offered during the summer. All mechanical and most nuclear engineering technical electives are offered once a year. In addition to the laboratories used exclusively for undergraduates, many of the research laboratories include significant undergraduate involvement. Some of these are Institute for Environmental Research (IER), National Gas Machinery Laboratory (NGML), Materials and Testing Laboratory, Semiconductor Materials and Radiological Testing (SMART) Laboratory, and TRIGA Mark II Nuclear Reactor Facility. These are unique facilities for Kansas and the Midwest region. The TRIGA reactor is used by researchers throughout the university and the state for research and teaching purposes. The capstone design course of ME 574 and ME 575 Industrial Design Project I and II is an important vehicle for interaction with industry. Consulting activities by faculty members, contacts with alumni, and meetings with company representatives who are on campus for recruiting are other avenues through which the faculty strengthen the department's ties to industry.

6. *Cost Effectiveness and program needs*

The faculty currently consists of 30 full-time-equivalent (FTE) members with ten full professors, ten associate professors, five tenure-track assistant professors, one tenured assistant professor, one teaching assistant professor, and three instructors. Searches are underway to hire two new tenure-track faculty members and to replace one temporary instructor. On average, faculty members spend about 40% of their effort on teaching duties, 20% on service, and 40% on research. In Fiscal Year 2017 with 31 FTE teaching, faculty produced 12,650 student credit hours or about 408 SCH/FTE. The department operates with an annual budget slightly in excess of \$7M, which comes approximately 20% from state funding, 30% from tuition/fees, 40% from extramural funding, and 10% from fundraising. The MNE Department is the largest department in the College of Engineering, representing almost 25% of the college. This fact has been aided by and requires that investment into top quality laboratory and instructional materials be judiciously made. The department's laboratory committee has a strategic plan to distribute the student equipment fee funding to keep computing resources up-to-date as well as to accept faculty requests for additional technology and equipment infrastructure that aid in producing high-quality degrees.

Industrial Engineering: Bachelor, Masters, Doctorate – CIP Code – 14.3501

Operations Research: Masters– CIP Code – 14.3701

Engineering Management: Masters – CIP Code – 15.1501

Kansas State University
Summary Assessment & Institutional Recommendations Reports
Program Review Year 2019

1. Mission, Centrality, Uniqueness

The Department of Industrial and Manufacturing Systems Engineering (IMSE) prepares students for successful life-long careers and provides leadership in industry and the profession through research and educational programs. To accomplish this mission, the department: (1) Educates students at the undergraduate level to be engineers who can design, analyze and improve systems that produce goods and services; (2) Educates students at the graduate level to become leaders in the application of industrial and manufacturing systems engineering skills and tools and lead the quest to advance the state-of-the-art in IMSE; (3) Performs research in the discipline that is both of fundamental importance and of value to industry, the profession and society as a whole; and (4) Serves the K-State institution, community and profession by using skills and time to advance their missions. In its 2018 report, the U. S. Bureau of Labor Statistics showed that industrial engineering had the third largest number of engineering graduates employed. Furthermore, industrial engineering jobs look to increase by about 10 percent over the next 10 years, faster than average for all engineering disciplines. Unique aspects of the IMSE department research are a strong emphasis in operations research, unique capabilities in advanced manufacturing processes, manufacturing systems, and an emerging emphasis on practical optimization of health care systems.

2. Strengths, Productivity and Qualifications of the Faculty

The IMSE faculty currently includes an annual average of 13 faculty computed over a 5-year period. Of this number, 12 are tenured or tenure-track (T/TT) faculty members and one is a Senior Professor of Practice, each with Ph.D. and are qualified to teach graduate level courses and mentor Ph.D. research. Average class size has increased from 27.2 in FY 2008 to 67.1 in FY 2018. Each IMSE course is evaluated by students using the nationally-normed IDEA evaluation system with average scores out of 5 possible: Progress on Relevant Objectives - 4.08, Excellent Teacher - 4.11, Excellent Course – 4.05, and Summary Evaluation - 4.11. In reference to research and extension expenditures, for the past five years IMSE faculty averaged \$2,589,351. Furthermore, university center expenditures allocated to the department through IMSE faculty involvement in the center averaged \$3,113,054 over the same five-year period. During this same period, the IMSE faculty published an average of 3.0 journal articles and 2.9 conference proceedings per faculty member per year.

3. Quality of Curriculum and Impact on Students

The Industrial Engineering BS degree is accredited by the Engineering Accreditation Commission of ABET, the most recent completed in the 2017/18 AY. During the past five years, the department graduated an average of 43 students each year. The average ACT composite scores for new freshmen students is 27.1. Students graduate, on average, in ten semesters. Since the last KBOR review, the number of industrial engineering majors has increased by 87 students. The five-year average annual enrollment is 251 with an annual average of 152 Junior/Seniors. In Fall 2018, 77 students (30.3%) enrolled in the program were female. This is an increase of 29 female students since the last KBOR report in 2010. The department also increased the number of multicultural students enrolled from 13 in the fall of 2010 to 22 in the fall of 2018, an increase of 73.3%. For the graduate programs, Industrial Engineering masters has a 5-year average enrollment of 18 and annual graduation number of 10. There was one low enrollment year that brought the average below the minima but the other years are consistently above. The IE doctoral program has a 5-year average enrollment of 18 with an average of 3 degrees annually. Operations Management masters has a 5-year average enrollment of 20 with an average of 9 degrees conferred. Engineering Management masters has a 5-year average enrollment of 31 with an average of 9 degrees conferred.

The IMSE department has established a comprehensive set of SLOs directly derived from the ABET student outcomes (a) to (k). Direct measures are used to assess the effectiveness of these SLO components. The IMSE assessment standard is that at least 80% of students earn a C or better for each direct measure. Over the last five years, evaluations show that all student learning outcomes meet the IMSE assessment standard. The quality of

Kansas State University
Summary Assessment & Institutional Recommendations Reports
Program Review Year 2019

the BSIE program is further illustrated by examples of student success. The K-State student chapter of the Institute of Industrial and Systems Engineers has been listed as one of the top student chapters in the nation in nine of the last ten years. IE students are very competitive for national scholarships. For example, one of the students received the Material Handling Education Foundation Scholarship in 2017. Since its inception in 1976, twenty-eight KSU IMSE students have been awarded this scholarship and K-State IE students account for 4.5% of all awards given nationally. Furthermore, K-State IE students who aspire to graduate study are accepted into the most prestigious graduate programs in the nation at a nearly 100 percent rate.

4. External Demand

Graduates of the K-State IE program are in strong demand in Kansas, the Midwest region and across the nation. Career and Employment Services reported collecting data on 42 of the 48 B.S. students who graduated in FY 17 (most recent data available). Of the 42 students, 40 found jobs (95%) and one went on for further education. Only one (2%) was shown in the still looking category at graduation. The average starting salary (n=31) was \$66,401. The IE median salary offer was \$65,000 and the mode was \$60,000. The companies that have recruited the most K-State IE graduates in the past five years include: Deloitte Consulting LLP, Cerner, ExxonMobil, Honeywell, Pepsico/Frito Lay, Altec, Anheuser-Busch, JB Hunt, and Walmart. K-State IE graduates pursue careers as: consultants, project engineers, financial analysts, production supervisors, operation analysts, logistics engineers, manufacturing engineers. About half of the IE graduates take a job in the manufacturing sector and 52% percent of these graduates take their first positions in KS or MO companies.

5. The service to the Discipline, the University and Beyond

The department instructs many students from outside of the department in the following classes: IMSE 250 – Introduction to Manufacturing Processes, IMSE - 251 Manufacturing Processes (laboratory) and IMSE 530 – Engineering Economic Analysis. During the past five years, the IMSE department generated 4,690 student credit hours per year. Fifty-three percent of the student credit hours were for IMSE undergraduate students, fifteen percent were for IMSE graduate students, and thirty-two percent were generated for non-majors. IMSE faculty members are actively engaged in professional service. Each faculty member has responsibilities for departmental and college committees. In addition to local obligations, IMSE faculty members are actively engaged in professional service. In 2017, IMSE faculty members served on the editorial board for 13 scholarly journals, held one significant national professional leadership role, led two national workshops, served on three significant technical committees, and organized and co-chaired two sessions at professional conferences. More than half of the IMSE research faculty regularly serve on research proposal review panels. The IMSE faculty are active within professional societies such as IISE, SME, APICS, INFORMS, ASEE, ASME, and others. These commitments serve our profession and society and advance the reputation of our department.

6. Cost Effectiveness and Program Needs

Kansas investments in the K-State IMSE Department yield substantial returns. The fourteen faculty members and three staff members are supporting strong undergraduate and graduate education programs, conducting research that is vital to business and industry, and working together to serve the college of engineering, Kansas State University, Kansas, and the profession. The five-year average state budgeted investment in the IMSE department was \$2,098,227. These funds supported the wages and salaries of faculty, staff, and students and operating expenses. The remaining department expenditures were covered by grants, gifts, and restricted fees. In return, the IMSE Department and associated center annually produced more than four million dollars in funded research and annually graduated 44 students with baccalaureate degrees, 29 students with master's degrees (10.2 MSIE, 9.6 MSOR, and 9.6 MEM), and 2.8 students with Ph.D. degrees. IMSE faculty members annually generate more than 4,700 student credit hours (SCHs). Student credit hour production has increased over the last five years by an average of 3.4 percent annually. In FY 2017, IMSE faculty members advised 267 undergraduate students and 72 graduate students, and graduated 48 students with BS degrees, 30 with MS degrees and 3 with the Ph.D. The average starting salary of the FY 2017 BS IE

Kansas State University
Summary Assessment & Institutional Recommendations Reports
Program Review Year 2019

graduates alone totaled more than \$2,650,000 for the forty that we have data for and 30 percent of them took their first job in Kansas (typical).

Agricultural Technology Management: Bachelor – CIP Code – 01.0201

Biological and Agricultural Engineering: Bachelor, Masters, Doctorate – CIP Code – 14.0301

1. Mission, Centrality, Uniqueness

The mission of the Department of Biological and Agricultural Engineering (BAE) is to advance the knowledge and application of engineering and technology to living systems, agriculture, and the environment. The department supports K-State's mission by providing academic programs in the Colleges of Engineering and Agriculture, and by conducting research and providing technology transfer through K-State Research and Extension. The department's academic programs include B.S. ATM, B.S. BSE, M.S. BAE, concurrent B.S. BSE and M.S. BAE, and PhD. BAE. All of these programs are at the heart of the land grant mission of K-State and are the only such programs in the state of Kansas. The BSE program, which offers environmental, machine systems, and biological engineering options, produces graduates who are equipped with an analytical, problem solving background and skillset to work with living systems. Through the program, students integrate engineering fundamentals and design principles with biology and chemistry to develop sustainable solutions for biological, agricultural, food, and natural resource systems. The ATM program, on the other hand, educates technology managers who can combine the critical understanding of agricultural and biological sciences with the problem-solving viewpoint of an engineer. The curriculum emphasizes the application and integration of agricultural sciences, technical systems, and management of people and resources.

2. Strengths, Productivity, and Qualifications of the Faculty

The BAE Department provides statewide leadership in teaching, research, and extension in advancing the knowledge and application of engineering and technology to living systems, agriculture, and the environment. The department has 15 faculty members (14 with tenure or on tenure-track and one instructor), including 13 with teaching responsibilities. The number of instructional faculty members provided by the Office of Planning and Analysis is eight. Note that BAE faculty FTE appointments are spread across teaching, research, and extension. BAE faculty members have been very successful in securing extramural funding to support research, two graduate programs, and extension, generating approximately \$1.29 million annually over a 5-yr period (FY13-FY17). BAE faculty members have been recognized for excellence in teaching, research, and/or extension. For example, during the 8-yr evaluation period, BAE faculty earned 27 national/international awards, 8 regional and state awards, 7 university, and 21 college awards. All current faculty members, except the instructor, are members of the graduate faculty. Currently, 12 graduate faculty members serve as major or co-major professors to 36 graduate students; the remaining two graduate faculty members serve on M.S. and/or Ph.D. supervisory committees. BAE faculty members have been very successful in securing extramural funding to support their research and the graduate program, generating approximately \$1.57 million annually over an 8-yr period (FY10-FY18). BAE faculty members have been recognized for excellence in teaching, research, and/or extension. During the 8-yr evaluation period, a BAE faculty received two international awards, seven received 10 national-level awards. Five faculty members were elected to the Fellow grade of ASABE. The extension faculty received eight blue ribbon awards from ASABE. Four faculty members received awards at the University level, and nine at the College level.

3. Quality of Curriculum and Impact on Students

The quality of the students are high with 5-year average ACT composite scores of 27.4 in the BSE program and 23.4 in the ATM program. For the BSE program, the 5-year average number of Jr/Sr students is 70, ranging

Kansas State University
Summary Assessment & Institutional Recommendations Reports
Program Review Year 2019

from 59 in FY14 to a high of 94 in FY17 (92 in FY18). For the ATM program, the 5-year average number of Jr/Sr students is 46, ranging from 38 in FY14 to a high of 54 in FY16 (47 in FY17). Both the BSE and ATM programs meet the KBOR minimum number of degrees granted (10). The 5-year average values are 23.6 (increased from 18 in 2014 to 37 in 2018) for the BSE program and 18.8 (range from 13 to 23) for the ATM program.

The BSE program offers environmental, machine systems, and biological engineering options. The biological option involves application of biological principles to engineering; enables sustainable processing for food, energy, and chemicals; efficient use of biological systems to maintain health of a growing population; and development of biomaterials and bioinstrumentation. The environmental option involves the design and management of systems that impact natural resources such as ecological engineering design; soil and water conservation; irrigation and drainage system design; and management, bioremediation, water quality and air pollution control. The machinery systems option involves designing, testing, and evaluating machines, machines components, manufacturing and processing equipment, and sensors and controls used in agriculture and off-road industries. The ATM program offers some specialization in technology; agribusiness and management; biological, natural resource and environmental sciences; animal science; and processing.

The BSE program has eleven student learning outcomes and uses a combination of performance criteria including coursework, projects, senior exit interviews, and industry feedback to assess student attainment. Courses selected for assessment are common to all BSE options to ensure consistency within the assessment process and include courses such as BAE 331, BAE 345, BAE 445, BAE 545, and BAE 640. Project assessment focuses on BAE 536 and BAE 640. Senior exit interviews are conducted at the end of each semester by the Department Head and provide information concerning the students' assessments of the program and their involvement in various activities. Industry feedback is collected from the Industry Advisory Council and input from student internships. In general, assessment data have indicated that students are attaining the student learning outcomes. For the ATM program, direct measures, including performance of students in specific course activities (e.g., specific problems in exams, specific problems in problem sets, laboratory exercises, class projects) and an indirect measure (i.e., self-assessment through the senior exit interview) are used to assess attainment of the learning outcomes. In general, assessment data suggest that ATM students have been able to achieve the learning outcomes. Since student performance has exceeded the evaluation metric for all learning outcomes, no formal corrective actions have been implemented by the faculty.

Students in the BSE program have exhibited outstanding success at national competitions. Many students have received numerous awards for excellence in classrooms and/or creative inquiry activities. Examples include: ¼-scale tractor team (placed in top 2 for 7 out of the past 8 years); Fountain wars team (placed in top 3 for 7 out of the past 8 years); ASABE Gunlogson Open Design Competition, 3rd place - 2018 (Stable Hands), 1st place - 2015 (Cadaver Rotation System); 2 recipients for the Nathan Undergraduate Research Experience Award; ASABE K.K. Barnes Undergraduate Paper Competition (2nd place – 2018, 1st place – 2015, 3rd place – 2016); 3 recipients for the 2018 Kirmser Undergraduate Research Award and one Honorable Mention in 2016; ATM students have also exhibited success at national competitions, primarily through the ¼-scale tractor teams, in which approximately 25% of the team members are in ATM. The BSE program is accredited by the Engineering Accreditation Commission of ABET. The accreditation visit was held in Fall 2017. The BSE program was accredited for the next six years. For the ATM program, external review is provided by the ATM Industry Advisory Council.

Graduate students have published their research results in refereed journals; during the past eight years, the average numbers of refereed journal articles are 1.0 per M.S. student, 3.0 per Ph.D. student, and 0.5 per concurrent BS/MS student. During the past eight years, three BAE graduate students received seven awards at the national level, including the First place 2016 ASABE Boyd-Scott Graduate Research Award, first place ASABE Ethics Video Challenge, and 1st place EPA Green Campus Rain Work Challenge. The KSU Student Robotics Design team, which was mainly formed by BAE graduate students, won the national/international

Kansas State University
Summary Assessment & Institutional Recommendations Reports
Program Review Year 2019

championship at the ASABE Student Robotics Design Competition for consecutive nine years (2007-2015). At the University and College levels, BAE also won 12 research awards.

4. External Demand

The 5-year average placement is for BSE are 91.6% employed or furthering their education. Students in the BSE are employed in government agencies, environmental design and consulting firms, biotechnology companies, electric power and utility companies, agriculture and off-road equipment industries, oil and gas industries, food and feed industries, and other diverse careers. The types of positions include environmental engineers, consulting engineers, environmental specialists, design and test engineers, project engineers, technical sales and validation engineers, bioprocess engineers, pharmaceutical manufacturing engineers. The 5-year average of graduates from the BSE result in 59.7% employed in KS, 20.9% in neighboring states (IA, CO, MO, NE, OK), and 19.4% in others areas.

Graduates from the ATM are employed with equipment companies, crop consulting, food and feed industries, government agencies in positions such as technical sales, service, and management in agricultural production operations, agribusiness and food and feed processing industries, government agencies, off-road equipment dealers and manufacturing companies, and conservation services. For the ATM graduates, 98.8% are employed or go on for furthered education. Of those employed 71.6% are in KS, 13.6% in neighboring states, and 14.8% in other areas. Review and inputs from Industry Advisory Council are held every semester for each program.

Employer demand of graduates of the BAE graduate program is high. Among the 42 M.S. graduates who graduated during the evaluation period, 98% were employed at graduation; 29% chose to further their graduate study at the PhD level, 31% working in industry, 14% at government agencies, and 17% in consulting firms. Among the 26 Ph.D. graduates, 25 were employed at graduation, with 30% taking faculty positions at various universities, 30% working in industry, 22% working at various government agencies, and 15% hired as post-docs conducting research.

5. Service to the Discipline, the University and Beyond

As part of the teaching mission, the BAE Department is responsible for the following academic degree programs: B.S. ATM, B.S. BSE, M.S. BAE, concurrent B.S. BSE/M.S. BAE, and PhD. BAE. BAE faculty members with research appointments pursue mission-oriented research as part of the mission of K-State Research and Extension. Faculty members with extension appointments provide high quality extension programs to the citizens of Kansas to ensure efficient, effective, and safe production and processing systems. On average, for the evaluation period, the FTEs (as percent of total FTE) allocated for instruction, research, and extension were roughly one third for each category, and 2% was allocated for administration. The BAE Department's instructional activity generated an average of 2,113 total student credit hours (SCH) from FY14 to FY18. On average, 70.7% of the BAE Department's SCH generated was associated with courses taken by undergraduate students in BSE and/or ATM, 9.5% was associated with courses taken by BAE graduate students, and 19.8% was associated with courses taken by students (including graduate students) from other departments.

6. Cost Effectiveness and Program Needs

The instructional programs of the BAE Department are delivered by 8.0 FTEs. The unique and specialized nature of the two undergraduate degree programs (i.e., BSE and ATM) requires a substantial teaching load. The 8-yr average annual instructional expenditures in the BAE Department amounted to about \$880,952. Most of these expenditures were used to pay for salaries of the teaching faculty and some support staff. Average total donations to the BAE Department were approximately \$337,393/yr (FY10 to FY18); these donations have been used to help support the instructional programs, including scholarships and student design teams, and to renovate laboratory spaces. Research has been supported in part by the K-State Research and Extension through

Kansas State University
Summary Assessment & Institutional Recommendations Reports
Program Review Year 2019

7.6 FTEs. BAE faculty members have been successful in obtaining extramural funding to support their research and the graduate programs, generating an average of over \$1.57 million annually over the 8-yr period. Thus, the BAE Department has generated funds from outside the state that were at least two times higher than the funding provided by K-State for instruction. In addition, part of the extramural grant support has been used to acquire state-of-the art research equipment that is also used to enhance the instructional programs. Funded research projects have also provided undergraduate students the opportunity to be employed full or part time on projects thereby obtaining valuable experiences in research and development of new products or technologies.

College of Veterinary Medicine

Veterinary Medicine: Doctorate – CIP Code – 51.2401

1. Centrality, mission and role

As a land grant university, the college mission is dedicated to the advancement of health and welfare of animals, people, the environment, and the veterinary profession through excellence in teaching, research, service and outreach. The College of Veterinary Medicine (CVM) is committed to a professional degree program with broad training opportunities involving a comprehensive range of companion and exotic animals, and livestock species. Their focus is on initiatives that address important societal needs at a local, national and global level. As the only Doctorate in Veterinary Medicine (DVM) degree program in the state of Kansas, the CVM plays a unique and essential role in providing training for veterinarians who will maintain the health and wellbeing of animals and support animal related industries throughout the state of Kansas. The CVM is the only veterinary college in North America to administer a loan forgiveness program specifically designed to meet animal health needs of rural communities. The Veterinary Training Program for Rural Kansas (VTPRK) is funded by the Kansas legislature and provides loan forgiveness to graduates who enter clinical practice in a Kansas county with a population of less than 35,000 people. Five students in each entering DVM class are chosen for VTPRK. These students receive additional training in public health, livestock biosecurity, foreign animal disease diagnosis, regulatory veterinary medicine, the detection and prevention of zoonotic diseases, rural demographics, rural sociology, and rural economics. Forty-five graduates have participated in VTPRK with an additional 21 students currently enrolled in the program.

2. Strengths, productivity, and qualifications of the Faculty

Faculty in the DVM program reside in one of three college departments; Anatomy and Physiology (AP), Clinical Sciences (CS), or Diagnostic Medicine/Pathobiology (DMP). Currently (Fall 2018), there are 87 tenure or tenure track faculty, 25 clinical non-tenure track faculty, and 7 non-clinical non-tenure track faculty representing 118.67 total FTE. Veterinarians in the faculty represent eighteen different board certified veterinary specialties. Along with instruction of DVM students, faculty provide rigorous post-graduate specialty training programs with 30-40 trainees enrolled annually in either internship (1 year) or residency (3-5 year) programs. Numerous faculty hold joint appointments in other colleges within the university participating in the instruction of undergraduate, MS, MPH, and PhD students. Extramural research income increased from \$11.5M in FY15 to \$16.1M in FY18. Since 2012, CVM faculty have published more than 300 manuscripts annually. The college houses nine nationally and internationally recognized centers of excellence. Numerous university, state, national, and international recognitions and awards also speak to the quality of CVM faculty. Select awards include: Regents Distinguished Professor, University Distinguished Professorships (8), Endowed Professorships (10), Presidential Advisory Council on Combating Antibiotic-Resistant Bacteria, American Association for the Advancement of Science (AAAS) Fellow, Association of American Veterinary Medical Colleges (AAVMC) Distinguished Veterinary Teacher Award, World Veterinary Association's Global Animal Welfare Award,

Kansas State University
Summary Assessment & Institutional Recommendations Reports
Program Review Year 2019

American Veterinary Medical Association Animal Welfare Award, and World Buiatrics Congress Ruminant Wellbeing Award.

3. Quality of Curriculum and Impact on Students

The CVM receives over 1,100 applications annually for each matriculating class of 112 students in the DVM program. Matriculating students demonstrate strong undergraduate academic performance. Students matriculating between 2013 and 2018 demonstrated an average GPA of 3.5 in both overall GPA and science GPA categories. Average GRE scores in verbal, written, and quantitative sections are consistently at or above the 60th percentile for the past five matriculating classes. The rigorous DVM curriculum prepares graduates for entry level practice of veterinary medicine through comprehensive pre-clinical and clinical training. Graduation rates for the previous five years range from 92.9% to 95.6%. Graduating classes have a 99% pass rate on North American Veterinary Licensing Exam in eight of the last ten years. In 2017, the DVM program received continued full accreditation from the American Veterinary Medical Association. In 2018, Collegemagazine.com ranked the DVM program #4 in the nation.

4. External Demand

Graduates of the DVM program are highly sought after for clinical associate positions and advanced training opportunities. Since 2012, over 90% of graduates had accepted a position prior to commencement. In 2018, 100% of graduates had accepted a position prior to commencement. College sponsored job fairs in the past two years have brought employers from private practice, corporate, industry, and government sectors from California to Connecticut and Wyoming to Florida in hopes of hiring a DVM from KSU. Ninety-four percent of employers of 2017 graduates would hire another KSU DVM graduate in the future. For employer of 2018 graduates, 100% would hire another KSU DVM. Graduates of the DVM program practice in all 50 states with 23-26% remaining in Kansas. On average, 25-30% of graduates are accepted into competitive advanced training programs including MS, MPH, PhD and clinical specialty programs.

5. Service to the Discipline, the University, and Beyond

Faculty provide service to local, regional, national, and international clients through the Kansas State Veterinary Diagnostic Laboratory (KSVDL) and Veterinary Health Center (VHC). KSVDL processes approximately 100,000 submissions and performs nearly 400,000 tests annually. It also houses an internationally-recognized Rabies Laboratory providing diagnostic services for humans, wildlife, companion animals, and livestock. VHC provides routine, specialty, and emergency care to over 20,000 patients annually. Faculty serve the veterinary profession and other professional areas through numerous leadership positions in state, national, and international organizations. Nearly 100 faculty serve on study sections, national advisory councils or advisory boards annually. Recent examples of national recognition for outstanding service include: American Association of Veterinary Parasitologists - Merit Distinguished Veterinary Parasitologist Award, Microbiologist of the Year by the American College of Veterinary Microbiologists, Lifetime Achievement Award from American Society for Veterinary Clinical Pathology (emeritus), and AABP-Zoetis Distinguished Service Award.

6. Cost Effectiveness and Program Needs

Overall growth in revenue sources from FY12-FY16 in support of the professional teaching program was ~ \$16M, an increase of 29.87%. Current fundraising activity in FY19 (July 1, 2018 to October 31, 2018) is \$6,094,784 with \$1,991,612 supporting student success. Scholarship endowment increased from \$13.8M in FY17 to \$15.9M in FY18. Annual scholarship distributions totaled \$1.23M in FY17 and \$1.27M in FY18. A strong effort has been made to identify and implement cost efficiencies to ensure state funding and tuition revenue enhance the educational program and growth of the VHC and KSVDL caseload. Every case admitted to the VHC and KSVDL is valued as a learning opportunity for veterinary students. DVM graduate salaries for clinical associate positions range from \$65,000 to \$90,000 with an average salary near \$74,000. In 2018, average educational debt for graduates who are Kansas residents was \$119,833 (range \$0 - \$236,731). For non-

Kansas State University
Summary Assessment & Institutional Recommendations Reports
Program Review Year 2019

resident graduates, average educational debt was \$225,204 (range \$0 - \$430,000). To help address student cost of education, DVM tuition was frozen in AY '17/'18 and AR '18/'19.