

# **“A White Paper on Increasing the Engineering BS Graduates in the State of Kansas”**

*Prepared by  
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## **Executive Summary:**

***Proposal description.*** This proposal is in response to a request made to the deans at Kansas’ three engineering schools and colleges (KSU, KU and WSU) to increase their annual number of BS engineering graduates. The target is an annual increase of 490 additional graduates from the schools (up from a five-year average of 875 graduates per year). Despite downturns in some sectors of the economy, the demand for engineering graduates at national and state levels has been increasing rapidly, and projections indicate this trend will continue through 2016. Currently, 80 percent of all science and technology-based occupations in Kansas are in the engineering and IT fields. The state’s engineering programs are the primary source of this workforce. As all three universities are essentially at capacity in engineering, increases in enrollment will necessitate expansion of resources (personnel as well as infrastructure). To fill this growing need for career-ready employees, resources are needed for:

- 1) Additional facilities at each of the three universities, and
- 2) Annual operating budget increases for new faculty, staff and program support to accommodate recruitment, teaching, advising, and retention activities for added students.

***Strategic alignment.*** In the National Academies report, “Rising Above The Gathering Storm,” the shortage of professionals in the science, technology, engineering and mathematics (STEM) areas was reported to be staggering and leading to a national and state crisis. The report pointed out that as much as 85 percent of measured growth in income per capita in the United States over the last several years has been due to technological change. And, unless we act, the technological innovation responsible for so much of the prosperity that Kansans and Americans enjoy will fade from our interests and our shores. In January, 2008, two of the literally hundreds of engineering firms of the region, Burns & McDonnell and Black & Veatch, publicly announced they will add 550 jobs in the Kansas City area by year’s end. The news article cited that the “soaring demand for engineering work in areas such as energy, pollution control, water, health care and aviation facilities” is driving this demand. Garmin in Olathe has expressed its plans to hire 400 new engineers. Economic challenges notwithstanding, demand for engineering graduates remains healthy. And, with the focus on infrastructure spending in stimulus plans, the demand for engineers will likely increase. Certainly, it is believed that industries that employ engineers will drive much of the economic recovery in Kansas and the United States over the next several years. Preparing a sufficient engineering workforce for Kansas is imperative to the economic development of the region.

***Budget requirements.*** Across the three universities, the first year cost to the state to start this effort is \$400,000. The eventual continuing annual cost to the state is estimated to be around \$15 million. Those costs include a portion of faculty, staff, operating expenses and costs for space expansion to support the goal of adding 490 new graduates per year. Additional sources from industry, donors and universities will leverage the state investment. The four-year phase in period is:

- Year 1: \$400,000
- Year 2: \$5 million
- Year 3: \$10 million and
- Year 4 and beyond: \$15 million.

**Introduction:**

In 2006 the National Academies released a report resulting from a congressional charge to investigate and address the national crisis in the shortage of professionals concentrating in basic areas of the science, technology, engineering and mathematics (STEM) in the United States. The shortage of professionals in the STEM areas described in the report “Rising Above The Gathering Storm” is staggering and is a national and state crisis. Just a few of the observations in this report include:

- Economic studies have shown that as much as 85 percent of measured growth in income per capita in the United States and its states is due to technological change.
- The United States is falling behind as a location for technology-based companies. One example cited: Chemical companies closed 70 facilities in the United States in 2004 and tagged 40 more for shutdown. Of 120 chemical plants being built around the world with price tags of \$1 billion or more, one is in the United States while 50 are in China. No new refineries have been built in the United States since 1976.
- A company can hire nine factory workers in Mexico for the cost of one in America. A company can hire eight young professional engineers in India for the cost of one in America.
- The share of leading-edge semiconductor manufacturing capacity owned or partly owned by U.S. companies today is one-half what it was as recently as 2001.

These items are only a few of the facts put forward in that report, which documents a disquieting trend. The technological innovation responsible for so much of the prosperity that Kansans and Americans enjoy is fading from our interests and our shores.

If that’s not enough, we also have fewer students in the United States choosing to pursue degrees in science and engineering, careers that fuel innovation in our state and nation. The American Society for Engineering Education (ASEE) reports that undergraduate graduation rates over the last several years have been essentially flat. Figure 1 shows the trends of science and engineering degrees in the United States for the last 20 years.

And, how do we do globally? Answer: Fewer U.S. students pursue science and engineering degrees than in other countries. About 6 percent of American undergraduates currently major in engineering; that percentage is the second lowest among all developed countries. Engineering students make up about 12 percent (double) of undergraduates in most of Europe, 20 percent (triple) in Singapore, and more than 40 percent (seven-fold) in China.

Is there an economic impact to Kansas and the nation? In 1986, the United States ranked no. 1 in the world in “high tech” exports and the United Kingdom ranked no. 4. By 2005, the United States had fallen to no. 2 and the U.K. to no. 10, likely to not return to a top-10 status again. Considering “new economy” indicators including entrepreneurial activity, initial public offerings, fast growing firms and inventor patents, today Kansas scores well below the U.S. national average and is lagging behind most of our neighboring states.

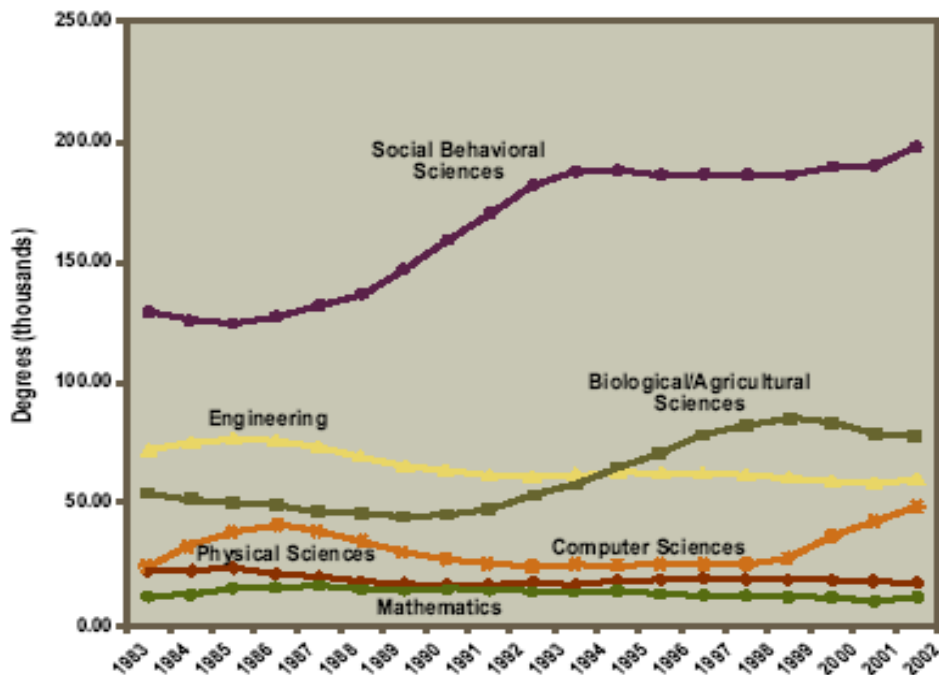


Figure 1. U.S. S&E Bachelor's Degrees by Fields 1983-2002. Source: *The Talent Imperative, Building Kansas' Capacity in Mathematics, Engineering, Technology and Science, December 2007.*

Today the demand for engineering graduates has been growing at a staggering rate. Evidence of this trend can be seen in career services data collected from any major university. In Kansas universities, the growth in number of engineering companies searching for graduates has more than doubled over the last three years. Similarly, job postings at the universities are providing conclusive evidence that the growth in engineering and IT career opportunities is dramatic and exceeds that of most other majors. These trends are being observed at all three of the engineering degree granting universities in Kansas.

The National Association of College and Employers released the publication *Job Outlook 2008* in November 2007. In that volume, engineering and computer-related fields were among the list of highest demand by employers. Of the top 10 bachelor's degrees in demand listed by this report, four were engineering programs. Of the top five master's degrees in demand, three were from engineering. Of the top five doctoral degrees in demand, four were engineering. Kansas has an opportunity to better meet these demands and strengthen the state economic development for years to come.

According to a recent report prepared by *Building Engineering & Science Talent (BEST)*, the engineering and information technology sectors in Kansas account for 80 percent of all science and engineering occupations. The data from the report are shown in Figure 2. Clearly, if Kansas is to position itself to meet the growing demand for high-tech jobs in the state and attract more companies, engineering graduates are going to drive this process.

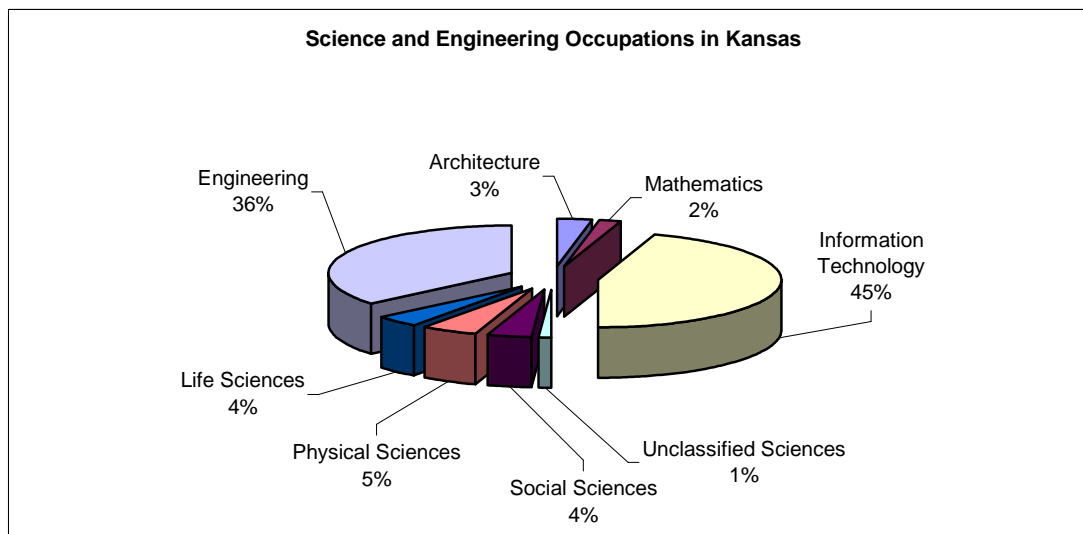


Figure 2. Science and Engineering Occupations in Kansas. Source: *The Talent Imperative, Building Kansas' Capacity in Mathematics, Engineering, Technology and Science, December 2007.*

In the *Kansas City Star* (1/24/2008), Burns & McDonnell and Black & Veatch announced they would add 550 jobs in the Kansas City area in 2008. The article states, the “soaring demand for engineering work in areas such as energy, pollution control, water, health care and aviation facilities” is driving this demand. Garmin in Olathe expressed its plans to hire 400 new engineers in 2008. And, while the aviation industry in Wichita has seen recent downturns, these will be temporary, and the high demands from those industries will soon return. A *Seattle Times* article (2/10/2008), which included several sources and referenced the Wichita, Kansas, market found, “The demand for aerospace, electrical, mechanical and computer engineering disciplines is expected to be double what it was 10 years ago... and...analysts and corporate bosses say higher education is turning out far too few engineering and aeronautical graduates to fill future vacancies.”

Although the economy has turned downward in the last few months, demand for engineering graduates has remained good. And, with the focus on infrastructure spending in stimulus plans, it is expected that the demand for engineers will likely increase. Certainly, it is believed that industries that employ engineers will drive much of the economic recovery in Kansas and the US over the next several years. Preparing a sufficient engineering workforce for Kansas is imperative to the economic development of the region.

The state’s three engineering programs annually produce around 875 undergraduates, approximately 70 to 80 percent of these are native Kansans. The employment base in the state is doing an exceptional job in recruiting local engineering graduates. To meet the demand for more engineers in Kansas, the state must invest in the promotion of the engineering programs and synergistically grow the student enrollment and generation of successful undergraduates.

**Proposed Goals:**

In order to meet the needs of the engineering companies in Kansas and to support the growth of high tech opportunities for Kansas students, the deans of the three engineering degree granting institutions have prepared this joint plan. With the necessary resources being provided by the state and industry partners, the engineering schools propose to increase the number of engineering graduates by 490 graduates over the next five years. Table 1 shows the five-year average production of BS degrees in engineering degrees from KSU, KU and WSU.

Table 1. Five-year Averages of Undergraduate Degree Earners in Engineering Programs in Kansas.

<b>School</b>	<b>Undergraduate Engineering Degrees Awarded Annually</b>
Kansas State University	423
University of Kansas	255
Wichita State University	197
<b>Total</b>	<b>875</b>
<i>Increase Goal:</i>	<i>490 additional graduates</i>

The goal is aggressive and will require considerable investment on the part of the state, universities and constituent companies. It is anticipated the growth will be accomplished through integrating our efforts in:

- 1) Recruiting more Kansas high school students to study engineering,
- 2) Retaining a greater fraction of those students who start in these fields through graduation, and
- 3) Providing the faculty, staff and facilities to accommodate the growth.

The institutions will work with prospective students to help them find the degree program that best fits their career aspirations. The institutions will work together to discover and share best practices in recruitment and retention to ensure more students seek and earn their degrees.

**Proposed Plan:**

While each of the three institutions will implement a unique plan for its campus that maximizes the effectiveness of the dollars committed to this proposal, there are several cross-cutting strategies common to the universities. The three overarching tasks are recruitment of new students; retention of those students; and building capacity in the schools to accommodate the larger number of students in school.

Recruitment

The universities rely on an adequate supply of motivated and prepared high school students to enter their programs. Each of the universities has significant recruitment efforts that work with K-12 in attracting students to programs. Engineering programs are somewhat atypical to most academic units in universities in that they have very close ties to their constituent companies. For example, the engineering schools/colleges in Kansas all have multiple industry boards that serve the schools/colleges and departments. These boards provide a direct link between the academic programs and the needs in industry and they provide assistance with various recruiting activities on behalf of the schools as well as providing financial support. Companies in Kansas

provide excellent support to the schools through student scholarships, assistance in K-12 recruiting (such as support for Boosting Engineering, Science & Technology (BEST) Program, FIRST Robotics Competition, Project Lead The Way, and the Future Cities Competition) and through career planning and services. Examples of the support being provided by industry and other partners at each of the schools are included in the appendix. As demonstrated in the appendix, the universities already have tapped many other sources to help provide resources needed for growth. And, this proposal will require extensive coordination across our programs and further collaboration and support from our engineering companies as well as the State of Kansas.

### Retention

In programs across the country less than one-half of students who begin their studies in engineering complete degrees in engineering. Many of those students transfer to other fields and still complete a bachelor's degree, and as a result, the institutional graduation rates of students starting in engineering, although they may not graduate in engineering, are often the highest for a university. In 2008, the National Academies issued a new document entitled "Changing the Conversation." The text embeds the concept that K-12 teachers and students have poor understanding of what engineers do. Evidence is provided that demonstrates that the public believes engineers are not as engaged in societal and community concerns. When you couple this concern with the predictions described in "Rising above the Gathering Storm," it is clear that public perception must change. In fact, engineering in all undergraduate retention and recruitment efforts should be significantly modified to impress upon the public that engineers sustain the United State's capacity for technological innovation. For example, one cannot get to work on a daily basis without utilizing the benefits for ingenuity (e.g., alarm clock, programmable coffee pots, water, power, highways, cellular phones, wireless connectivity, etc.).

In essence the language must change so young people are attracted to careers in engineering, and to drive this, the technological literacy of our societies must be improved. As cited in the text, contrary to wide-spread opinion, only 15% of those polled see engineers associated with "nerdy" or "boring" and most respect engineers, but they don't want to become one! Therefore, engineering must be "branded" to appeal to teens and adults. In fact, the text suggests that engineering should be presented as a field built upon concepts that are well liked (verses focusing on required skills and personal benefits) by embedding concepts such as :

"Engineers make a world of difference"

"Engineers are creative problem solvers"

"Engineers help shape the future," or

"Engineering is essential to our health, happiness and safety"

A component of the proposed effort will be to increase the engineering retention rates in each of the schools by embedding in our recruitment and retention activities the "new perspective" of the impact of engineering. Furthermore, activities such as intervening early with students who show signs of struggle will result in more students successfully completing engineering degrees. Providing greater contact with new students and offering tutoring for courses known to be difficult for entering students are other ways to enhance retention. To the greatest extent possible, the three schools will coordinate the recruiting and retention activities. The schools already coordinate several student competition activities such as MathCounts and the Future City Competition. Project Lead the Way is another program that is gaining widespread national attention and WSU is currently coordinating that effort in Kansas.

### Capacity

Each of the universities will require additional capacity for handling the planned enrollment and graduation increases. The planned resources are consistent with the magnitude of the proposed growth goal. Faculty and staff resources will focus on the increased demand in academic and career advising and classroom and laboratory teaching. Simply stated, serving hundreds of more students will require some new people.

Building space is the final capacity element, as all three universities are essentially at capacity in engineering, and increases in enrollment will necessitate additional space. Each of the engineering programs already has begun informal planning for increasing space. The needs include space required for classrooms, academic laboratories and office space for faculty and staff. Funding of new facilities will be realized through institutionally specific combinations of new bonds and donations from companies and private donors. It is envisioned that the service of new bonds will be met through institutionally specific combinations of increased tuition revenue and the proposed increased state appropriations.

### **Budget:**

The state's three engineering schools propose efforts that, within five years, will produce an increase of an additional 490 graduates annually. The cost to the state for supporting this undergraduate degree goal is estimated to be \$15 million on a continuing basis. In addition to the increase in state appropriation, significant leveraging from new private donations, issuance of new bonds, and increased tuition revenue from the increase in enrollment institutionally will be realized.

Recognizing the economic pressures on the state, the request for the first year is focused on *initiating* this plan. In the first year, the funds would be used to 1) hold a "Summer Engineering Institute" for secondary counselors and science teachers; 2) provide a small investment for each school to strengthen and expand "Retention Programs"; and 3) provide a modest fund for completing preliminary space planning on each campus. The Summer Institute will help those in secondary education better understand the field of engineering so they can provide a greater level of information to students with whom they interact. Counselors and teachers will learn about the exciting challenges engineers address, career opportunities for graduates and spend time on each campus to experience what a typical engineering student sees. Strengthening and expanding the retention efforts would start small with the first year resources, but would allow these efforts to have early and significant impact. And, finally, approximately \$100,000 would be split between the three campuses to allow preliminary planning on space needs for each campus. A deliverable of the planning would be facility drawings and supporting materials that could be used to engage potential partners.

The total for these three items for the first year would be \$400,000. The suggested phase-in timing for the out-years' budget is shown in Table 2.

Table 2. Requested State Support

Year →	Year 1	Year 2	Year 3	Year 4 & beyond
State Support	\$400,000	\$5,000,000	\$10,000,000	\$15,000,000

## **Appendix A: Industry Support for Engineering Education**

### **Kansas State University College of Engineering Ongoing Efforts in Support of Students Earning Engineering Degrees**

Kansas State University's College of Engineering continues to maintain a modest but sustained growth in its undergraduate programs. During the past five years approximately 450 undergraduates per year have earned their degrees from the twelve undergraduate degree programs offered by eight academic departments. About 40 percent of these graduates are employed by industries (small and large) located in Kansas. Recent data (FY08) indicate employment of these engineering graduates in 125 different industries in the state of Kansas, thus giving recognition to the fact that a broad spectrum of Kansas industries profit from the hiring of our engineering graduates.

Many Kansas industries partner with K-State's College of Engineering and support enhancement of its undergraduate programs. In the past two fiscal years (FY08 and FY09) 116 Kansas industries have provided a total of \$9M in the form of Scholarships, Faculty support, support of Facilities, and in the category of Excellence. It should be noted that during these two fiscal years individuals, many employed by these same 116 industries, contributed over \$25M in support of scholarships, faculty, facilities, and the promotion of excellence.

Types of support can be identified as cash, pledges, deferred gifts, and Gift-in-Kind. The Scholarship category includes scholarships, student awards, student fellowships and other student assistance and support. The Faculty category includes professorships, faculty fellowships, and other faculty/staff assistance and support. The Facilities category relates to property, plant, and equipment and operational maintenance of the plant. The Excellence category relates to departmental or dean's support for areas of greatest need of supplemental support, e.g., undergraduate scholarships, summer camps. Also, major types of Gift-in-Kind (GIK) include software for engineering coursework, art work, books and publications, closely held stock, equipment, real estate, GIK services, rental services, construction, and marketable securities.

In the context of this proposal, it is beneficial to discuss specific investments made to support efforts of recruitment, retention, and capacity. In particular, industrial support of such efforts allows K-State's College of Engineering to advance and prosper.

#### **A. Recruitment**

Programs focusing on recruitment activity are offered to students from elementary/middle school through high school. A few of these important efforts are enumerated here.

1. Middle and high school design competitions. Examples include Future City Competitions, Bridge Building, K-State's Engineering and Science Summer Institute (for high school students and teachers), MathCounts, Science Olympiad, and US FIRST Robotics. Industry support includes cash donations, speakers, mentors, judges (e.g., 73 judges from industry are supporting the 2009 Future City Competition on January 24, 2009), administrative support, and equipment.
2. Industry support for science and engineering explorations for middle and high school students in their own communities throughout the state.
3. Programs focusing on increasing the number of females in engineering curricula. For the past several years K-State's Girls Researching Our World (GROW) summer workshops and Explore sCIence Technology & Engineering (EXCITE) programs have been offered to middle and high school girls to encourage them to consider pursuing engineering fields.

4. Career Nights and other career events hosted by industries. These events are held at various locations around the state and average 300+ students and parents per event.
5. Industry personnel support outreach program. In the past two years there have been hundreds of volunteer hours and related donations (mileage, meals, and supplies) given by industry personnel to support outreach activities around the state.
6. Scholarships offered by the College of Engineering. In addition to scholarships offered to freshmen by the University Scholarship Program, students enrolled in the college receive an additional \$230-250K in freshmen scholarships.

#### B. Retention

A wide range of retention programs and scholarships (over 600/year, total of \$1.5M from endowments and discretionary funds) are offered to assist students. Many of the retention programs emanate from the support programs of the Multicultural Engineering Program (MEP) and the Women in Engineering and Science Program (WESP). Examples of the scholarship and support programs include the following:

1. Merit-based Scholarship Program. Industry support of the College of Engineering's overall scholarship program is significant, e.g., one industry supports 16 \$6000 scholarships/year.
2. Minority scholarship program. The National Action Council for Minorities in Engineering (NACME), a philanthropic organization supported in part by industry, provides 24 \$2500 scholarships/year.
3. Learning Communities. Faculty led learning communities foster academic support groups and build upon the notion of developing a better understanding of how individuals learn and how they can be more productive in group settings.
4. Personal and Professional Development course. Industry supports student salaries and course materials for this course. Students are required to work on projects in a team environment and make presentations to industry personnel.
5. Leadership Days. Several Leadership Days and Leadership Workshops throughout the year are supported by industries.
6. Activities such as New Student Orientation Sessions, Rally Days, Annual Engineering Open House, Honors Research Projects, Scholars Assisting Scholars Program, Career Fairs, and other similar events support and encourage students to continue and be successful in their chosen engineering, computer science, and construction science curricula. Furthermore, they promote an exciting student focused community.

#### C. Capacity

Over \$7.5M of the \$9M of industry support during FY08 and FY09 has been used to support senior design projects, competition teams and student organizations, laboratory development and equipment, purchase of specialized equipment, faculty support, and physical infrastructure.

## **University of Kansas School of Engineering Industry Support Overview**

More than 225 corporations and foundations contributed more than \$1.5 million to support the University of Kansas School of Engineering during fiscal years 2007 and 2008 (non-capital campaign years). Company and agency staff members also provided untold hours in service to further our shared goals of increasing the number of engineering graduates.

### **RECRUITMENT:**

1. **Corporate Partners Program:** KU's Corporate Partners Program gives industry an opportunity to assist in increasing the number and quality of engineering students and graduates. The program underwrites staff who recruit high school students into the School of Engineering. Corporate Partners for 2008 include Burns & McDonnell, Chevron Phillips Chemical Co. LP, CVR Energy, Embarq Corporation, Garmin International, HEMCO Corporation, Kiewit Power Constructors, Sabre Holdings, and Spirit Aerosystems.
2. **Scholarships:** More than 600 students in the School of Engineering received more than \$2 million in scholarships for the 2008-2009 academic year. Scholarship funding comes from private and corporate donors to the school and the university.
3. **Engineering Expo:** More than 1,000 K-12 students from Kansas and the Kansas City region attend this free School of Engineering open house in February. KU students organize and create interactive displays, run contests for K-12 visitors, and invite industry speakers. Expenses for the event are borne in part through industry contributions.
4. **Project Discovery and KU Survivor Camp:** KU offers two different weeklong summer technology exploration camps, one for girls (Project Discovery) and one for boys (KU Survivor Camp). Industry provides speakers, company tours and contributes funding to underwrite some of the program expenses and/or attendance fees for some campers.
5. **SWE Weekend of Engineering:** High school girls attend a weekend engineering experience at KU during either the fall or spring semester. Members of regional chapters of the Society of Women Engineers – professionals in the field – take part in presentations to give students a glimpse into the exciting world of engineering.
6. **Exponent:** Underrepresented minority high school students are invited to spend the weekend at KU and learn about opportunities in engineering. Companies underwrite some of the expenses, provide tours of their facilities and offer engineers as speakers who can address career opportunities and the work experiences of minority engineers.
7. **Engineer Your Career:** Girls in eighth through 12<sup>th</sup> grade can attend a half-day information session about opportunities as engineers and meet with women engineering students at KU. Expenses are covered in part through contributions to the school.
8. **Eureka Weekend:** Students in sixth, seventh and eighth grades are invited to a Saturday of engineering discovery at KU. Easy but eye-opening experiments, lab tours and presentations keep students focused on the coolness of engineering. Program expenses are underwritten in part through contributions to the school.
9. **KUTI:** High school science teachers and counselors are invited to an extended weekend at KU with hands-on lessons and information they can take back to the classrooms. Program costs are underwritten through contributions to the school.
10. **Celebration of Excellence and Diversity:** Underrepresented minority high school seniors are invited to take part in an information and scholarship-presentation session hosted by an industry partner. Two CEDs are held each year, one in Kansas City, another in Wichita.

11. **MathCounts:** KU hosts the annual competition of the Topeka Region Chapter of MathCounts, a national math contest for middle school students. The Kansas Society of Professional Engineers and industry volunteers assist to make this event a success.
12. **Future City Competition:** Several engineering employers provide financial support and volunteers to assist with mentoring, coordination and judging at the Great Plains Region Future City Competition for seventh- and eighth-graders. This annual program held every other year at KU lets students explore infrastructure and planning issues.

#### **RETENTION:**

1. **Engineering Learning Community:** KU ELCs help freshmen connect with their peers, develop study skills and learn about career opportunities and employers through tours and activities. The free program also provides tutoring and mentoring from upperclassmen.
2. **Student Projects, Capstone Design Projects and Engineering Expo** (Jayhawk Motorsports, ASCE Concrete Canoe Club, Engineers Without Borders, Solar Decathlon etc.): Students raise funds from engineering firms to support completion of their student projects, or work on projects specifically requested by firms. Such projects help students connect with peers and faculty while applying engineering principles and completing projects.
3. **Engineering Student Council:** KU Engineering Student Council organizes numerous activities throughout the year designed to help the engineering student body become more cohesive and achieve its goals. Students seek funding and involvement from industry.
4. **Scholarships:** Contributions in the form of scholarships from firms such as Garmin and ExxonMobil let students focus on learning.
5. **Career Fairs and Career Nights:** Students are invigorated to know numerous employers waiting for them to graduate. Corporations and agencies pay a fee to attend career fairs where they can interact with students and cultivate ties for future employees and interns.
6. **Industry Internships:** Often the first opportunity for students to become immersed in their chosen discipline, an internship provides a real-world connection to classroom learning as well as funds for the next school year.

#### **CAPACITY/BUILDING:**

1. **Infrastructure:** Industry has long supported infrastructure improvements. Students, faculty and staff also benefit through equipment and software donations as well as improvements to labs, classrooms and other facilities. Recent physical improvements include:
  - KU's Bioengineering Research Center, made possible through monetary and in-kind gifts from the leaders of HEMCO
  - The Robison-Veatch Office Complex for the Department of Civil, Environmental and Architectural Engineering
  - The Garrison Flight Research Center at the KU Hangar, portions of which were renovated with funds from Cessna
  - Eaton Hall, which was built entirely through donations to the School of Engineering and includes support from Daimler-Chrysler, SWB (now AT&T) and Butler Manufacturing.
2. **Faculty Support:** Industry supports faculty through endowed professorships and consulting opportunities during semester breaks. In addition, industry seeks and provides support for research through KU's research Centers of Excellence, such as the Center for Environmentally Beneficial Catalysis.

## **Wichita State University College of Engineering Ongoing Efforts to Build Kansas Supply Chain of Engineers**

The College of Engineering (CoE) at Wichita State University (WSU) has worked on building Kansas' "Supply Chain of Engineers" for the last decade. Below is a summary of key efforts under way in the college in three areas: recruitment, retention, and capacity building.

**Recruitment.** The total private investment for the last 10 years in recruitment activities has exceeded \$4M. In the next five years, this private investment is expected to reach \$5M.

1. Kansas Affiliate of Project Lead the Way (PLTW). The college is the state affiliate of this nonprofit, nationwide organization that provides curriculum and teacher training to implement hands-on pre-engineering education for high schools and middle schools.
2. Boosting Engineering, Science & Technology (BEST) Robotics. Annual sports-like competition hosted by the college that challenges high school students to build a robot that accomplishes a defined task. More than 400 high school students compete. CoE students interact with competitors, serving as spirit and sportsmanship judges, referees and volunteers.
3. Changing Faces. Groups of students from underrepresented groups in engineering are brought to the college to participate in a set of hands-on events.
4. Switch On Saturdays (SOS). A free semimonthly program to increase interest in Science, Technology, Engineering, and Math (STEM) among middle school students, specifically females and minorities. Professional engineers and CoE students hold classes at a local museum and WSU. SOS provides a fun, hands-on, learning experience of STEM topics, and shows participants what engineers do and how what they learn is applied in the real world.
5. SEEDS. Hands-on engineering lessons are taught to local K-12 students in the classroom, exposing them to the practice of engineering in a fun and active environment.
6. Shocker Mindstorms. Teams of middle school students from across the state develop a robot using Lego robotics that senses its environment and responds to complete a course designed by CoE students. Professional engineers judge the event and encourage students. The event helps students build skills in design, teamwork and effective communication.
7. Engineering Summer Camps. Six to seven camps are offered per year to different age groups in fourth through 12<sup>th</sup> grade. Held to build interest in engineering, science and math.
8. Boys and Girls Club Partnership. WSU engineering students serve as mentors in an afterschool Lego robotics program for club members. The program strives to develop design, teamwork, and effective communication skills of participants.
9. Mueller Elementary and Aerospace Engineering Magnet School Partnership. WSU CoE supported Mueller as it obtained board approval to become a magnet school. CoE faculty members are helping teachers develop the pre-engineering curriculum to be offered.
10. Wallace Invitational for Scholarships in Engineering (WISE). Over 160 high school seniors participate in this annual event, which includes a student panel where engineering students from each major discuss their experiences as engineering students, coop programs, and extra-curricular activities. Students also tour the college, view senior design project presentations, visit unique laboratory facilities and take part in a group hands-on activity.
11. Principal and Counselor Day. The CoE was the focus of this event that aims to stimulate discussion about WSU's engineering program between counselors and high school students.
12. Community College Day. Community college advisers and staff visit the college every year to learn more about engineering and engineering programs at WSU.

13. Engineering Open House. The facilities of the CoE are open to the community once a year. Invitations are sent to high schools interested in engineering and about 250 students are given personal tours, which includes more than 80 senior design projects on display.
14. Recruiting Scholarships. Between 65 and 70 scholarships are given to high school seniors on an annual basis. The scholarships are offered based on academic achievement, participation in PLTW, or for recruitment of specific student populations of interest to industry.
15. Coordinating Opportunities for Engineering Careers System (COFEC). A system to address the need for centralized strategic management and distribution of funding and support for technical education in the Wichita area. A partnership of WSU and Wichita industry.

**Retention.** The total private investment for the last 10 years in retention efforts has exceeded \$4.5 M. In the next five years, this private investment is expected to reach \$5M.

1. Great Expectations; Engineering Kansas Scholars (GEEKS). The program has six elements including a two-year scholarship; tutoring in STEM courses; mentoring with professional engineers; a learning community on a residence hall floor; cohort scheduling or enrollment in a set of similar courses for the students; and a three-year cooperative education opportunity.
2. Engineer 2020. The goal of this strategic initiative is to increase retention as well as prepare WSU CoE graduates for effective engagement in the profession in the year 2020. This initiative has been in effect for all CoE undergraduate students since Fall 2007. The CoE requires that every student complete the program requirements, including at least three of the following six activities: Undergraduate research, cooperative education or internship, global learning or study abroad, service learning, leadership and multidisciplinary education.
3. Retention Study. A study has been completed by the WSU Psychology Department to determine the key causes of students not completing their degrees.
4. Faculty Mentoring Program. A program which matches new faculty with mentors with the objective of developing the skills needed to facilitate student success.
5. Faculty Development Program. Aimed at providing faculty with tools and knowledge to improve teaching quality, student learning and engagement and student success.
6. Ice Cream Socials. Twice a year, free ice cream is served to CoE students by faculty and staff to promote connection and relationships.
7. Engineering Scholarship Receptions. Students receiving scholarships from the CoE have a reception to meet their donor and be recognized by the college.
8. Wallace Scholars Socials. Each semester, bowling and pizza parties are held to facilitate camaraderie and bonding between the Wallace Scholars.
9. New Student Orientation. All new engineering scholarship recipients are introduced to the college and trained on the use of *myWSU*, email and Blackboard.
10. Engineering Block Party. An informal fall social event that introduces freshmen to the CoE and helps them forge a connection at WSU.
11. Scholarship Programs. Multiple scholarships programs provide around 250 scholarships every year encouraging students in good academic standing to persevere.

**Capacity Building.** The total private investment for the last 10 years to build capacity in the college exceeded \$8.5M. In the next five years, private investment is expected to reach \$8M.

1. Physical Infrastructure (Facilities)
2. Laboratory Development, Equipment and Technology Purchase and Upgrade
3. Faculty Support (Fellowships, Endowed Chairs and Professorships)