

MEMORANDUM TO: Ogden College of Science and Engineering Curriculum Committee

Dr. Jack Rudolph

Dr. James Gary

Dr. Greg Arbuckle

Dr. Martin Stone

Dr. Rong Yang

Dr. John Khouryieh

Dr. Bruce Schulte

Dr. Julie Ellis

Dr. Bruce Kessler

Dr. Phil Lienesch

Dr. Warren Campbell

Dr. Richard Schugart

Dr. Cathleen Webb

Dr. David Keeling

Dr. Keith Andrew

Dr. Hemali Rathnayake

Dr. Xingang Fan

Dr. Les Pesterfield

FROM: Kenneth Crawford, Chair

SUBJECT: Agenda for Wednesday, January 15, 2013 special electronic meeting

A. NEW BUSINESS:

Action Items

Department of Engineering

- I. Proposal for a New Academic Program
 - a. Civil Engineering
 - b. Electrical Engineering
 - c. Mechanical Engineering

PRE-PROPOSAL FOR NEW ACADEMIC PROGRAM

Western Kentucky University
Institution Submitting Proposal

Single
Program Type

Civil Engineering
Title of Proposed Degree Program

Baccalaureate
Degree Level

EEO Status	<u>???</u>
CIP Code	<u>Civil 14.0801</u>
Academic Unit	<u>Department</u>
Name of Academic Unit	<u>Department of Engineering</u>
Name of Program Co-ordinator	<u>Shane Palmquist, Ph.D., P.E.</u>
Date of pre-proposal	<u>???</u>
End of review period	<u>???</u>
Intended Date of Implementation	<u>Fall 2014</u>
Name, Title and Information of Contact Person	<u>Julie Ellis, Ph.D., P.E.</u> <u>Department Head and Professor</u> <u>WKU Engineering</u> <u>1906 College Heights Blvd</u> <u>Bowling Green, Kentucky 42101</u> <u>julie.ellis@wku.edu</u>

Is this program a pre-baccalaureate certificate or diploma program? Y ___ N ✓ _

Date of CPE Approval _____

A. Centrality to the Institution's Mission and Consistency with the State's Goals

A.1. Program Description

The civil engineering program proposed here is identical in its curriculum to the corresponding existing engineering program now operating at WKU, currently offered jointly with the University of Kentucky.

Civil engineers design a better world in which to live. They design, build, and maintain our nation's infrastructure. Some of the things that civil engineers design include: roads and bridges; buildings and foundations; water supply and waste-water facilities; storm water management systems; and environmental protection facilities.

The civil engineering program at WKU provides a broad educational background with a foundation in basic engineering and business principles. Topics include construction, geotechnical engineering, construction materials, structures, surveying, and hydrology. These basic topics are complemented by advanced topics in engineering design, management, finance, and computer applications. Real-world civil engineering experiences are incorporated throughout the baccalaureate degree program. The WKU civil engineering program prepares students for professional engineering and management positions in all phases of civil engineering projects.

The teaching philosophy of this program focuses on project-based learning. This is achieved by placing competent, practicing engineers in the classroom as professors, engaging students in the practice of civil engineering through hands-on class projects, and involving students in faculty consulting and applied research activities. Real engineering projects often serve as class projects. Project sites and professional engineering and construction management firms' offices often serve as classrooms.

This program does not contain any specializations.

A.2. Program Objectives

The program objectives remain identical to those of the corresponding existing program now operating at WKU, currently offered jointly with the University of Kentucky. These program objectives have been affirmed through ABET accreditation since the programs' inception.

The WKU civil engineering program has three educational objectives.

Objective 1: The graduates of the civil engineering program are technically competent. They will possess a broad knowledge of the principles and fundamentals of civil engineering and their application, and thus be able to: successfully practice as professional civil engineers; pursue graduate or professional degrees; or engage in other professional careers that involve the application of the engineering method.

Objective 2: The graduates of the civil engineering program are effective team members. They will function effectively in multicultural and multidisciplinary groups in their practice of the civil engineering. They will effectively participate in the management of projects and the business of which they are a part.

Objective 3: The graduates of the civil engineering program are professional. They will perform all of their duties professionally and ethically. They will understand that what they do is a part of a larger society and will understand their part within that society. They will engage in life-long learning to continually provide themselves with the

necessary skills, certifications, and licenses to effectively perform their professional duties, even if their career takes them beyond engineering and into another profession.

Graduates of the proposed engineering program will receive a Bachelors of Science degree, just as graduates of the three existing engineering programs do.

A.3. Alignment with Institutional Mission and Strategic Priorities, Statewide Postsecondary Education Vision, Strategic, and the Statewide Strategic Implementation Plan

A.3.a. WKU Institutional Mission

The WKU Institutional Mission is to

“prepare students of all backgrounds to be productive, engaged, and socially responsible citizen-leaders in a global society. The University provides research, service and lifelong learning opportunities for its students, faculty, and other constituents. WKU enriches the quality of life for those within its reach.” (WKU)

With minor changes to include engineering language, this could be each program’s mission statement; the alignment is that tight. As laid out in the objectives in A.2 above, our programs prepare students well; members of our community—faculty, staff, and students—engage in research, service, and lifelong learning; and WKU engineering programs affect the quality of life in the region in multiple positive ways. To be more specific, each WKU engineering program prepares students to be technically competent, professional engineers with strong communication skills and awareness of their professional responsibilities to society and of engineering’s role in global issues. We take special care to ensure our graduates meet the needs of industry in the region and beyond. With students and as individuals, each faculty member of WKU Engineering engages in applied research and service activities that draw on her or his professional skills and preparation, and they contribute to their profession locally, regionally, nationally, and occasionally globally. We provide continuing education opportunities to the engineering profession, and we participate in STEM outreach to the K-12 community.

In preparing outstanding engineering graduates for employment and further study, in providing educational programs at a variety of levels, and in executing meaningful projects for local industry and organizations, the Department of Engineering supports the WKU Mission every way it can.

A.3.b. WKU Strategic Priorities

The WKU engineering programs have aligned our departmental objectives with the four strategic priorities of the university (WKU)

WKU Engineering Objectives

related WKU Engineering goal

WKU Strategic Goal 1: Foster academic excellence.

Deliver high-quality engineering education using efficient and sustainable project-based pedagogies. (ENGR2)
Continuously develop and support faculty and staff. (ENGR5)

Produce competent practitioners
Steward our resources responsibly

WKU Strategic Goal 2: Promote a dynamic and diverse university community.

Communicate effectively with internal and external constituencies about WKU Engineering: what we do, how we do it, our dreams, and our needs. (ENGR4)

Tell our story well

Be a good departmental citizen in our college, in our university, and in our professional and civic communities. (ENGR9)

Steward our resources responsibly

WKU Strategic Goal 3: Improve the quality of life for our communities.

Produce competent engineering practitioners in the fields of civil, electrical, and mechanical engineering. (ENGR1)

Produce competent practitioners

Provide engineering expertise responsive to the needs of the region. (ENGR3)

Produce competent practitioners

WKU Strategic Goal 4: Support the core mission with a robust campus infrastructure.

Raise the research profile of WKU Engineering. (ENGR6)

Produce competent practitioners

Strengthen private support for WKU Engineering. (ENGR7)

Steward our resources responsibly

Emancipate the joint programs. (ENGR8)

Tell our story well

A.3.c. Statewide Postsecondary Education Vision

The vision of the Kentucky Council for Postsecondary Education is: *All Kentuckians will be prepared to succeed in a global economy.* (Kentucky Council on Postsecondary Education) The engineering programs at WKU support this vision. Engineers make life better by designing systems that improve the quality of life. Manufacturing equipment, highways, bridges, robotics, and many other systems improve the quality of life of everyone in Kentucky and beyond. Focusing locally, the WKU engineering programs provide a path to better jobs and more industry in the region, stimulating more and better jobs here in south-central Kentucky.

According to many economic development theories, engineering programs attract industries that need engineers, and high-tech businesses increase awareness and create demand for engineering programs. As the only engineering school in south-central Kentucky, WKU has already drawn (and will continue to draw) new high-quality firms and industries to this region. Additionally, new engineering talent that is connected to this region already helps (and will continue to help) existing companies develop new capabilities and innovations. WKU Engineering and regional industry are collaborating in creating more success for south-central Kentuckians in the global economy.

A.3.d. Statewide Strategic Agenda

The Mission of the CPE's Strategic Agenda is: *to deliver a world-class education to students, create and apply new knowledge, and grow the economy of the Commonwealth.*

The WKU engineering programs contribute to achieving this mission through our project-based curricula that enable students to learn by doing. At WKU, we believe creating real-world projects where students complete realistic and real-world engineering projects is the best way to both prepare our graduates for the global marketplace and support the growth of the Kentucky economy. By the time each student graduates, he or she will have had multiple experiences of

designing and building innovative products and completing engineering projects on time, within budget, to specification. At the end of their undergraduate years, our students are ready to begin engineering practice or go to graduate school. In the first 10 years of the programs, our students have completed many significant projects. They have tested concrete for several WKU buildings and for structures around the region. They have developed a controller for a submersible system used by Warren County Search and Rescue for underwater searches, and that system is now under development as a commercial product to be used in a variety of applications, including bridge inspection. With funding from the Gates Foundation and NSF, WKU engineering students collaborating with animal behaviorists from WKU Biology have developed systems to warn villagers in Africa of marauding elephants that eat their crops. Our faculty and students have developed a method for testing better and safer horse reins used at race tracks across the country.

WKU is the only U.S. university to require that all of the engineering faculty be licensed professional engineers as a condition for tenure. Our faculty are practitioners teaching practical methods of engineering. All our faculty have all done real engineering work and can transmit this knowledge to students. Licensure is not a priority for most other institutions, and this is one thing that distinguishes our program.

One of the challenges for post-secondary education cited by the CPE is that Kentucky is “47th among the 50 states in the number of science, technology, engineering, and math (STEM) degrees awarded per capita.” (Kentucky Council on Postsecondary Education) The first WKU engineering graduates received their degrees ten years ago, and since that first class, almost 500 engineers have graduated from the WKU engineering programs. Most of these students would not have chosen to attend other engineering programs in the state, so they represent a new source of technical talent in the engineering workforce.

Currently more than 600 engineering students are enrolled at WKU. The ones that graduate will be a new pool of engineers that would not have been available to our region without the presence of WKU Engineering. With these programs, we will be able to continue to grow the number of Kentucky’s engineering graduates and better prepare students to contribute to the Commonwealth’s economic growth.

The CPE’s Strategic Agenda includes 4 key policy objectives:

- College Readiness
- Student Success
- Research, Economic, and Community Development
- Efficiency and Innovation

The WKU engineering programs address three of these components of the CPE Strategic Agenda: student success; research, economic, and community development; and efficiency and innovation.

Student Success – Objective 1: To increase production and improve graduation rates at all levels.

The WKU engineering programs have produced 468 graduates since 2004 in an area deemed as high demand by the CPE. (Kentucky Council on Postsecondary Education) A significant factor in justifying the engineering programs at WKU initially was that according to the Kentucky Science and Technology 1999 Entrepreneurial Capacity Report, the Commonwealth ranked 47th

in the number of scientists and engineers per capita and 45th in science and engineering graduates per capita. From 2005 to 2009 the production of science and engineering graduates increased almost 10% in Kentucky while the population of 18-24 year olds decreased slightly according to the National Science Foundation Science and Engineering Indicators 2012 report. (National Science Board) During this time period the WKU engineering programs were just beginning; since then, we have continued to grow and produce more graduates, drawing from populations that would probably not choose other programs in the state.

Student Success - Objective 3: To provide high-quality, competitive undergraduate and graduate programs that support academic achievement and program completion, a capacity and desire for life-long learning, and skills and behaviors promoting civic engagement, global awareness, and career readiness.

As presented elsewhere in this document [Student Learning Outcomes, page 2], the learning outcomes of the WKU engineering programs require that all graduates are prepared to achieve this specific objective; this objective is consistent with the ABET criteria and learning outcomes. (ABET) The WKU programs have undergone two successful ABET accreditation visits where these outcomes have been documented, reviewed, and deemed acceptable by the most significant engineering accreditation body in the world. The faculty view the items stated in the CPE objective to be valuable, and have worked diligently to make sure they are met, and the accreditation review has shown the efforts to be successful.

Efficiency and Innovation - Objective 3: To better align academic programs with the current and future needs of the Commonwealth.

As stated above under *Student Success – Objective 1*, the growth and number of graduates produced by the WKU Engineering program shows significant support of this objective. Graduates, their employers, and economic development professionals attest to the need for engineering programs in south-central Kentucky and to the excellent alignment of WKU's project-based approach with their requirements.

Research and Economic Competitiveness – Objective 1: To increase research and development efforts to promote innovation and economic development.

As stated specifically in the CPE document detailing this objective, the WKU Engineering program has demonstrated support through its endowment of over \$3 million through the combination of private and public support in the Bucks for Brains program. During the startup phase of the engineering programs at WKU these funds helped to develop the programs' capacity to provide these project-based curricula. As the programs have evolved, these funds are being used to develop the applied research capabilities as well.

Research and Economic Competitiveness – Objective 3: To align education, economic development, and workforce policies and programs to develop, attract, and maintain jobs.

The CPE Strategic Agenda specifically states that STEM fields are high demand areas. The WKU Engineering program is making significant contributions in producing graduates in the

high demand fields, as shown in our graduation and employment information elsewhere in this document. [Student Demand, page 2 and Employer Demand, page 14]

A.3.e. Statewide Strategic Implementation Plan

The statewide implementation plan (Kentucky Council on Postsecondary Education) identifies several specific areas for each program to address: funding, accountability, measurable performance, and the balance between quality and quantity.

Adequate Funding

Sustained, adequate funding in direct operating support to public postsecondary education institutions is vital to achieving statewide policy objectives and moving forward on the aggressive, long-term goals of HB 1 (1997). Increases in state funding, tuition revenue, and financial aid, as well as aggressive cost control, will be required to increase productivity and protect college access for low- and moderate-income students and families.

WKU fully supports cost control and two ways this is achieved is through scholarships for students and the Bucks for Brains program. For example, of 150 civil engineering students at WKU, approximately 20 receive Kentucky Transportation Cabinet scholarships. These are available to worthy students at every level of their studies, giving them access to productive college degrees that improve the quality of life for people in Kentucky and in this region.

Of 14 engineering faculty members at WKU, 4 hold endowed chairs or professorships which enhance teaching, research, and service. This funding, much of it through the Bucks for Brains program, allows faculty members to expand their activities well beyond what would be possible with basic program funding. An example of teaching enhancement is provided by the WKU Study Away Program. In 2012, 9 civil engineering students were able to travel to Hoover Dam, and other locations in the desert southwest to study flood control and water supply. They interacted with flood control district personnel in Arizona and Nevada and studied problems with water supply that the flood control districts have dealt with for decades. One goal of this study was to understand methods that could be used to alleviate water supply and pollution problems that now face our region. Each of these students received grants, funded by private support, that made this program affordable and provided them with an unforgettable educational experience.

The support of the Engineering Program by regional businesses and donors has been phenomenal. These business people have concluded that this program is worth supporting and have opened their pocketbooks as a clear indication of the need of this program.

Accountability

Accountability in higher education is a shared responsibility that includes common goals and objectives, a division of labor, measured results, and a focus on continuous improvement. It will take a common commitment between the Council; institutional governing boards, policy leaders, faculty, and staff; Kentucky's adult education system, students, and parents; the Governor and the General Assembly; the K-12 system; and key state agencies and stakeholders to demonstrate accountability at both the state and institution level.

One of the goals of the CPE is to increase the number of STEM degrees earned in Kentucky. The state has been underperforming in this important area for years. Figure XXX illustrates the point. In the figure, each color represents a different quintile and Kentucky ranks in the lowest quintile of states in the per capita production of science and engineering degrees, and is surrounded by states with better performance in this important area. Since 2004 WKU has produced 468 graduates. During that time, engineering enrollment at other state schools offering

engineering degrees has remained stable. These are 468 graduates who improved the goal of increasing the number of STEM degrees earned in the Commonwealth.

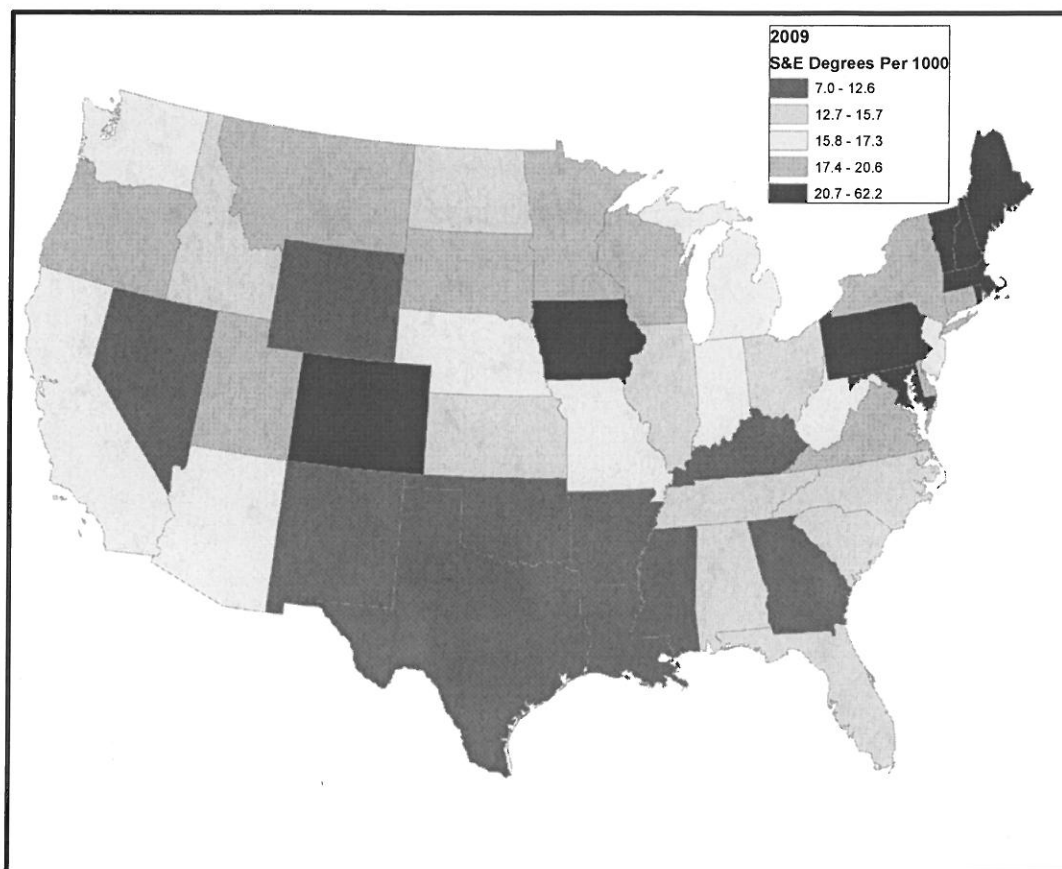


Figure 1: Science and engineering degrees awarded per 1,000 18-24 yr olds (National Science Board)

Performance Metrics and Targets

A select number of state and institutional performance metrics, with negotiated targets for 2015, will help guide progress on the 2011-15 Strategic Agenda, HB 1 mandates, and other reform legislation. Other data, including various leading and lagging indicators, will be monitored to gauge improvement and assist in policy development.

The WKU Engineering Program contributes most to the Research, Economic and Community Development category of metrics. One of these is the number of degrees and credentials in science, technology, engineering, mathematics, and health-related fields. The Engineering Program historically has added engineering degrees without reducing enrollment in engineering at other state institutions.

Engineering schools produce STEM degrees and attract high tech industry. This directly impacts the regional economy. Our donors have been willing to open their pocketbooks to support WKU engineering. They believe in this program. WKU Engineering will help the CPE and the state achieve its implementation plans.

Implementation Plans

The Council is directed by statute to draft an implementation plan that will be pursued collaboratively with institutional representatives and other key stakeholders over the next four years. This policy work is intended to complement, not supplant, the strategic plans approved by institutional governing boards that broadly align with the strategic agenda and allow postsecondary education institutions to achieve their unique missions.

Reporting and Benchmarking

A new Web-based performance dashboard and improvements to the Council's accountability reports will provide easy access to the data and information needed to understand absolute and relative progress on key objectives and strategies. Council and other stakeholder meetings will allow for regular updates on progress.

This relates to a CPE function and does not apply to WKU Engineering.

Incentives

As originally envisioned by HB1, strategic trust funds and various incentive programs are crucial to stimulating increases in degree production, research activity, community outreach, and workforce development. Kentucky must continue to fund proven programs like "Bucks for Brains," Regional Stewardship, Workforce Development, Kentucky Innovation Funds, and EPSCoR, and provide new incentives directly related to improvements in degree production.

WKU Engineering is a beneficiary of the Kentucky Bucks for Brains program. Currently, 4 of our 14 faculty hold endowed chairs or professorships. Another is imminent. These programs allow our faculty to enhance teaching, research, and service. Endowment funds have enabled students to travel for Study Away courses at very reasonable cost. Engineering Study Away courses have traveled to Hoover Dam and flood control districts in Arizona and Nevada, and to the Gulf Coast to study the effects of hurricanes.

The Bucks for Brains program enhances our research infrastructure by providing the means to acquire research equipment such as instrumentation for the Corvette Museum track, materials to help the local rescue squad acquire a submersible search robot, and to develop a testing protocol for all horse reins used at tracks across the U.S.

Bucks for Brains allows our faculty to participate in conferences, national boards, and committees that enhance the reputations of WKU, the state of Kentucky, and of our faculty.

Balancing Quality and Quantity

One of the key challenges is balancing the need for high-quality credentials that allow individuals to be successful in their work, life, and communities with the demand to increase degree production and educational attainment. Strengthening current programs and expanding new ones will help the system control costs, both for students and the state.

Engineering curricula are rigorous, but provide a great return on investment for graduates. It also provides an excellent return on investment for Kentucky because engineers are good for the economy since they design and build new products.

WKU engineering students also have the opportunity to receive minors in Systems Engineering, Land Surveying, Entrepreneurship, Floodplain Management, and Mathematics. Since 2004, more than 200 civil engineering students have achieved American Concrete Institute Grade 1 Certification, and currently 42 of our students have become nationally Certified Floodplain Managers. The state of Kentucky currently has 64 Certified Floodplain Managers. The Minor in

Floodplain Management is the first in the U.S. Fifty-seven of our graduates have become licensed professional engineers serving this state and this region.

A.4. Approval letter from Education Professional Standards Board (EPSB)

Not required

B. Program Quality and Student Success

B.1. Student Learning Outcomes

Consistent with ABET, this program demonstrates that each graduate possesses

- a) an ability to apply knowledge of mathematics, science, and engineering;
- b) an ability to design and conduct experiments, as well as to analyze and interpret data;
- c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability;
- d) an ability to function on multidisciplinary teams;
- e) an ability to identify, formulate, and solve engineering problems;
- f) an understanding of professional and ethical responsibility;
- g) an ability to communicate effectively;
- h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context;
- i) a recognition of the need for, and an ability to engage in life-long learning;
- j) a knowledge of contemporary issues; and
- k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

These are the learning outcomes for each student graduating from each program.

B.2. Program Support Provided by Other Units within the Institution

Most of the general education requirements that each student satisfies are provided by academic departments elsewhere in the university. The Mathematics, Physics, and Chemistry Departments provide significant numbers of courses to all three engineering programs. In addition to those, civil engineering students take courses from the Architectural and Manufacturing Sciences Department, as well as geology from the Department of Geography and Geology.

B.3. Relationship to the Existing Program

This program replaces the current civil engineering program, which is offered jointly with the University of Kentucky.

B.4. Will this be a 100% distance learning program? No

B.5. Alternative Learning Formats Utilized (**those that apply** shown in **BOLD**)

- Distance learning

- **Courses that combine various modes of interaction**, such as face-to-face, videoconferencing, audio-conferencing, mail, telephone, fax, e-mail, interactive television, or World Wide Web
- **Technology-enhanced instruction**
- Evening/weekend/early morning classes
- Accelerated courses
- **Instruction at nontraditional locations**, such as employer worksite
- Courses with multiple entry, exit, and reentry points
- Courses with “rolling” entrance and completion times, based on self-pacing
- Modularized courses

Delivery of the WKU engineering programs takes multiple forms while taking advantage of the growing technological tools available to the education community. The major focus is on the use of tools that help maximize student success and progress towards their degree, while emphasizing technologies implemented in the professional engineering environment.

The Western Kentucky University campus has multiple technological tools which can be utilized by faculty and students. The campus is fully wireless, allowing communication linkups in both academic and residential buildings. This can be used as a means of augmenting education including the use of Blackboard, Skype, online threaded discussion boards, and classroom instruction where students utilize their own laptop computers. By using both synchronous and asynchronous communication methods, a robust educational setting is established while mimicking methods used by the professional engineering community to maintain communication among far-flung groups.

Sharing of information using technology is a key component of the programs. Technology can facilitate meetings between student groups and project sponsors from industry when distance is too great to allow face-to-face meetings, thus improving efficiency. Already faculty and students from WKU have taken advantage of this for meetings spanning the country, from Florida to the state of Washington and places in between. Work in any engineering community involves operating on a global scale, so technology-mediated communication provides valid real-world challenges for students in south-central Kentucky while engaging them in meaningful professional preparation.

Modern laboratory technologies are also used in the WKU engineering programs. The equipment in the WKU laboratories replicates many of the resources available in a professional engineering setting and allows students the opportunity to develop skills that are consistent with those needed by future employers. Laboratory experiences are used in multiple points of each curriculum to extend learning into the realm of modern engineering practice. These facilities are also available to support projects with industry.

Completion of realistic projects, creation of engineered systems, and design of products are key components of the programs. In today’s engineering community there is much use of technological tools to accomplish these tasks. Computer-aided design and computer-aided manufacturing tools are implemented throughout the programs. Computer-assisted analysis tools such as Matlab and Mathcad and LabView, which are all widely used in industry, find use throughout the programs. Use of computer simulation packages to visualize and measure

performance of designed systems are implemented as warranted. By guiding students in the use of professional full-strength technological tools, we provide a professional setting such that graduates are better prepared to enter the workforce ready to work as engineering practitioners. In this way greater efficiencies in student education and workforce productivity can be achieved.

One area to be evaluated for implementation in the future is the use of distance-taught courses. In a time when technology has progressed to allow for Massive Online Open Courses (MOOCs) and various online degree options, it appears a proper time to explore such technology with the aim of improving engineering course variety without compromising student educational needs. Engineering is somewhat restrained in the use of distance classes as compared to some other disciplines. A part of this can be attributed to the difficulty of conveying a practice-based class experience, though some examples exist where undergraduate engineering coursework is offered online. As example, North Dakota State University offers some of its undergraduate engineering classes online (www.distance.und.edu/engineering) owing to the vast distances that exist between some students and the campus. Other examples of colleges offering limited online undergraduate engineering courses include Arizona State University, Stanford, Drexel, and the Massachusetts Institute of Technology. At this time there are no accredited undergraduate degree programs available online, but there are a few graduate engineering programs offered largely by distance means.

Western Kentucky University has an infrastructure in place for delivery and reception of distance courses. The Division of Extended Learning and Outreach (DELO) at WKU facilitates the use of distance education. At present the most common forms are web/online courses, independent learning, and interactive video service (IVS)/teleconference courses (<http://www.wku.edu/dl>). The infrastructure that DELO provides allows the engineering programs to explore accessing course from universities both inside and outside of Kentucky as well as offering our courses to the wider world off campus. DELO can provide a means to expand the educational opportunities such that broader coursework is available to WKU engineering students while maximizing efficiencies of program delivery. In all cases the focus will remain on pedagogically sound methods that best serve the student educational and workforce needs.

B.6. Faculty Requirements

At this time, no additional full-time faculty members are required. Consolidating courses shared by different programs, combining small sections, adjusting scheduled offerings, and expanding the students' choices of electives allows for more effective utilization of existing faculty resources. Some part-time instructors will be needed.

Growth in student enrollment will necessitate additional faculty members in the future.

C. Program Demand/Unnecessary Duplication

C.1. Need and Demand

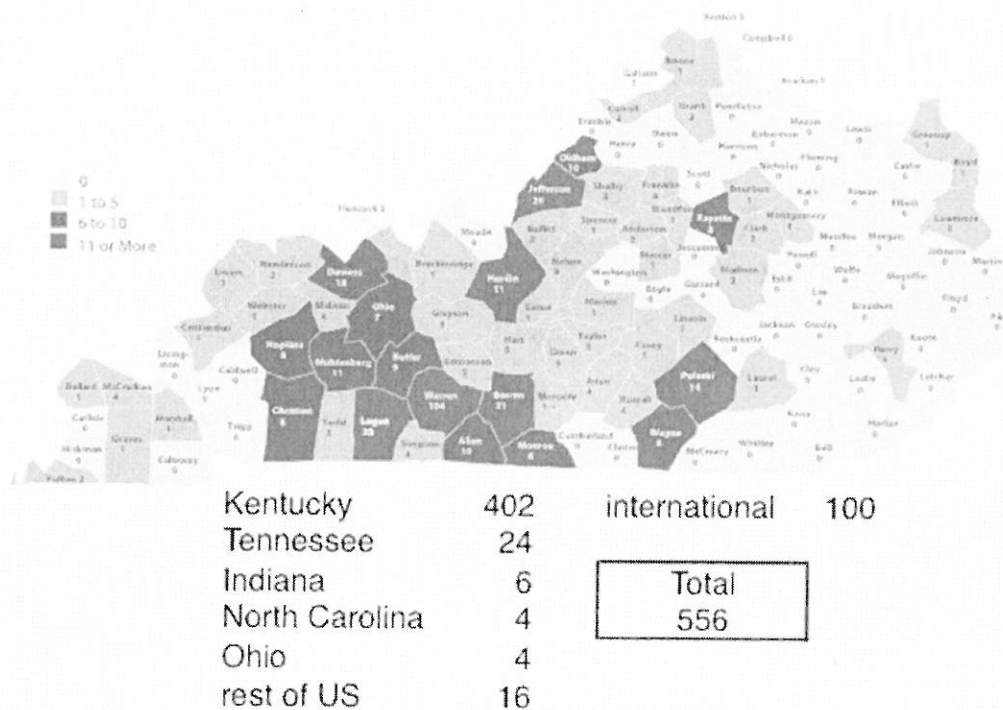
C.1.a. Student Demand

The WKU Engineering programs have consistently attracted a wide range of students since their inception in 2001. Initially the enrollment grew quite rapidly, and over the last seven academic years, enrollment has grown at a modest but steady pace.

Academic Year Ending	2007	2008	2009	2010	2011	2012	2013
Civil Engineering	137	140	139	154	162	160	191
Electrical Engineering	110	119	173	186	198	204	228
Mechanical Engineering	163	173	226	228	229	248	260
Total	410	432	538	568	589	612	679

Table 1: Enrollment in WKU engineering programs has steadily increased over the past seven academic years. source: WKU Institutional Research

Most of the students served by these programs come from the south-central Kentucky area, as shown in Figure 2. They perceive that their access to other engineering programs in the Commonwealth is limited. Students who choose to attend WKU engineering programs report that, without these programs, they would either choose a different major at WKU or seek an engineering degree outside the Commonwealth.



as of 25Sep2012

Figure 2: Origins of WKU Engineering students enrolled in Fa2012

Over the past ten academic years (academic years: 2003–2004 through 2012–2013), the three programs have produced 468 engineering graduates as shown in Figure 3.

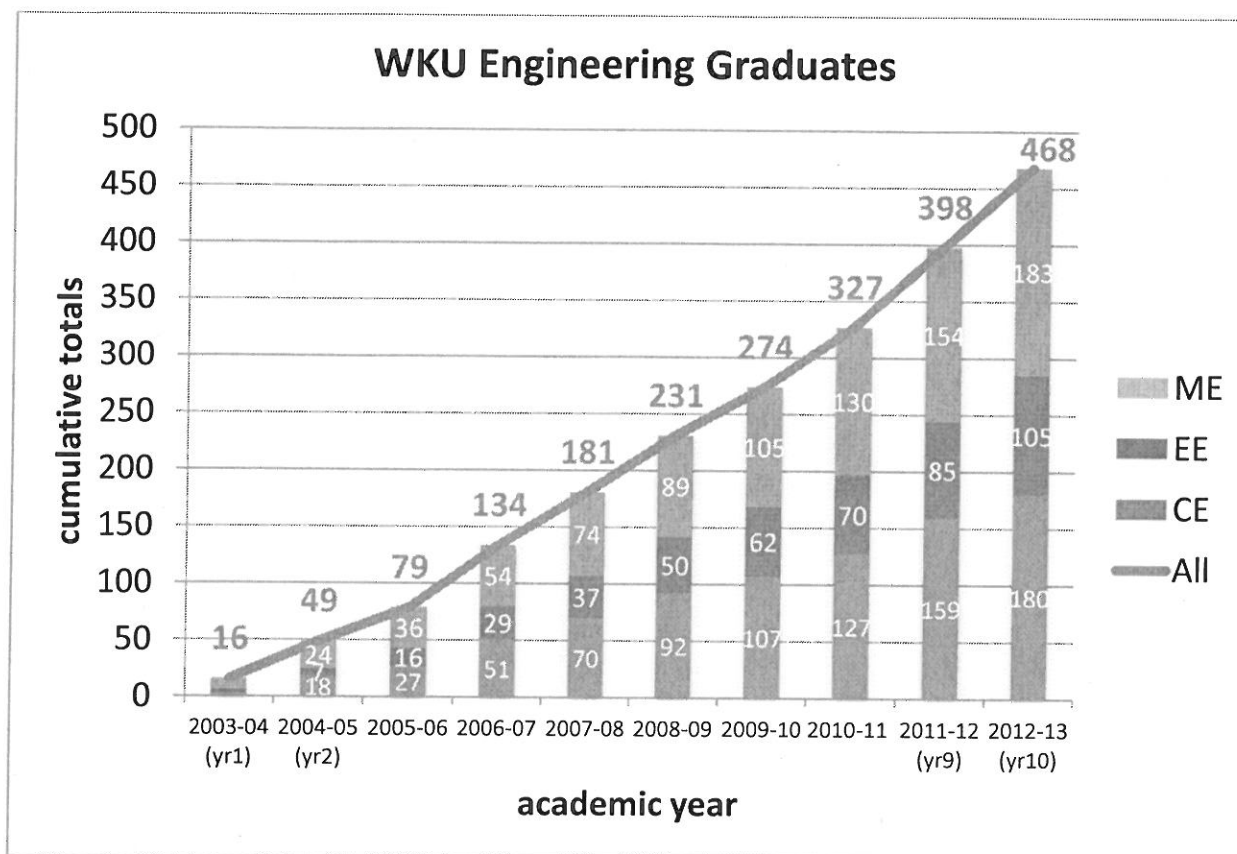


Figure 3: Cumulative WKU Engineering Graduates: Academic Years 2003–2004 through 2012–2013

We anticipate graduating another 58 engineering students during academic year 2013–2014, thereby producing a total of 530 engineering graduates from our three engineering programs over the past 11 years. Most of our graduates secure engineering employment by graduation or shortly after. The majority of our graduates are employed in the state of Kentucky, and in particular, the south-central region of Kentucky.

C.1.b. Employer Demand

When the WKU engineering programs were originally proposed, documentation was presented concerning the need for engineering graduates in south-central Kentucky. Many graduates from more urban areas are unwilling to pursue careers in rural areas such as Logan and Allen County, even though there are good employment opportunities there. . Since that time, it has been well documented that an insufficient number of engineering graduates are being produced by all the engineering programs across the Commonwealth to meet the current and future anticipated demand of the workforce. (Kentucky Council on Postsecondary Education) WKU's programs have responded to those needs, with the majority of our graduates finding permanent employment in the region.

For the two most recent academic years (academic years 2011–2012 and 2012–2013), our graduates have reported employment at 44 different employer locations (28 Kentucky and 16 out-of-state locations) [Berry, D. 2011–2013]. This data acquired via graduate survey provides a summary of employers and types of positions as reported by our engineering alumni.

Additionally, this graduate survey data is merged with data mined from our Alumni Services Office, which provides an employment summary with 114 (US Dept of Labor)ed employers from 154 alumni reports [Berry, D. 2002–2013]. At some locations multiple WKU engineering alumni are employed.

As indicated by this employment data, the demand for our graduates has been strong in spite of a difficult economic period over the past five years due to reduced manufacturing demand, particularly automobile manufacturing, which is a critical portion of our regional economy. Nationally, a decline in engineering employment occurred over this time period. To indicate sustained and future demand, several sources were consulted for information regarding engineering employment demand currently and through the current decade: 2010–2020. These sources included: United States Bureau of Labor Statistics, JobsEQ provided by the Bowling Green Chamber of Commerce, and surveys of regional industrial companies likely to employ our engineering graduates [BLS 2012–2013, Carpenter, M. 2013Q2, and Berry, D. 2013]. The U.S. Bureau of Labor Statistics provides demand data and statistical projections at the national and state levels. It indicates increased demand for engineering due to both new opportunities and net replacement of retiring and resigning employees. JobsEQ and surveys received from regional companies provide a higher fidelity regional indicator of employment demand for our graduates.

At its highest level, employment projections from the United States Bureau of Labor Statistics combine architecture and engineering occupation together. (US Dept of Labor) Their projections indicate that architecture and engineering occupations are projected to add 252,800 new jobs nationally between 2010 and 2020 as they grow by 10.4 percent. Engineers are the largest component of this major occupational group and will add the most new jobs at 160,400. Data for these projections, broken down by discipline, are shown in Table 2 below.

2010-2020 employment projections	US	% growth	Kentucky	% growth
Civil Engineering	51,100	19%	110	18%
Electrical Engineering	10,700	7%	60	15%
Mechanical Engineering	21,400	9%	110	6%

Table 2: US Labor Department projections for engineering employment

Regional projections are somewhat more optimistic. The Bowling Green Chamber of Commerce provided projections from JobsEQ. JobsEQ is a subset of data extracted from the U.S. Bureau of Labor Statistics and modified by regional and local factors. (Carpenter) These projections assist the Chamber in forecasting regional and City of Bowling Green growth. According to JobsEQ, for the most recent four quarters (ending 2013Q2) in the south-central Kentucky region, which includes the 10-county Barren River Area Development District (BRADD) shown in Figure C.2.2, the total number of engineering jobs (Standard Occupations Code 17-2000) is 1,081. The anticipated 10-year average annual growth including replacement demand is 3.24% for the region. The 10-year forecasted total number of job openings for engineers is 395 for the region, with 272 attributed to replacement demand and 123 to growth.

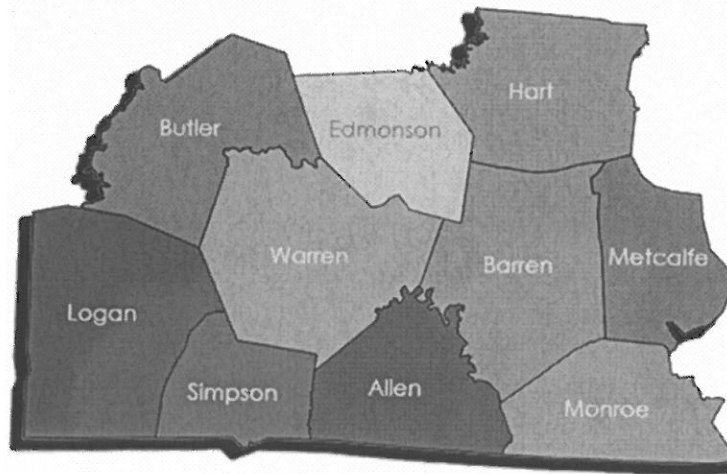


Figure 4: Barren River Area Development District (BRADD) counties are all within the WKU service area

Finally, surveys of regional industries were administered to gain insight into our primary employment base. The WKU Industrial Partnership members were the focus of these inquiries. The Industrial Partnership currently includes 10 member companies: GM/BG Corvette Assembly Plant, Fruit of the Loom, Logan Aluminum, MTD Products, Scotty's Contracting & Stone, J.M. Smuckers, Span Tech, Trace Die Cast, Stupp Bridge, and Sumitomo Electric Wiring Systems. The Industrial Partnership was originally funded by Logan Aluminum with a \$300,000 gift in 2010. Each of the partnership members has made a three-year commitment to pay membership fees of \$5,000 annually, which covers the operational expenses of the program. The outcomes of this program have been to enrich relationships and to promote opportunities among WKU engineering students, faculty, and local and regional industries. The industries are eager to actively engage with our engineering students to build meaningful relationships through mentoring, events, projects, and employment. The member industries benefit through dollars saved in recruitment costs and dollars saved by improved retention rates resulting from hiring local engineering students. They also benefit by involving the university and our students in research and development projects, which can save dollars and provide fresh ideas and solutions. Most of our partner industries provide internship/co-op opportunities to our students allowing them to gain hands-on, real-world work experiences which enhance their technical, professional, and communication skills. These internship/co-op students are a primary source from which many of our partner companies fill full-time engineering openings.

Demand for WKU engineering graduates is strong among this group. The 10 partner companies included in the survey currently employ 169 engineers of which 42 (25%) are WKU engineering alumni. The average annual growth for this group is 4.1%, which outpaces that of the region by 3%. Also, the anticipated replacement demand is strong as well. Replacement plus growth account for an annual number of 15 (8 from replacement and 7 from growth) positions from this group alone. We anticipate a large portion of that demand being filled by WKU engineering graduates.

Another strong indicator of the demand for engineering graduates is the number of students employed in internships/co-ops with regional, state, and national employers. A survey of student employment shows that 36 employers employed 55 students during academic year 2012–2013.

An additional demand indicator is total number of engineering job openings posted annually through the WKU Center for Career and Professional Development and through our Engineering Department. For academic year 2012–2013, a total of 237 engineering positions were posted: 194 full time positions and 43 internship/co-op positions. Additionally, over 20 engineering employers attended our Ogden Science and Engineering job fair in February 2013, and all had openings for engineering interns or full-time engineers.

Another attribute of employer preference for our WKU engineering graduates is the salary of the positions secured by our graduates. The most recent average starting salary data reported by graduates of our WKU engineering programs were as follows:

Average starting salaries	reported by WKU graduates	NACE 2013 salary survey	national percentile
civil	\$43,095	\$58,000	25th
electrical	\$58,508	\$62,500	50th
mechanical	\$58,100	\$63,900	50th

Table 3: Comparison of starting salaries for WKU graduates with national averages (National Association of Colleges and Employers)

This same NACE report found that as a group engineering majors earned the top starting salaries of all undergraduate majors, which were consistent with their 2012 results as well.

Employers surveyed also indicated a preference for baccalaureate of science degreed engineers from ABET-accredited programs rather than engineering technology or manufacturing science degrees. As indicated from the salaries above, employers are willing to pay competitive wages to secure WKU engineering graduates. The WKU engineering program curricula provide a rigorous series of science, mathematics, and engineering courses and integrate industry projects throughout the program to effectively bridge from the science to the art of engineering. We produce successful engineers with a desirable skill set that can benefit regional, state, and national industries.

Additionally, many of our graduates take and pass the fundamentals of engineering (FE) examination, which provides a path to licensure as a professional engineer (PE). This credential is often a requirement for a successful career in civil engineering. For the period 2004–2013, our civil engineering graduates sitting for the fundamentals of engineering examination passed this national norm examination at a rate of 58.1%. Similarly, our electrical and mechanical engineering graduates passed this exam at rates of 63.8% and 68.7% respectively. This is consistent with state and national averages. However, a more remarkable indicator of the practiced-based mission of our engineering programs is that a total of 409 graduates sat for these examinations, which represents 87% of our graduates. This is significantly higher than the national average. Finally, 49 civil engineering, 4 electrical engineering and 5 mechanical engineering graduates have become licensed professional engineers through at least 4 year of experience and passing the principles and practices of engineering (PE) examination during this same time period.

C.2. Distinctive Qualities

All three WKU engineering programs make extensive use of project-based learning, integrating a variety of project experiences at every level of the curriculum. Beginning with the first freshman class and progressing through the last senior class, engineering students at WKU engage in the practice of engineering under the instruction and guidance of degreed, practicing engineers. In building the foundation of basic engineering knowledge by working on realistic and real-world projects, students apply and integrate their traditional coursework into a unified body of theoretical knowledge, deepened and enriched by practical experiences. By learning to complete projects within time and materials budgets while meeting performance specifications, our students begin to think and work like engineers do.

Engineering at WKU differs from most other institutions because its faculty is dedicated exclusively to undergraduate engineering education and to engaging students in the practice of engineering without the requirement of supervising graduate research. All faculty members in the WKU Department of Engineering are required to obtain and maintain licensure as professional engineers in the Commonwealth of Kentucky. Many studies have shown that the educational methodologies employed by engineering faculty at WKU are not only the most enjoyable and interesting for students; they are also a more effective way to learn engineering.

All three WKU engineering programs focus on the needs of the region, in terms of educational offerings and applied research.

C.3. Relationships to Similar Programs in the Commonwealth

The University of Louisville and the University of Kentucky have civil, electrical, and mechanical engineering programs. Graduate and undergraduate programs exist at both institutions. The WKU engineering programs were developed with a focus on undergraduate project based curricula. These programs were originally developed as joint programs, with the University of Louisville and the University of Kentucky providing a portion of the more traditional coursework.

Since 2001, the WKU Department of Engineering has been offering joint degrees with the University of Louisville and the University of Kentucky. During that time, almost 500 students have graduated from these programs. Each student has been required to take at least 16 credit hours from the partner institution. The proposed programs will not include this requirement. But new reciprocal relationships could be worked out. It is anticipated that the partner institutions could continue to offer courses to WKU students in areas in which their faculty have special expertise. Additionally, WKU faculty could also offer courses in their areas of expertise that could be taken remotely by students at other universities across the Commonwealth. Reciprocal relationships could add flexibility to course offerings at all the institutions, creating more responsiveness in our programs collectively in order to produce more engineering graduates for Kentucky.

The WKU Department of Engineering has been a pipeline to the University of Kentucky and the University of Louisville for graduate students. This relationship should continue and expand over time. We anticipate that removing the 16-credit-hour requirement from all students will allow the students who are most interested in pursuing graduate school to choose technical electives offered from the research universities, improving the quality of student experience and leading to even more students choosing the University of Kentucky and the University of Louisville for graduate study. Asynchronous web-based courses could greatly enhance the success of this

approach and increase the number of Kentucky undergraduate students entering this pipeline to graduate work at Kentucky's research universities.

Through projects and applied research, collaborative relationships have existed for some time between engineering faculty at WKU, UK, and Louisville. These relationships have grown out of common research interests and should continue to flourish.

D. Advanced Practice Doctorates

Does not apply

E. Cost and Funding of the Proposed Program

Funding sources and costs of the proposed program are identical to those of the existing program.

The existing program is funded through WKU's internal allocation from the General Fund, with no additional federal or state sources. Private support for special projects, professorships, and faculty development is in the WKU Foundation.

Breakdown of Budget Expenses/Requirements	1 st Year (based on 2012-13 budget)	2 nd Year (assuming 2% salary increases annually)	3 rd Year	4 th Year	5 th Year
Staff (salaries only):					
Executive, administrative, and managerial					
New					
Existing (1/3 of dept)	51,932	52,971	54,030	55,111	56,213
Other Professional					
New					
Existing (1/3 of dept)	62,048	63,289	64,555	65,846	67,163
Faculty					
New					
Existing	334,908	341,606	348,438	355,407	362,515
Fringe Benefits (34%)	152,622	155,674	158,788	161,964	165,203
Graduate Assistants					
New	n/a				
Existing					
Student Employees					
New					
Existing	18,133	18,133	18,133	18,133	18,133
Equipment and Instructional Materials					

New					
Existing	46,732	46,732	46,732	46,732	46,732
Library					
New	n/a				
Existing					
Narrative Explanation/Justification: Library expenses supporting this program are contained within the library budgets.					
Contractual Services					
New	n/a				
Existing					
Academic and/or Student Services					
New	n/a				
Existing					
Other Support Services					
New	n/a				
Existing					
Faculty Development					
New					
Existing					
Narrative Explanation/Justification Faculty development is typically funded through WKU Foundation funds allocated to Engineering.					
Assessment					
New	included				
Existing					
Narrative Explanation/Justification Assessment is part of the regular workload of all members of the staff and not separately accounted. No additional external expenses related to assessment are anticipated.					
Student Space and Equipment (if doctorate)					
New	n/a				
Existing					
Faculty Space and Equipment (if doctorate)					
New	n/a				
Existing					
Other					
New	n/a				
Existing					

TOTAL					
New					
Existing	666,375	678,405	690,676	703,192	715,959

F. Program Review and Assessment

All three engineering programs at WKU are accredited by ABET, and have been since their inception. The first accreditation was received in 2004, and the programs successfully conducted a second accreditation review in 2010. The programs are currently in the third accreditation cycle. Continued accreditation by ABET is of the highest importance to our programs, and the ABET process is the heart and soul of the programs' review and assessment.

ABET requires a continuous improvement approach to assuring quality. Criteria that must be satisfied concern the background of incoming students, the appropriateness of the program's educational objectives and outcomes, the effectiveness of the curriculum through which those are achieved, the adequacy of faculty and staff members in terms of numbers and qualifications, the suitability of facilities and space, the strength of the institutional support, and the process for revising and adapting the program in response to changes, including growth. The full and current version of ABET's criteria for engineering programs is available from the ABET website. <http://www.abet.org> [ABET, 2013]

Aligned with the continuous improvement approach required by ABET, each of the WKU engineering programs follows an annual system of reviewing student performance as evidence of attaining the program's educational outcomes. Student attainment of those outcomes is evaluated in their coursework, on the FE exam, and as entry-level employees. Particular assessments in most courses are mapped to particular outcomes, and student work on those assessments is evaluated using rubrics identified for different developmental levels for each skill set. For instance, the electrical engineering program uses levels of novice, apprentice, proficient, and exemplary. The rubrics are used to evaluate the following: fundamental knowledge; math and science knowledge; design skills; experimental skills; teamwork; professionalism and ethics; written, visual, and graphical communications; and oral and visual communications. In addition, student performance on the Fundamentals of Engineering exam is considered as evidence of how well each program is meeting some of its educational objectives. Finally, recent graduates and their employers are surveyed with regard to their ability to perform effectively in their positions as practicing engineers. This combination of evaluation methods provides a range of perspectives from which the program can be evaluated and adjustments and improvements can be designed.

Another form of review and assessment utilized in the WKU engineering programs is an annual review of each course relative to its prerequisites and courses on which it depends. Once a year, the program faculty meet to review the learning objectives of each course, the activities and assessments used in the course, and the strengths and weaknesses of that year's implementation of the course. This discipline and collaboration among the program faculty provide a level of cooperation and integration that is unusual in modern higher education. The results of this review are used to tune the operational details of the courses in order to strengthen the program, to improve student success, and to make the project-based learning approach sustainable.

ABET is not the entire story however; WKU and the CPE have interest in other aspects of the

program, as outlined in the institutional template for academic program review. Areas of interest there that are not explicitly called for in ABET are the places graduates went, the relationships with other institutions in Kentucky, allocation and productivity of faculty resources and success with regard to extramural funding. All these factors are already being tracked as important areas of our collective and individual performance, and they will be incorporated into the annual program and departmental review conducted each year anticipating the academic program review for the engineering programs in 2015-2016.

G. Works Cited

- ABET. "2014-2015 ABET-EAC Criteria." ABET. Nov 2013
<http://www.abet.org/uploadedFiles/Accreditation/Accreditation_Step_by_Step/Accreditation_Documents/Current/2014_-_2015/E001%2014-15%20EAC%20Criteria%2010-26-13.pdf>.
- Carpenter, Maureen. regional engineering employment projections per JobsEQ Debra Berry. 30 Oct 2013.
- Kentucky Council on Postsecondary Education. "Kentucky's STEM Imperative - Competing in the Global Economy." Task Force Report. 2007.
- . "Stronger By Degrees: A Strategic Agenda for Kentucky Postsecondary and Adult Education." February 2011. Kentucky CPE Planning. November 2013 <<http://goo.gl/zAiPjX>>.
- National Association of Colleges and Employers. "September 2013 NACE Salary Survey Report." 2013.
- National Science Board. Science and Engineering Indicators. National Science Foundation. Arlington, VA, 2012.
- US Dept of Labor. Occupational Outlook Handbook (2012-2013 Edition). 2013. Nov 2013 <<http://www.bls.gov/ooh/architecture-and-engineering>>.
- WKU. About WKU. Nov 2013 <<http://www.wku.edu/about>>.
- . "Challenging the Spirit, WKU Action Plan 2011-12 to 2017-18." Western Kentucky University, n.d.

Dates of prior committee approvals:

Department of Engineering	<u>January 14, 2014</u>
Ogden College Curriculum Committee	_____
Undergraduate Curriculum Committee	_____
University Senate	_____

PRE-PROPOSAL FOR NEW ACADEMIC PROGRAM

Western Kentucky University
Institution Submitting Proposal

Single
Program Type

Electrical Engineering
Title of Proposed Degree Program

Baccalaureate
Degree Level

EEO Status	<u>???</u>
CIP Code	<u>Electrical 14.1001</u>
Academic Unit Name of Academic Unit Name of Program Co-ordinator	<u>Department</u> <u>Department of Engineering</u> <u>Mark Cambron, Ph.D., P.E.</u>
Date of pre-proposal	<u>???</u>
End of review period	<u>???</u>
Intended Date of Implementation	<u>Fall 2014</u>
Name, Title and Information of Contact Person	<u>Julie Ellis, Ph.D., P.E.</u> <u>Department Head and Professor</u> <u>WKU Engineering</u> <u>1906 College Heights Blvd</u> <u>Bowling Green, Kentucky 42101</u> <u>julie.ellis@wku.edu</u>

Is this program a pre-baccalaureate certificate or diploma program? Y___ N _

Date of CPE Approval _____

A. Centrality to the Institution's Mission and Consistency with the State's Goals

A.1. Program Description

The electrical engineering program proposed here is identical in its curriculum to the corresponding existing engineering program now operating at WKU, currently offered jointly with the University of Louisville.

Electrical engineering is an exciting field that touches virtually every aspect of life in the twenty-first century. For example, electrical engineers design and improve communication such as computer and information systems and smart phones. Also, electrical engineers improve the efficiency of tasks with advancements in robotics and electrical systems. Electrical engineers are employed in a variety of industries including the power industry and the manufacturing sector where tasks can range from controlling a process to designing a component or system. Our electrical engineering curriculum exposes students to a variety of topics to prepare them for careers as electrical engineers.

To ensure the necessary breadth of knowledge, the WKU electrical engineering curriculum includes basic engineering courses as well as courses in circuits and networks, electronics, electromagnetics, digital signal processing, microprocessors, control systems, industrial automation, and electrical power systems. Additionally, the curriculum has four design courses, and other elective courses that prepare students for further specialization in the areas of digital systems, robotics, communications, control systems, or power systems.

This program does not contain any specializations.

A.2. Program Objectives

The program objectives remain identical to those of the corresponding existing program now operating at WKU, currently offered jointly with the University of Louisville. These program objectives have been affirmed through ABET accreditation since the programs' inception.

The WKU electrical engineering program has five educational objectives:

Objective 1: Our graduates are prepared to pursue successful and productive engineering careers and are technically competent with the ability to analyze and solve electrical engineering problems.

Objective 2: Our graduates are application-oriented problem solvers, accomplishing solutions through sound engineering and economic practice.

Objective 3: Our graduates are involved in continuing professional development and lifelong learning.

Objective 4: Our graduates practice engineering in a professional manner demonstrating an awareness of legal and ethical responsibilities.

Objective 5: Our graduates have the ability to effectively communicate their ideas and designs.

Graduates of the proposed engineering program will receive a Bachelors of Science degree, just as graduates of the three existing engineering programs do.

A.3. Alignment with Institutional Mission and Strategic Priorities, Statewide Postsecondary Education Vision, Strategic, and the Statewide Strategic Implementation Plan

A.3.a. WKU Institutional Mission

The WKU Institutional Mission is to

“prepare students of all backgrounds to be productive, engaged, and socially responsible citizen-leaders in a global society. The University provides research, service and lifelong learning opportunities for its students, faculty, and other constituents. WKU enriches the quality of life for those within its reach.” (WKU)

With minor changes to include engineering language, this could be each program’s mission statement; the alignment is that tight. As laid out in the objectives in A.2 above, our programs prepare students well; members of our community—faculty, staff, and students—engage in research, service, and lifelong learning; and WKU engineering programs affect the quality of life in the region in multiple positive ways. To be more specific, each WKU engineering program prepares students to be technically competent, professional engineers with strong communication skills and awareness of their professional responsibilities to society and of engineering’s role in global issues. We take special care to ensure our graduates meet the needs of industry in the region and beyond. With students and as individuals, each faculty member of WKU Engineering engages in applied research and service activities that draw on her or his professional skills and preparation, and they contribute to their profession locally, regionally, nationally, and occasionally globally. We provide continuing education opportunities to the engineering profession, and we participate in STEM outreach to the K-12 community.

In preparing outstanding engineering graduates for employment and further study, in providing educational programs at a variety of levels, and in executing meaningful projects for local industry and organizations, the Department of Engineering supports the WKU Mission every way it can.

A.3.b. WKU Strategic Priorities

The WKU engineering programs have aligned our departmental objectives with the four strategic priorities of the university (WKU)

<i>WKU Engineering Objectives</i>	<i>related WKU Engineering goal</i>
<p>WKU Strategic Goal 1: Foster academic excellence. Deliver high-quality engineering education using efficient and sustainable project-based pedagogies. (ENGR2) Continuously develop and support faculty and staff. (ENGR5)</p>	<p>Produce competent practitioners Steward our resources responsibly</p>
<p>WKU Strategic Goal 2: Promote a dynamic and diverse university community. Communicate effectively with internal and external constituencies about WKU Engineering: what we do, how we do it, our dreams, and our needs. (ENGR4)</p>	<p>Tell our story well</p>

Be a good departmental citizen in our college, in our university, and in our professional and civic communities. (ENGR9)

Steward our resources responsibly

WKU Strategic Goal 3: Improve the quality of life for our communities.

Produce competent engineering practitioners in the fields of civil, electrical, and mechanical engineering. (ENGR1)

Produce competent practitioners

Provide engineering expertise responsive to the needs of the region. (ENGR3)

Produce competent practitioners

WKU Strategic Goal 4: Support the core mission with a robust campus infrastructure.

Raise the research profile of WKU Engineering. (ENGR6)

Produce competent practitioners

Strengthen private support for WKU Engineering. (ENGR7)

Steward our resources responsibly

Emancipate the joint programs. (ENGR8)

Tell our story well

A.3.c. Statewide Postsecondary Education Vision

The vision of the Kentucky Council for Postsecondary Education is: *All Kentuckians will be prepared to succeed in a global economy.* (Kentucky Council on Postsecondary Education) The engineering programs at WKU support this vision. Engineers make life better by designing systems that improve the quality of life. Manufacturing equipment, highways, bridges, robotics, and many other systems improve the quality of life of everyone in Kentucky and beyond. Focusing locally, the WKU engineering programs provide a path to better jobs and more industry in the region, stimulating more and better jobs here in south-central Kentucky.

According to many economic development theories, engineering programs attract industries that need engineers, and high-tech businesses increase awareness and create demand for engineering programs. As the only engineering school in south-central Kentucky, WKU has already drawn (and will continue to draw) new high-quality firms and industries to this region. Additionally, new engineering talent that is connected to this region already helps (and will continue to help) existing companies develop new capabilities and innovations. WKU Engineering and regional industry are collaborating in creating more success for south-central Kentuckians in the global economy.

A.3.d. Statewide Strategic Agenda

The Mission of the CPE's Strategic Agenda is: *to deliver a world-class education to students, create and apply new knowledge, and grow the economy of the Commonwealth.*

The WKU engineering programs contribute to achieving this mission through our project-based curricula that enable students to learn by doing. At WKU, we believe creating real-world projects where students complete realistic and real-world engineering projects is the best way to both prepare our graduates for the global marketplace and support the growth of the Kentucky economy. By the time each student graduates, he or she will have had multiple experiences of designing and building innovative products and completing engineering projects on time, within budget, to specification. At the end of their undergraduate years, our students are ready to begin engineering practice or go to graduate school. In the first 10 years of the programs, our students

have completed many significant projects. They have tested concrete for several WKU buildings and for structures around the region. They have developed a controller for a submersible system used by Warren County Search and Rescue for underwater searches, and that system is now under development as a commercial product to be used in a variety of applications, including bridge inspection. With funding from the Gates Foundation and NSF, WKU engineering students collaborating with animal behaviorists from WKU Biology have developed systems to warn villagers in Africa of marauding elephants that eat their crops. Our faculty and students have developed a method for testing better and safer horse reins used at race tracks across the country.

WKU is the only U.S. university to require that all of the engineering faculty be licensed professional engineers as a condition for tenure. Our faculty are practitioners teaching practical methods of engineering. All our faculty have all done real engineering work and can transmit this knowledge to students. Licensure is not a priority for most other institutions, and this is one thing that distinguishes our program.

One of the challenges for post-secondary education cited by the CPE is that Kentucky is “47th among the 50 states in the number of science, technology, engineering, and math (STEM) degrees awarded per capita.” (Kentucky Council on Postsecondary Education) The first WKU engineering graduates received their degrees ten years ago, and since that first class, almost 500 engineers have graduated from the WKU engineering programs. Most of these students would not have chosen to attend other engineering programs in the state, so they represent a new source of technical talent in the engineering workforce.

Currently more than 600 engineering students are enrolled at WKU. The ones that graduate will be a new pool of engineers that would not have been available to our region without the presence of WKU Engineering. With these programs, we will be able to continue to grow the number of Kentucky’s engineering graduates and better prepare students to contribute to the Commonwealth’s economic growth.

The CPE’s Strategic Agenda includes 4 key policy objectives:

- College Readiness
- Student Success
- Research, Economic, and Community Development
- Efficiency and Innovation

The WKU engineering programs address three of these components of the CPE Strategic Agenda: student success; research, economic, and community development; and efficiency and innovation.

Student Success – Objective 1: To increase production and improve graduation rates at all levels.

The WKU engineering programs have produced 468 graduates since 2004 in an area deemed as high demand by the CPE. (Kentucky Council on Postsecondary Education) A significant factor in justifying the engineering programs at WKU initially was that according to the Kentucky Science and Technology 1999 Entrepreneurial Capacity Report, the Commonwealth ranked 47th in the number of scientists and engineers per capita and 45th in science and engineering graduates per capita. From 2005 to 2009 the production of science and engineering graduates increased almost 10% in Kentucky while the population of 18-24 year olds decreased slightly according to

the National Science Foundation Science and Engineering Indicators 2012 report. (National Science Board) During this time period the WKU engineering programs were just beginning; since then, we have continued to grow and produce more graduates, drawing from populations that would probably not choose other programs in the state.

Student Success - Objective 3: To provide high-quality, competitive undergraduate and graduate programs that support academic achievement and program completion, a capacity and desire for life-long learning, and skills and behaviors promoting civic engagement, global awareness, and career readiness.

As presented elsewhere in this document [Student Learning Outcomes, page 2], the learning outcomes of the WKU engineering programs require that all graduates are prepared to achieve this specific objective; this objective is consistent with the ABET criteria and learning outcomes. (ABET) The WKU programs have undergone two successful ABET accreditation visits where these outcomes have been documented, reviewed, and deemed acceptable by the most significant engineering accreditation body in the world. The faculty view the items stated in the CPE objective to be valuable, and have worked diligently to make sure they are met, and the accreditation review has shown the efforts to be successful.

Efficiency and Innovation - Objective 3: To better align academic programs with the current and future needs of the Commonwealth.

As stated above under *Student Success – Objective 1*, the growth and number of graduates produced by the WKU Engineering program shows significant support of this objective. Graduates, their employers, and economic development professionals attest to the need for engineering programs in south-central Kentucky and to the excellent alignment of WKU's project-based approach with their requirements.

Research and Economic Competitiveness – Objective 1: To increase research and development efforts to promote innovation and economic development.

As stated specifically in the CPE document detailing this objective, the WKU Engineering program has demonstrated support through its endowment of over \$3 million through the combination of private and public support in the Bucks for Brains program. During the startup phase of the engineering programs at WKU these funds helped to develop the programs' capacity to provide these project-based curricula. As the programs have evolved, these funds are being used to develop the applied research capabilities as well.

Research and Economic Competitiveness – Objective 3: To align education, economic development, and workforce policies and programs to develop, attract, and maintain jobs.

The CPE Strategic Agenda specifically states that STEM fields are high demand areas. The WKU Engineering program is making significant contributions in producing graduates in the high demand fields, as shown in our graduation and employment information elsewhere in this document. [Student Demand, page 2 and Employer Demand, page 14]

A.3.e. Statewide Strategic Implementation Plan

The statewide implementation plan (Kentucky Council on Postsecondary Education) identifies several specific areas for each program to address: funding, accountability, measurable performance, and the balance between quality and quantity.

Adequate Funding

Sustained, adequate funding in direct operating support to public postsecondary education institutions is vital to achieving statewide policy objectives and moving forward on the aggressive, long-term goals of HB 1 (1997). Increases in state funding, tuition revenue, and financial aid, as well as aggressive cost control, will be required to increase productivity and protect college access for low- and moderate-income students and families.

WKU fully supports cost control and two ways this is achieved is through scholarships for students and the Bucks for Brains program. For example, of 150 civil engineering students at WKU, approximately 20 receive Kentucky Transportation Cabinet scholarships. These are available to worthy students at every level of their studies, giving them access to productive college degrees that improve the quality of life for people in Kentucky and in this region.

Of 14 engineering faculty members at WKU, 4 hold endowed chairs or professorships which enhance teaching, research, and service. This funding, much of it through the Bucks for Brains program, allows faculty members to expand their activities well beyond what would be possible with basic program funding. An example of teaching enhancement is provided by the WKU Study Away Program. In 2012, 9 civil engineering students were able to travel to Hoover Dam, and other locations in the desert southwest to study flood control and water supply. They interacted with flood control district personnel in Arizona and Nevada and studied problems with water supply that the flood control districts have dealt with for decades. One goal of this study was to understand methods that could be used to alleviate water supply and pollution problems that now face our region. Each of these students received grants, funded by private support, that made this program affordable and provided them with an unforgettable educational experience.

The support of the Engineering Program by regional businesses and donors has been phenomenal. These business people have concluded that this program is worth supporting and have opened their pocketbooks as a clear indication of the need of this program.

Accountability

Accountability in higher education is a shared responsibility that includes common goals and objectives, a division of labor, measured results, and a focus on continuous improvement. It will take a common commitment between the Council; institutional governing boards, policy leaders, faculty, and staff; Kentucky's adult education system, students, and parents; the Governor and the General Assembly; the K-12 system; and key state agencies and stakeholders to demonstrate accountability at both the state and institution level.

One of the goals of the CPE is to increase the number of STEM degrees earned in Kentucky. The state has been underperforming in this important area for years. Figure XXX illustrates the point. In the figure, each color represents a different quintile and Kentucky ranks in the lowest quintile of states in the per capita production of science and engineering degrees, and is surrounded by states with better performance in this important area. Since 2004 WKU has produced 468 graduates. During that time, engineering enrollment at other state schools offering engineering degrees has remained stable. These are 468 graduates who improved the goal of

increasing the number of STEM degrees earned in the Commonwealth.

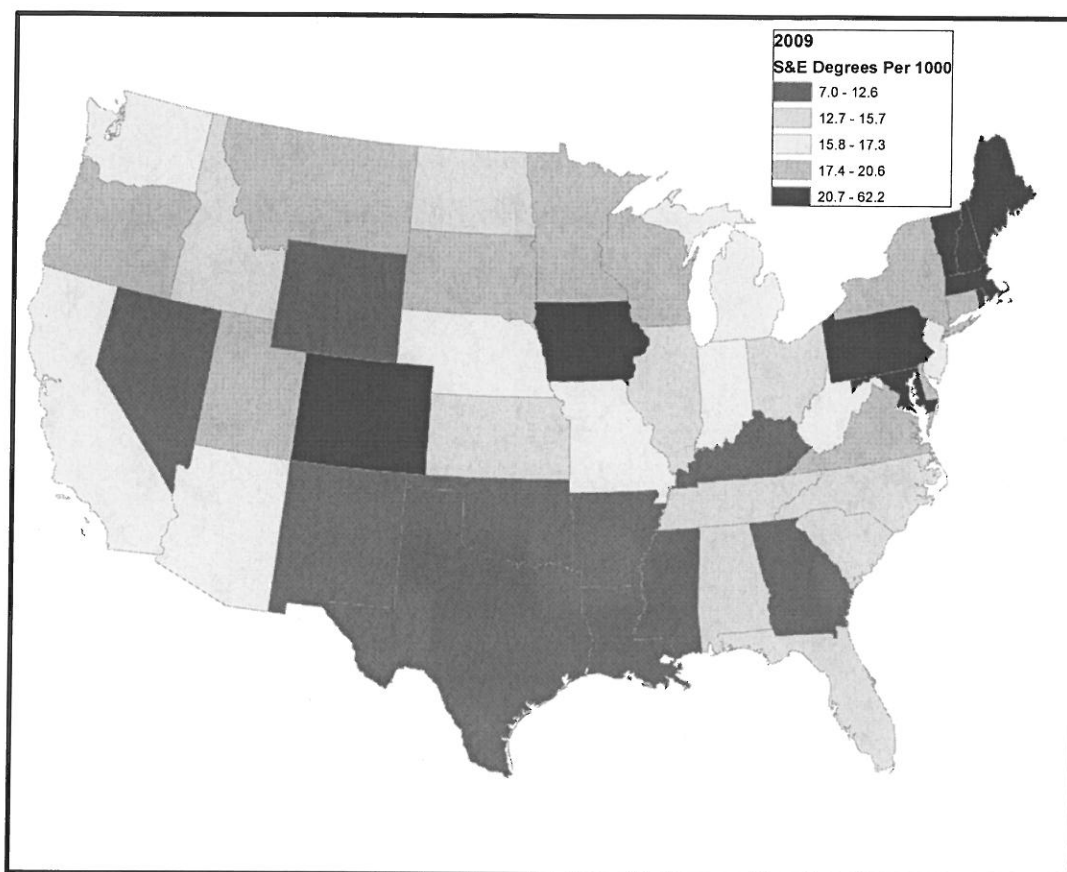


Figure 1: Science and engineering degrees awarded per 1,000 18-24 yr olds (National Science Board)

Performance Metrics and Targets

A select number of state and institutional performance metrics, with negotiated targets for 2015, will help guide progress on the 2011-15 Strategic Agenda, HB 1 mandates, and other reform legislation. Other data, including various leading and lagging indicators, will be monitored to gauge improvement and assist in policy development.

The WKU Engineering Program contributes most to the Research, Economic and Community Development category of metrics. One of these is the number of degrees and credentials in science, technology, engineering, mathematics, and health-related fields. The Engineering Program historically has added engineering degrees without reducing enrollment in engineering at other state institutions.

Engineering schools produce STEM degrees and attract high tech industry. This directly impacts the regional economy. Our donors have been willing to open their pocketbooks to support WKU engineering. They believe in this program. WKU Engineering will help the CPE and the state achieve its implementation plans.

Implementation Plans

The Council is directed by statute to draft an implementation plan that will be pursued collaboratively with institutional representatives and other key stakeholders over the next four years. This policy work is intended to complement, not supplant, the strategic plans approved by institutional governing boards that broadly align with the strategic agenda and allow postsecondary education institutions to achieve their unique missions.

Reporting and Benchmarking

A new Web-based performance dashboard and improvements to the Council's accountability reports will provide easy access to the data and information needed to understand absolute and relative progress on key objectives and strategies. Council and other stakeholder meetings will allow for regular updates on progress.

This relates to a CPE function and does not apply to WKU Engineering.

Incentives

As originally envisioned by HB1, strategic trust funds and various incentive programs are crucial to stimulating increases in degree production, research activity, community outreach, and workforce development. Kentucky must continue to fund proven programs like "Bucks for Brains," Regional Stewardship, Workforce Development, Kentucky Innovation Funds, and EPSCoR, and provide new incentives directly related to improvements in degree production.

WKU Engineering is a beneficiary of the Kentucky Bucks for Brains program. Currently, 4 of our 14 faculty hold endowed chairs or professorships. Another is imminent. These programs allow our faculty to enhance teaching, research, and service. Endowment funds have enabled students to travel for Study Away courses at very reasonable cost. Engineering Study Away courses have traveled to Hoover Dam and flood control districts in Arizona and Nevada, and to the Gulf Coast to study the effects of hurricanes.

The Bucks for Brains program enhances our research infrastructure by providing the means to acquire research equipment such as instrumentation for the Corvette Museum track, materials to help the local rescue squad acquire a submersible search robot, and to develop a testing protocol for all horse reins used at tracks across the U.S.

Bucks for Brains allows our faculty to participate in conferences, national boards, and committees that enhance the reputations of WKU, the state of Kentucky, and of our faculty.

Balancing Quality and Quantity

One of the key challenges is balancing the need for high-quality credentials that allow individuals to be successful in their work, life, and communities with the demand to increase degree production and educational attainment. Strengthening current programs and expanding new ones will help the system control costs, both for students and the state.

Engineering curricula are rigorous, but provide a great return on investment for graduates. It also provides an excellent return on investment for Kentucky because engineers are good for the economy since they design and build new products.

WKU engineering students also have the opportunity to receive minors in Systems Engineering, Land Surveying, Entrepreneurship, Floodplain Management, and Mathematics. Since 2004, more than 200 civil engineering students have achieved American Concrete Institute Grade 1 Certification, and currently 42 of our students have become nationally Certified Floodplain Managers. The state of Kentucky currently has 64 Certified Floodplain Managers. The Minor in

Floodplain Management is the first in the U.S. Fifty-seven of our graduates have become licensed professional engineers serving this state and this region.

A.4. Approval letter from Education Professional Standards Board (EPSB)

Not required

B. Program Quality and Student Success

B.1. Student Learning Outcomes

Consistent with ABET, this program demonstrates that each graduate possesses

- a) an ability to apply knowledge of mathematics, science, and engineering;
- b) an ability to design and conduct experiments, as well as to analyze and interpret data;
- c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability;
- d) an ability to function on multidisciplinary teams;
- e) an ability to identify, formulate, and solve engineering problems;
- f) an understanding of professional and ethical responsibility;
- g) an ability to communicate effectively;
- h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context;
- i) a recognition of the need for, and an ability to engage in life-long learning;
- j) a knowledge of contemporary issues; and
- k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

These are the learning outcomes for each student graduating from each program.

B.2. Program Support Provided by Other Units within the Institution

Most of the general education requirements that each student satisfies are provided by academic departments elsewhere in the university. The Mathematics, Physics, and Chemistry Departments provide significant numbers of courses to all three engineering programs.

B.3. Relationship to the Existing Program

This program replaces the current electrical engineering program, which is offered jointly with the University of Louisville.

B.4. Will this be a 100% distance learning program? No

B.5. Alternative Learning Formats Utilized (**those that apply** shown in **BOLD**)

- Distance learning
- **Courses that combine various modes of interaction**, such as face-to-face, videoconferencing, audio-conferencing, mail, telephone, fax, e-mail, interactive television, or World Wide Web

- **Technology-enhanced instruction**
- Evening/weekend/early morning classes
- Accelerated courses
- **Instruction at nontraditional locations**, such as employer worksite
- Courses with multiple entry, exit, and reentry points
- Courses with “rolling” entrance and completion times, based on self-pacing
- Modularized courses

Delivery of the WKU engineering programs takes multiple forms while taking advantage of the growing technological tools available to the education community. The major focus is on the use of tools that help maximize student success and progress towards their degree, while emphasizing technologies implemented in the professional engineering environment.

The Western Kentucky University campus has multiple technological tools which can be utilized by faculty and students. The campus is fully wireless, allowing communication linkups in both academic and residential buildings. This can be used as a means of augmenting education including the use of Blackboard, Skype, online threaded discussion boards, and classroom instruction where students utilize their own laptop computers. By using both synchronous and asynchronous communication methods, a robust educational setting is established while mimicking methods used by the professional engineering community to maintain communication among far-flung groups.

Sharing of information using technology is a key component of the programs. Technology can facilitate meetings between student groups and project sponsors from industry when distance is too great to allow face-to-face meetings, thus improving efficiency. Already faculty and students from WKU have taken advantage of this for meetings spanning the country, from Florida to the state of Washington and places in between. Work in any engineering community involves operating on a global scale, so technology-mediated communication provides valid real-world challenges for students in south-central Kentucky while engaging them in meaningful professional preparation.

Modern laboratory technologies are also used in the WKU engineering programs. The equipment in the WKU laboratories replicates many of the resources available in a professional engineering setting and allows students the opportunity to develop skills that are consistent with those needed by future employers. Laboratory experiences are used in multiple points of each curriculum to extend learning into the realm of modern engineering practice. These facilities are also available to support projects with industry.

Completion of realistic projects, creation of engineered systems, and design of products are key components of the programs. In today’s engineering community there is much use of technological tools to accomplish these tasks. Computer-aided design and computer-aided manufacturing tools are implemented throughout the programs. Computer-assisted analysis tools such as Matlab and Mathcad and LabView, which are all widely used in industry, find use throughout the programs. Use of computer simulation packages to visualize and measure performance of designed systems are implemented as warranted. By guiding students in the use of professional full-strength technological tools, we provide a professional setting such that

graduates are better prepared to enter the workforce ready to work as engineering practitioners. In this way greater efficiencies in student education and workforce productivity can be achieved.

One area to be evaluated for implementation in the future is the use of distance-taught courses. In a time when technology has progressed to allow for Massive Online Open Courses (MOOCs) and various online degree options, it appears a proper time to explore such technology with the aim of improving engineering course variety without compromising student educational needs. Engineering is somewhat restrained in the use of distance classes as compared to some other disciplines. A part of this can be attributed to the difficulty of conveying a practice-based class experience, though some examples exist where undergraduate engineering coursework is offered online. As example, North Dakota State University offers some of its undergraduate engineering classes online (www.distance.und.edu/engineering) owing to the vast distances that exist between some students and the campus. Other examples of colleges offering limited online undergraduate engineering courses include Arizona State University, Stanford, Drexel, and the Massachusetts Institute of Technology. At this time there are no accredited undergraduate degree programs available online, but there are a few graduate engineering programs offered largely by distance means.

Western Kentucky University has an infrastructure in place for delivery and reception of distance courses. The Division of Extended Learning and Outreach (DELO) at WKU facilitates the use of distance education. At present the most common forms are web/online courses, independent learning, and interactive video service (IVS)/teleconference courses (<http://www.wku.edu/dl>). The infrastructure that DELO provides allows the engineering programs to explore accessing course from universities both inside and outside of Kentucky as well as offering our courses to the wider world off campus. DELO can provide a means to expand the educational opportunities such that broader coursework is available to WKU engineering students while maximizing efficiencies of program delivery. In all cases the focus will remain on pedagogically sound methods that best serve the student educational and workforce needs.

B.6. Faculty Requirements

At this time, no additional full-time faculty members are required. Consolidating courses shared by different programs, combining small sections, adjusting scheduled offerings, and expanding the students' choices of electives allows for more effective utilization of existing faculty resources. Some part-time instructors will be needed.

Growth in student enrollment will necessitate additional faculty members in the future.

C. Program Demand/Unnecessary Duplication

C.1. Need and Demand

C.1.a. Student Demand

The WKU Engineering programs have consistently attracted a wide range of students since their inception in 2001. Initially the enrollment grew quite rapidly, and over the last seven academic years, enrollment has grown at a modest but steady pace.

Academic Year Ending	2007	2008	2009	2010	2011	2012	2013
Civil Engineering	137	140	139	154	162	160	191

Electrical Engineering	110	119	173	186	198	204	228
Mechanical Engineering	163	173	226	228	229	248	260
Total	410	432	538	568	589	612	679

Table 1: Enrollment in WKU engineering programs has steadily increased over the past seven academic years. source: WKU Institutional Research

Most of the students served by these programs come from the south-central Kentucky area, as shown in Figure 2. They perceive that their access to other engineering programs in the Commonwealth is limited. Students who choose to attend WKU engineering programs report that, without these programs, they would either choose a different major at WKU or seek an engineering degree outside the Commonwealth.

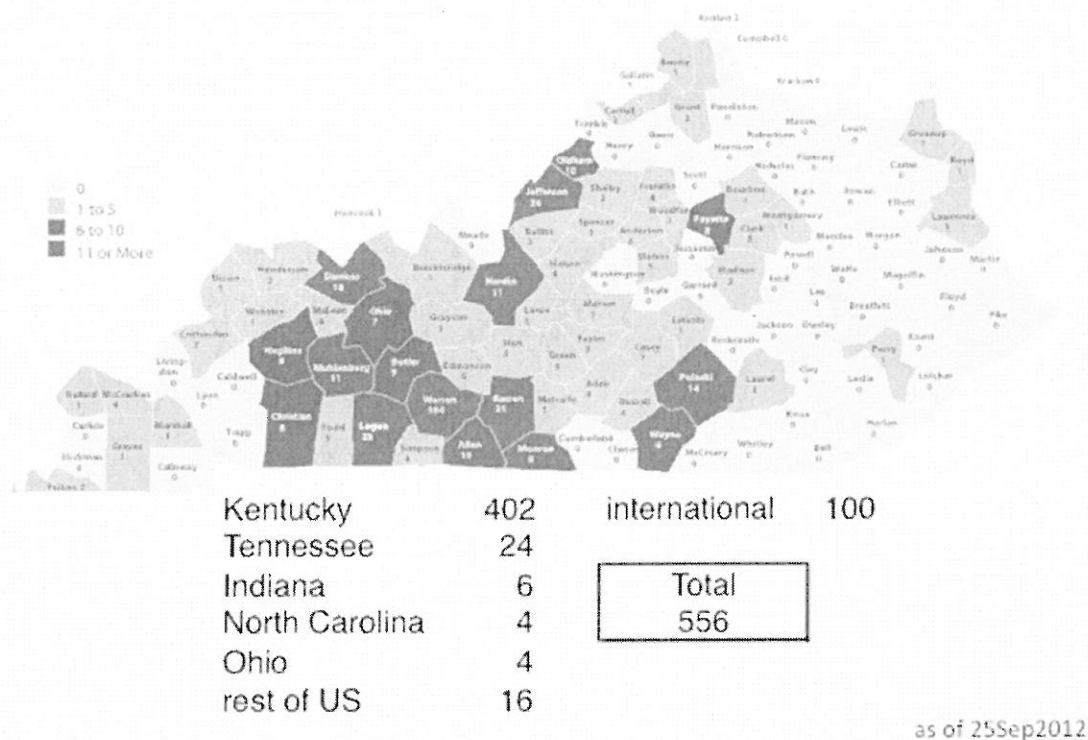


Figure 2: Origins of WKU Engineering students enrolled in Fa2012

Over the past ten academic years (academic years: 2003–2004 through 2012–2013), the three programs have produced 468 engineering graduates as shown in Figure 3.

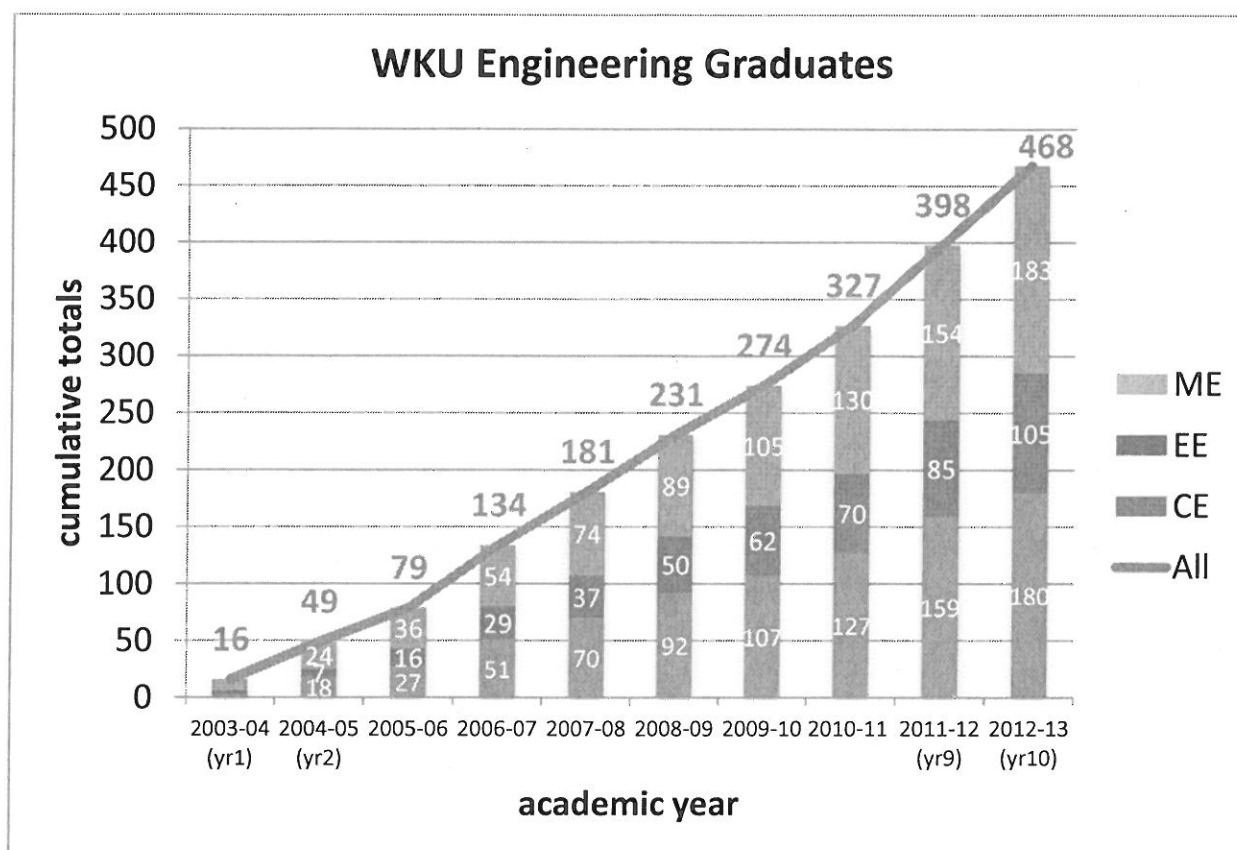


Figure 3: Cumulative WKU Engineering Graduates: Academic Years 2003–2004 through 2012–2013

We anticipate graduating another 58 engineering students during academic year 2013–2014, thereby producing a total of 530 engineering graduates from our three engineering programs over the past 11 years. Most of our graduates secure engineering employment by graduation or shortly after. The majority of our graduates are employed in the state of Kentucky, and in particular, the south-central region of Kentucky.

C.1.b. Employer Demand

When the WKU engineering programs were originally proposed, documentation was presented concerning the need for engineering graduates in south-central Kentucky. Many graduates from more urban areas are unwilling to pursue careers in rural areas such as Logan and Allen County, even though there are good employment opportunities there. . Since that time, it has been well documented that an insufficient number of engineering graduates are being produced by all the engineering programs across the Commonwealth to meet the current and future anticipated demand of the workforce. (Kentucky Council on Postsecondary Education) WKU's programs have responded to those needs, with the majority of our graduates finding permanent employment in the region.

For the two most recent academic years (academic years 2011–2012 and 2012–2013), our graduates have reported employment at 44 different employer locations (28 Kentucky and 16 out-of-state locations) [Berry, D. 2011–2013]. This data acquired via graduate survey provides a summary of employers and types of positions as reported by our engineering alumni.

Additionally, this graduate survey data is merged with data mined from our Alumni Services Office, which provides an employment summary with 114 (US Dept of Labor)ed employers from 154 alumni reports [Berry, D. 2002–2013]. At some locations multiple WKU engineering alumni are employed.

As indicated by this employment data, the demand for our graduates has been strong in spite of a difficult economic period over the past five years due to reduced manufacturing demand, particularly automobile manufacturing, which is a critical portion of our regional economy. Nationally, a decline in engineering employment occurred over this time period. To indicate sustained and future demand, several sources were consulted for information regarding engineering employment demand currently and through the current decade: 2010–2020. These sources included: United States Bureau of Labor Statistics, JobsEQ provided by the Bowling Green Chamber of Commerce, and surveys of regional industrial companies likely to employ our engineering graduates [BLS 2012–2013, Carpenter, M. 2013Q2, and Berry, D. 2013]. The U.S. Bureau of Labor Statistics provides demand data and statistical projections at the national and state levels. It indicates increased demand for engineering due to both new opportunities and net replacement of retiring and resigning employees. JobsEQ and surveys received from regional companies provide a higher fidelity regional indicator of employment demand for our graduates.

At its highest level, employment projections from the United States Bureau of Labor Statistics combine architecture and engineering occupation together. (US Dept of Labor) Their projections indicate that architecture and engineering occupations are projected to add 252,800 new jobs nationally between 2010 and 2020 as they grow by 10.4 percent. Engineers are the largest component of this major occupational group and will add the most new jobs at 160,400. Data for these projections, broken down by discipline, are shown in Table 2 below.

2010-2020 employment projections	US	% growth	Kentucky	% growth
Civil Engineering	51,100	19%	110	18%
Electrical Engineering	10,700	7%	60	15%
Mechanical Engineering	21,400	9%	110	6%

Table 2: US Labor Department projections for engineering employment

Regional projections are somewhat more optimistic. The Bowling Green Chamber of Commerce provided projections from JobsEQ. JobsEQ is a subset of data extracted from the U.S. Bureau of Labor Statistics and modified by regional and local factors. (Carpenter) These projections assist the Chamber in forecasting regional and City of Bowling Green growth. According to JobsEQ, for the most recent four quarters (ending 2013Q2) in the south-central Kentucky region, which includes the 10-county Barren River Area Development District (BRADD) shown in Figure C.2.2, the total number of engineering jobs (Standard Occupations Code 17-2000) is 1,081. The anticipated 10-year average annual growth including replacement demand is 3.24% for the region. The 10-year forecasted total number of job openings for engineers is 395 for the region, with 272 attributed to replacement demand and 123 to growth.

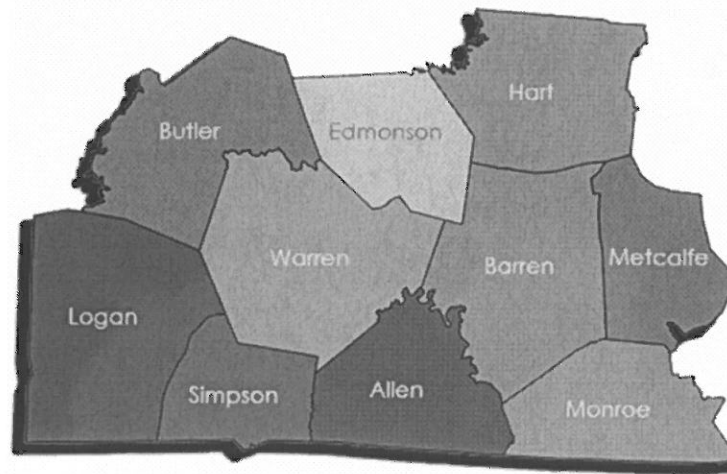


Figure 4: Barren River Area Development District (BRADD) counties are all within the WKU service area

Finally, surveys of regional industries were administered to gain insight into our primary employment base. The WKU Industrial Partnership members were the focus of these inquiries. The Industrial Partnership currently includes 10 member companies: GM/BG Corvette Assembly Plant, Fruit of the Loom, Logan Aluminum, MTD Products, Scotty's Contracting & Stone, J.M. Smuckers, Span Tech, Trace Die Cast, Stupp Bridge, and Sumitomo Electric Wiring Systems. The Industrial Partnership was originally funded by Logan Aluminum with a \$300,000 gift in 2010. Each of the partnership members has made a three-year commitment to pay membership fees of \$5,000 annually, which covers the operational expenses of the program. The outcomes of this program have been to enrich relationships and to promote opportunities among WKU engineering students, faculty, and local and regional industries. The industries are eager to actively engage with our engineering students to build meaningful relationships through mentoring, events, projects, and employment. The member industries benefit through dollars saved in recruitment costs and dollars saved by improved retention rates resulting from hiring local engineering students. They also benefit by involving the university and our students in research and development projects, which can save dollars and provide fresh ideas and solutions. Most of our partner industries provide internship/co-op opportunities to our students allowing them to gain hands-on, real-world work experiences which enhance their technical, professional, and communication skills. These internship/co-op students are a primary source from which many of our partner companies fill full-time engineering openings.

Demand for WKU engineering graduates is strong among this group. The 10 partner companies included in the survey currently employ 169 engineers of which 42 (25%) are WKU engineering alumni. The average annual growth for this group is 4.1%, which outpaces that of the region by 3%. Also, the anticipated replacement demand is strong as well. Replacement plus growth account for an annual number of 15 (8 from replacement and 7 from growth) positions from this group alone. We anticipate a large portion of that demand being filled by WKU engineering graduates.

Another strong indicator of the demand for engineering graduates is the number of students employed in internships/co-ops with regional, state, and national employers. A survey of student employment shows that 36 employers employed 55 students during academic year 2012–2013.

An additional demand indicator is total number of engineering job openings posted annually through the WKU Center for Career and Professional Development and through our Engineering Department. For academic year 2012–2013, a total of 237 engineering positions were posted: 194 full time positions and 43 internship/co-op positions. Additionally, over 20 engineering employers attended our Ogden Science and Engineering job fair in February 2013, and all had openings for engineering interns or full-time engineers.

Another attribute of employer preference for our WKU engineering graduates is the salary of the positions secured by our graduates. The most recent average starting salary data reported by graduates of our WKU engineering programs were as follows:

Average starting salaries	reported by WKU graduates	NACE 2013 salary survey	national percentile
civil	\$43,095	\$58,000	25th
electrical	\$58,508	\$62,500	50th
mechanical	\$58,100	\$63,900	50th

Table 3: Comparison of starting salaries for WKU graduates with national averages (National Association of Colleges and Employers)

This same NACE report found that as a group engineering majors earned the top starting salaries of all undergraduate majors, which were consistent with their 2012 results as well.

Employers surveyed also indicated a preference for baccalaureate of science degreed engineers from ABET-accredited programs rather than engineering technology or manufacturing science degrees. As indicated from the salaries above, employers are willing to pay competitive wages to secure WKU engineering graduates. The WKU engineering program curricula provide a rigorous series of science, mathematics, and engineering courses and integrate industry projects throughout the program to effectively bridge from the science to the art of engineering. We produce successful engineers with a desirable skill set that can benefit regional, state, and national industries.

Additionally, many of our graduates take and pass the fundamentals of engineering (FE) examination, which provides a path to licensure as a professional engineer (PE). This credential is often a requirement for a successful career in civil engineering. For the period 2004–2013, our civil engineering graduates sitting for the fundamentals of engineering examination passed this national norm examination at a rate of 58.1%. Similarly, our electrical and mechanical engineering graduates passed this exam at rates of 63.8% and 68.7% respectively. This is consistent with state and national averages. However, a more remarkable indicator of the practiced-based mission of our engineering programs is that a total of 409 graduates sat for these examinations, which represents 87% of our graduates. This is significantly higher than the national average. Finally, 49 civil engineering, 4 electrical engineering and 5 mechanical engineering graduates have become licensed professional engineers through at least 4 year of experience and passing the principles and practices of engineering (PE) examination during this same time period.

C.2. Distinctive Qualities

All three WKU engineering programs make extensive use of project-based learning, integrating a variety of project experiences at every level of the curriculum. Beginning with the first freshman class and progressing through the last senior class, engineering students at WKU engage in the practice of engineering under the instruction and guidance of degreed, practicing engineers. In building the foundation of basic engineering knowledge by working on realistic and real-world projects, students apply and integrate their traditional coursework into a unified body of theoretical knowledge, deepened and enriched by practical experiences. By learning to complete projects within time and materials budgets while meeting performance specifications, our students begin to think and work like engineers do.

Engineering at WKU differs from most other institutions because its faculty is dedicated exclusively to undergraduate engineering education and to engaging students in the practice of engineering without the requirement of supervising graduate research. All faculty members in the WKU Department of Engineering are required to obtain and maintain licensure as professional engineers in the Commonwealth of Kentucky. Many studies have shown that the educational methodologies employed by engineering faculty at WKU are not only the most enjoyable and interesting for students; they are also a more effective way to learn engineering.

All three WKU engineering programs focus on the needs of the region, in terms of educational offerings and applied research.

C.3. Relationships to Similar Programs in the Commonwealth

The University of Louisville and the University of Kentucky have civil, electrical, and mechanical engineering programs. Graduate and undergraduate programs exist at both institutions. The WKU engineering programs were developed with a focus on undergraduate project based curricula. These programs were originally developed as joint programs, with the University of Louisville and the University of Kentucky providing a portion of the more traditional coursework.

Since 2001, the WKU Department of Engineering has been offering joint degrees with the University of Louisville and the University of Kentucky. During that time, almost 500 students have graduated from these programs. Each student has been required to take at least 16 credit hours from the partner institution. The proposed programs will not include this requirement. But new reciprocal relationships could be worked out. It is anticipated that the partner institutions could continue to offer courses to WKU students in areas in which their faculty have special expertise. Additionally, WKU faculty could also offer courses in their areas of expertise that could be taken remotely by students at other universities across the Commonwealth. Reciprocal relationships could add flexibility to course offerings at all the institutions, creating more responsiveness in our programs collectively in order to produce more engineering graduates for Kentucky.

The WKU Department of Engineering has been a pipeline to the University of Kentucky and the University of Louisville for graduate students. This relationship should continue and expand over time. We anticipate that removing the 16-credit-hour requirement from all students will allow the students who are most interested in pursuing graduate school to choose technical electives offered from the research universities, improving the quality of student experience and leading to even more students choosing the University of Kentucky and the University of Louisville for graduate study. Asynchronous web-based courses could greatly enhance the success of this

approach and increase the number of Kentucky undergraduate students entering this pipeline to graduate work at Kentucky's research universities.

Through projects and applied research, collaborative relationships have existed for some time between engineering faculty at WKU, UK, and Louisville. These relationships have grown out of common research interests and should continue to flourish.

D. Advanced Practice Doctorates

Does not apply

E. Cost and Funding of the Proposed Program

Funding sources and costs of the proposed program are identical to those of the existing program.

The existing program is funded through WKU's internal allocation from the General Fund, with no additional federal or state sources. Private support for special projects, professorships, and faculty development is in the WKU Foundation.

Breakdown of Budget Expenses/Requirements	1 st Year (based on 2012-13 budget)	2 nd Year (assuming 2% salary increases annually)	3 rd Year	4 th Year	5 th Year
Staff (salaries only):					
Executive, administrative, and managerial					
New					
Existing (1/3 of dept)	51,932	52,971	54,030	55,111	56,213
Other Professional					
New					
Existing (1/3 of dept)	62,048	63,289	64,555	65,846	67,163
Faculty					
New					
Existing	330,384	336,992	343,732	350,606	357,618
Fringe Benefits (34%)	151,084	154,105	157,188	160,331	163,538
Graduate Assistants					
New	n/a				
Existing					
Student Employees					
New					
Existing	18,133	18,133	18,133	18,133	18,133
Equipment and Instructional Materials					

New					
Existing	46,732	46,732	46,732	46,732	46,732
Library					
New	n/a				
Existing					
Narrative Explanation/Justification: Library expenses supporting this program are contained within the library budgets.					
Contractual Services					
New	n/a				
Existing					
Academic and/or Student Services					
New	n/a				
Existing					
Other Support Services					
New	n/a				
Existing					
Faculty Development					
New					
Existing					
Narrative Explanation/Justification Faculty development is typically funded through WKU Foundation funds allocated to Engineering.					
Assessment					
New	included				
Existing					
Narrative Explanation/Justification Assessment is part of the regular workload of all members of the staff and not separately accounted. No additional external expenses related to assessment are anticipated.					
Student Space and Equipment (if doctorate)					
New	n/a				
Existing					
Faculty Space and Equipment (if doctorate)					
New	n/a				
Existing					
Other					
New	n/a				
Existing					

TOTAL					
New					
Existing	660,313	672,222	684,369	696,759	709,397

F. Program Review and Assessment

All three engineering programs at WKU are accredited by ABET, and have been since their inception. The first accreditation was received in 2004, and the programs successfully conducted a second accreditation review in 2010. The programs are currently in the third accreditation cycle. Continued accreditation by ABET is of the highest importance to our programs, and the ABET process is the heart and soul of the programs' review and assessment.

ABET requires a continuous improvement approach to assuring quality. Criteria that must be satisfied concern the background of incoming students, the appropriateness of the program's educational objectives and outcomes, the effectiveness of the curriculum through which those are achieved, the adequacy of faculty and staff members in terms of numbers and qualifications, the suitability of facilities and space, the strength of the institutional support, and the process for revising and adapting the program in response to changes, including growth. The full and current version of ABET's criteria for engineering programs is available from the ABET website. <http://www.abet.org> [ABET, 2013]

Aligned with the continuous improvement approach required by ABET, each of the WKU engineering programs follows an annual system of reviewing student performance as evidence of attaining the program's educational outcomes. Student attainment of those outcomes is evaluated in their coursework, on the FE exam, and as entry-level employees. Particular assessments in most courses are mapped to particular outcomes, and student work on those assessments is evaluated using rubrics identified for different developmental levels for each skill set. For instance, the electrical engineering program uses levels of novice, apprentice, proficient, and exemplary. The rubrics are used to evaluate the following: fundamental knowledge; math and science knowledge; design skills; experimental skills; teamwork; professionalism and ethics; written, visual, and graphical communications; and oral and visual communications. In addition, student performance on the Fundamentals of Engineering exam is considered as evidence of how well each program is meeting some of its educational objectives. Finally, recent graduates and their employers are surveyed with regard to their ability to perform effectively in their positions as practicing engineers. This combination of evaluation methods provides a range of perspectives from which the program can be evaluated and adjustments and improvements can be designed.

Another form of review and assessment utilized in the WKU engineering programs is an annual review of each course relative to its prerequisites and courses on which it depends. Once a year, the program faculty meet to review the learning objectives of each course, the activities and assessments used in the course, and the strengths and weaknesses of that year's implementation of the course. This discipline and collaboration among the program faculty provide a level of cooperation and integration that is unusual in modern higher education. The results of this review are used to tune the operational details of the courses in order to strengthen the program, to improve student success, and to make the project-based learning approach sustainable.

ABET is not the entire story however; WKU and the CPE have interest in other aspects of the

program, as outlined in the institutional template for academic program review. Areas of interest there that are not explicitly called for in ABET are the places graduates went, the relationships with other institutions in Kentucky, allocation and productivity of faculty resources and success with regard to extramural funding. All these factors are already being tracked as important areas of our collective and individual performance, and they will be incorporated into the annual program and departmental review conducted each year anticipating the academic program review for the engineering programs in 2015-2016.

G. Works Cited

- ABET. "2014-2015 ABET-EAC Criteria." ABET. Nov 2013 <http://www.abet.org/uploadedFiles/Accreditation/Accreditation_Step_by_Step/Accreditation_Documents/Current/2014_-_2015/E001%2014-15%20EAC%20Criteria%2010-26-13.pdf>.
- Carpenter, Maureen. regional engineering employment projections per JobsEQ Debra Berry. 30 Oct 2013.
- Kentucky Council on Postsecondary Education. "Kentucky's STEM Imperative - Competing in the Global Economy." Task Force Report. 2007.
- . "Stronger By Degrees: A Strategic Agenda for Kentucky Postsecondary and Adult Education." February 2011. Kentucky CPE Planning. November 2013 <<http://goo.gl/zAiPjX>>.
- National Association of Colleges and Employers. "September 2013 NACE Salary Survey Report." 2013.
- National Science Board. Science and Engineering Indicators. National Science Foundation. Arlington, VA, 2012.
- US Dept of Labor. Occupational Outlook Handbook (2012-2013 Edition). 2013. Nov 2013 <<http://www.bls.gov/ooh/architecture-and-engineering>>.
- WKU. About WKU. Nov 2013 <<http://www.wku.edu/about>>.
- . "Challenging the Spirit, WKU Action Plan 2011-12 to 2017-18." Western Kentucky University, n.d.

Dates of prior committee approvals:

Department of Engineering	<u>January 14, 2014</u>
Ogden College Curriculum Committee	_____
Undergraduate Curriculum Committee	_____
University Senate	_____

PRE-PROPOSAL FOR NEW ACADEMIC PROGRAM

Western Kentucky University
Institution Submitting Proposal

Single
Program Type

Mechanical Engineering
Title of Proposed Degree Program

Baccalaureate
Degree Level

EEO Status	<u>???</u>
CIP Code	<u>Mechanical 14.1901</u>
Academic Unit	<u>Department</u>
Name of Academic Unit	<u>Department of Engineering</u>
Name of Program Co-ordinator	<u>Joel Lenoir, P.E.</u>
Date of pre-proposal	<u>???</u>
End of review period	<u>???</u>
Intended Date of Implementation	<u>Fall 2014</u>
Name, Title and Information of Contact Person	<u>Julie Ellis, Ph.D., P.E.</u> <u>Department Head and Professor</u> <u>WKU Engineering</u> <u>1906 College Heights Blvd</u> <u>Bowling Green, Kentucky 42101</u> <u>julie.ellis@wku.edu</u>

Is this program a pre-baccalaureate certificate or diploma program? Y ___ N ✓ _

Date of CPE Approval _____

A. Centrality to the Institution's Mission and Consistency with the State's Goals

A.1. Program Description

The mechanical engineering program proposed here is identical in its curriculum to the corresponding existing engineering program now operating at WKU, currently offered jointly with the University of Kentucky.

Mechanical engineers are involved in designing and building almost everything that is needed in our modern world—from microscopic electro-mechanical devices implanted into our bodies to the planes, trains and automobiles that transport us and the things we need, to enormous power generating and distribution systems that produce and control millions of horsepower. Mechanical engineers use scientific principles from the physical world to create a tremendous variety of mechanical and thermal systems. Practicing mechanical engineers use these principles to design, analyze, manufacture, and maintain systems that include:

- automobiles and aircraft
- heating and cooling systems
- electric power plants
- specialized materials
- manufacturing plants
- industrial equipment and machinery

Mechanical engineers need a solid understanding of engineering science, which includes mechanics, engineering materials, thermodynamics and fluid mechanics. The mechanical engineering program at WKU focuses on these sciences as well as design principles and practice. Students also gain professional skills necessary for a successful career in mechanical engineering.

The WKU mechanical engineering program produces graduates who are well prepared for the start of productive, successful careers as practicing engineers. Our graduates have a strong competitive advantage with their unique background of engineering fundamentals combined with practical knowledge and experience. The mechanical engineering program provides a project-based, learner-driven environment relevant to the needs of our region. In support of this learning environment, the professional engineering activities of the faculty create opportunities for the students to practice the art and science of contemporary Mechanical Engineering.

This program does not contain any specializations.

A.2. Program Objectives

The program objectives remain identical to those of the corresponding existing program now operating at WKU, currently offered jointly with the University of Kentucky. These program objectives have been affirmed through ABET accreditation since the programs' inception.

The WKU mechanical engineering program has seven educational objectives grouped into three general areas.

Technical

- Our graduates demonstrate competence in the use of scientific, technical, and professional skills for the practice of mechanical engineering.

- Our graduates demonstrate the ability to identify problem causation and to implement practical, application-oriented solutions.
- Our graduates demonstrate the ability to find additional knowledge necessary to solve unfamiliar problems.

Professional

- Our graduates exhibit excellent two-way communication skills in written, oral, visual, and graphical forms with a wide variety of audiences.
- Our graduates demonstrate ethical professional behavior and a comprehension of the breadth of the engineer's professional roles and responsibilities.

Societal

- Our graduates adapt to an ever-changing world by engaging in life-long learning and professional development activities.
- Our graduates contribute to their region's economic development through their professional practice.

Graduates of the proposed engineering program will receive a Bachelors of Science degree, just as graduates of the three existing engineering programs do.

A.3. Alignment with Institutional Mission and Strategic Priorities, Statewide Postsecondary Education Vision, Strategic, and the Statewide Strategic Implementation Plan

A.3.a. WKU Institutional Mission

The WKU Institutional Mission is to

“prepare students of all backgrounds to be productive, engaged, and socially responsible citizen-leaders in a global society. The University provides research, service and lifelong learning opportunities for its students, faculty, and other constituents. WKU enriches the quality of life for those within its reach.” (WKU)

With minor changes to include engineering language, this could be each program's mission statement; the alignment is that tight. As laid out in the objectives in A.2 above, our programs prepare students well; members of our community—faculty, staff, and students—engage in research, service, and lifelong learning; and WKU engineering programs affect the quality of life in the region in multiple positive ways. To be more specific, each WKU engineering program prepares students to be technically competent, professional engineers with strong communication skills and awareness of their professional responsibilities to society and of engineering's role in global issues. We take special care to ensure our graduates meet the needs of industry in the region and beyond. With students and as individuals, each faculty member of WKU Engineering engages in applied research and service activities that draw on her or his professional skills and preparation, and they contribute to their profession locally, regionally, nationally, and occasionally globally. We provide continuing education opportunities to the engineering profession, and we participate in STEM outreach to the K-12 community.

In preparing outstanding engineering graduates for employment and further study, in providing educational programs at a variety of levels, and in executing meaningful projects for local industry and organizations, the Department of Engineering supports the WKU Mission every way it can.

A.3.b. WKU Strategic Priorities

The WKU engineering programs have aligned our departmental objectives with the four strategic priorities of the university (WKU)

<i>WKU Engineering Objective</i>	<i>related WKU Engineering Goal</i>
<p>WKU Strategic Goal 1: Foster academic excellence. Deliver high-quality engineering education using efficient and sustainable project-based pedagogies. (ENGR2) Continuously develop and support faculty and staff. (ENGR5)</p>	<p>Produce competent practitioners Steward our resources responsibly</p>
<p>WKU Strategic Goal 2: Promote a dynamic and diverse university community. Communicate effectively with internal and external constituencies about WKU Engineering: what we do, how we do it, our dreams, and our needs. (ENGR4) Be a good departmental citizen in our college, in our university, and in our professional and civic communities. (ENGR9)</p>	<p>Tell our story well Steward our resources responsibly</p>
<p>WKU Strategic Goal 3: Improve the quality of life for our communities. Produce competent engineering practitioners in the fields of civil, electrical, and mechanical engineering. (ENGR1) Provide engineering expertise responsive to the needs of the region. (ENGR3)</p>	<p>Produce competent practitioners Produce competent practitioners</p>
<p>WKU Strategic Goal 4: Support the core mission with a robust campus infrastructure. Raise the research profile of WKU Engineering. (ENGR6) Strengthen private support for WKU Engineering. (ENGR7) Emancipate the joint programs. (ENGR8)</p>	<p>Produce competent practitioners Steward our resources responsibly Tell our story well</p>

A.3.c. Statewide Postsecondary Education Vision

The vision of the Kentucky Council for Postsecondary Education is: *All Kentuckians will be prepared to succeed in a global economy.* (Kentucky Council on Postsecondary Education) The engineering programs at WKU support this vision. Engineers make life better by designing systems that improve the quality of life. Manufacturing equipment, highways, bridges, robotics, and many other systems improve the quality of life of everyone in Kentucky and beyond. Focusing locally, the WKU engineering programs provide a path to better jobs and more industry in the region, stimulating more and better jobs here in south-central Kentucky.

According to many economic development theories, engineering programs attract industries that need engineers, and high-tech businesses increase awareness and create demand for engineering programs. As the only engineering school in south-central Kentucky, WKU has already drawn

(and will continue to draw) new high-quality firms and industries to this region. Additionally, new engineering talent that is connected to this region already helps (and will continue to help) existing companies develop new capabilities and innovations. WKU Engineering and regional industry are collaborating in creating more success for south-central Kentuckians in the global economy.

A.3.d. Statewide Strategic Agenda

The Mission of the CPE's Strategic Agenda is: *to deliver a world-class education to students, create and apply new knowledge, and grow the economy of the Commonwealth.*

The WKU engineering programs contribute to achieving this mission through our project-based curricula that enable students to learn by doing. At WKU, we believe creating real-world projects where students complete realistic and real-world engineering projects is the best way to both prepare our graduates for the global marketplace and support the growth of the Kentucky economy. By the time each student graduates, he or she will have had multiple experiences of designing and building innovative products and completing engineering projects on time, within budget, to specification. At the end of their undergraduate years, our students are ready to begin engineering practice or go to graduate school. In the first 10 years of the programs, our students have completed many significant projects. They have tested concrete for several WKU buildings and for structures around the region. They have developed a controller for a submersible system used by Warren County Search and Rescue for underwater searches, and that system is now under development as a commercial product to be used in a variety of applications, including bridge inspection. With funding from the Gates Foundation and NSF, WKU engineering students collaborating with animal behaviorists from WKU Biology have developed systems to warn villagers in Africa of marauding elephants that eat their crops. Our faculty and students have developed a method for testing better and safer horse reins used at race tracks across the country.

WKU is the only U.S. university to require that all of the engineering faculty be licensed professional engineers as a condition for tenure. Our faculty are practitioners teaching practical methods of engineering. All our faculty have all done real engineering work and can transmit this knowledge to students. Licensure is not a priority for most other institutions, and this is one thing that distinguishes our program.

One of the challenges for post-secondary education cited by the CPE is that Kentucky is "47th among the 50 states in the number of science, technology, engineering, and math (STEM) degrees awarded per capita." (Kentucky Council on Postsecondary Education) The first WKU engineering graduates received their degrees ten years ago, and since that first class, almost 500 engineers have graduated from the WKU engineering programs. Most of these students would not have chosen to attend other engineering programs in the state, so they represent a new source of technical talent in the engineering workforce.

Currently more than 600 engineering students are enrolled at WKU. The ones that graduate will be a new pool of engineers that would not have been available to our region without the presence of WKU Engineering. With these programs, we will be able to continue to grow the number of Kentucky's engineering graduates and better prepare students to contribute to the Commonwealth's economic growth.

The CPE's Strategic Agenda includes 4 key policy objectives:

- College Readiness
- Student Success
- Research, Economic, and Community Development
- Efficiency and Innovation

The WKU engineering programs address three of these components of the CPE Strategic Agenda: student success; research, economic, and community development; and efficiency and innovation.

Student Success – Objective 1: To increase production and improve graduation rates at all levels.

The WKU engineering programs have produced 468 graduates since 2004 in an area deemed as high demand by the CPE. (Kentucky Council on Postsecondary Education) A significant factor in justifying the engineering programs at WKU initially was that according to the Kentucky Science and Technology 1999 Entrepreneurial Capacity Report, the Commonwealth ranked 47th in the number of scientists and engineers per capita and 45th in science and engineering graduates per capita. From 2005 to 2009 the production of science and engineering graduates increased almost 10% in Kentucky while the population of 18-24 year olds decreased slightly according to the National Science Foundation Science and Engineering Indicators 2012 report. (National Science Board) During this time period the WKU engineering programs were just beginning; since then, we have continued to grow and produce more graduates, drawing from populations that would probably not choose other programs in the state.

Student Success - Objective 3: To provide high-quality, competitive undergraduate and graduate programs that support academic achievement and program completion, a capacity and desire for life-long learning, and skills and behaviors promoting civic engagement, global awareness, and career readiness.

As presented elsewhere in this document [Student Learning Outcomes, page 2], the learning outcomes of the WKU engineering programs require that all graduates are prepared to achieve this specific objective; this objective is consistent with the ABET criteria and learning outcomes. (ABET) The WKU programs have undergone two successful ABET accreditation visits where these outcomes have been documented, reviewed, and deemed acceptable by the most significant engineering accreditation body in the world. The faculty view the items stated in the CPE objective to be valuable, and have worked diligently to make sure they are met, and the accreditation review has shown the efforts to be successful.

Efficiency and Innovation - Objective 3: To better align academic programs with the current and future needs of the Commonwealth.

As stated above under *Student Success – Objective 1*, the growth and number of graduates produced by the WKU Engineering program shows significant support of this objective. Graduates, their employers, and economic development professionals attest to the need for engineering programs in south-central Kentucky and to the excellent alignment of WKU's project-based approach with their requirements.

Research and Economic Competitiveness – Objective 1: To increase research and development efforts to promote innovation and economic development.

As stated specifically in the CPE document detailing this objective, the WKU Engineering program has demonstrated support through its endowment of over \$3 million through the combination of private and public support in the Bucks for Brains program. During the startup phase of the engineering programs at WKU these funds helped to develop the programs' capacity to provide these project-based curricula. As the programs have evolved, these funds are being used to develop the applied research capabilities as well.

Research and Economic Competitiveness – Objective 3: To align education, economic development, and workforce policies and programs to develop, attract, and maintain jobs.

The CPE Strategic Agenda specifically states that STEM fields are high demand areas. The WKU Engineering program is making significant contributions in producing graduates in the high demand fields, as shown in our graduation and employment information elsewhere in this document. [Student Demand, page 2 and Employer Demand, page 15]

A.3.e. Statewide Strategic Implementation Plan

The statewide implementation plan (Kentucky Council on Postsecondary Education) identifies several specific areas for each program to address: funding, accountability, measurable performance, and the balance between quality and quantity.

Adequate Funding

Sustained, adequate funding in direct operating support to public postsecondary education institutions is vital to achieving statewide policy objectives and moving forward on the aggressive, long-term goals of HB 1 (1997). Increases in state funding, tuition revenue, and financial aid, as well as aggressive cost control, will be required to increase productivity and protect college access for low- and moderate-income students and families.

WKU fully supports cost control and two ways this is achieved is through scholarships for students and the Bucks for Brains program. For example, of 150 civil engineering students at WKU, approximately 20 receive Kentucky Transportation Cabinet scholarships. These are available to worthy students at every level of their studies, giving them access to productive college degrees that improve the quality of life for people in Kentucky and in this region.

Of 14 engineering faculty members at WKU, 4 hold endowed chairs or professorships which enhance teaching, research, and service. This funding, much of it through the Bucks for Brains program, allows faculty members to expand their activities well beyond what would be possible with basic program funding. An example of teaching enhancement is provided by the WKU Study Away Program. In 2012, 9 civil engineering students were able to travel to Hoover Dam, and other locations in the desert southwest to study flood control and water supply. They interacted with flood control district personnel in Arizona and Nevada and studied problems with water supply that the flood control districts have dealt with for decades. One goal of this study was to understand methods that could be used to alleviate water supply and pollution problems that now face our region. Each of these students received grants, funded by private support, that made this program affordable and provided them with an unforgettable educational experience.

The support of the Engineering Program by regional businesses and donors has been phenomenal. These business people have concluded that this program is worth supporting and have opened their pocketbooks as a clear indication of the need of this program.

Accountability

Accountability in higher education is a shared responsibility that includes common goals and objectives, a division of labor, measured results, and a focus on continuous improvement. It will take a common commitment between the Council; institutional governing boards, policy leaders, faculty, and staff; Kentucky's adult education system, students, and parents; the Governor and the General Assembly; the K-12 system; and key state agencies and stakeholders to demonstrate accountability at both the state and institution level.

One of the goals of the CPE is to increase the number of STEM degrees earned in Kentucky. The state has been underperforming in this important area for years. Figure XXX illustrates the point. In the figure, each color represents a different quintile and Kentucky ranks in the lowest quintile of states in the per capita production of science and engineering degrees, and is surrounded by states with better performance in this important area. Since 2004 WKU has produced 468 graduates. During that time, engineering enrollment at other state schools offering engineering degrees has remained stable. These are 468 graduates who improved the goal of increasing the number of STEM degrees earned in the Commonwealth.

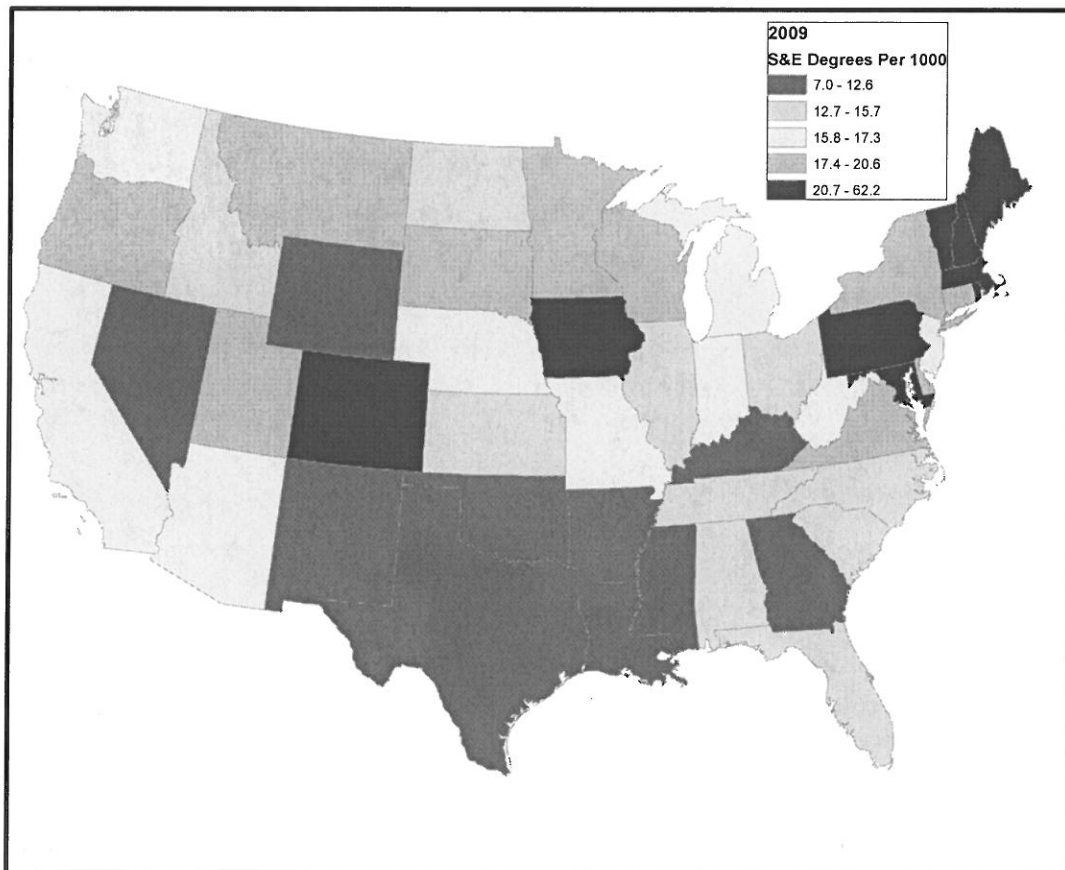


Figure 1: Science and engineering degrees awarded per 1,000 18-24 yr olds (National Science Board)

Performance Metrics and Targets

A select number of state and institutional performance metrics, with negotiated targets for 2015, will help guide progress on the 2011-15 Strategic Agenda, HB 1 mandates, and other reform legislation. Other data, including various leading and lagging indicators, will be monitored to gauge improvement and assist in policy development.

The WKU Engineering Program contributes most to the Research, Economic and Community Development category of metrics. One of these is the number of degrees and credentials in science, technology, engineering, mathematics, and health-related fields. The Engineering Program historically has added engineering degrees without reducing enrollment in engineering at other state institutions.

Engineering schools produce STEM degrees and attract high tech industry. This directly impacts the regional economy. Our donors have been willing to open their pocketbooks to support WKU engineering. They believe in this program. WKU Engineering will help the CPE and the state achieve its implementation plans.

Implementation Plans

The Council is directed by statute to draft an implementation plan that will be pursued collaboratively with institutional representatives and other key stakeholders over the next four years. This policy work is intended to complement, not supplant, the strategic plans approved by institutional governing boards that broadly align with the strategic agenda and allow postsecondary education institutions to achieve their unique missions.

Reporting and Benchmarking

A new Web-based performance dashboard and improvements to the Council's accountability reports will provide easy access to the data and information needed to understand absolute and relative progress on key objectives and strategies. Council and other stakeholder meetings will allow for regular updates on progress.

This relates to a CPE function and does not apply to WKU Engineering.

Incentives

As originally envisioned by HB1, strategic trust funds and various incentive programs are crucial to stimulating increases in degree production, research activity, community outreach, and workforce development. Kentucky must continue to fund proven programs like "Bucks for Brains," Regional Stewardship, Workforce Development, Kentucky Innovation Funds, and EPSCoR, and provide new incentives directly related to improvements in degree production.

WKU Engineering is a beneficiary of the Kentucky Bucks for Brains program. Currently, 4 of our 14 faculty hold endowed chairs or professorships. Another is imminent. These programs allow our faculty to enhance teaching, research, and service. Endowment funds have enabled students to travel for Study Away courses at very reasonable cost. Engineering Study Away courses have traveled to Hoover Dam and flood control districts in Arizona and Nevada, and to the Gulf Coast to study the effects of hurricanes.

The Bucks for Brains program enhances our research infrastructure by providing the means to acquire research equipment such as instrumentation for the Corvette Museum track, materials to

help the local rescue squad acquire a submersible search robot, and to develop a testing protocol for all horse reins used at tracks across the U.S.

Bucks for Brains allows our faculty to participate in conferences, national boards, and committees that enhance the reputations of WKU, the state of Kentucky, and of our faculty.

Balancing Quality and Quantity

One of the key challenges is balancing the need for high-quality credentials that allow individuals to be successful in their work, life, and communities with the demand to increase degree production and educational attainment. Strengthening current programs and expanding new ones will help the system control costs, both for students and the state.

Engineering curricula are rigorous, but provide a great return on investment for graduates. It also provides an excellent return on investment for Kentucky because engineers are good for the economy since they design and build new products.

WKU engineering students also have the opportunity to receive minors in Systems Engineering, Land Surveying, Entrepreneurship, Floodplain Management, and Mathematics. Since 2004, more than 200 civil engineering students have achieved American Concrete Institute Grade 1 Certification, and currently 42 of our students have become nationally Certified Floodplain Managers. The state of Kentucky currently has 64 Certified Floodplain Managers. The Minor in Floodplain Management is the first in the U.S. Fifty-seven of our graduates have become licensed professional engineers serving this state and this region.

A.4. Approval letter from Education Professional Standards Board (EPSB)

Not required

B. Program Quality and Student Success

B.1. Student Learning Outcomes

Consistent with ABET, this program demonstrates that each graduate possesses

- a) an ability to apply knowledge of mathematics, science, and engineering;
- b) an ability to design and conduct experiments, as well as to analyze and interpret data;
- c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability;
- d) an ability to function on multidisciplinary teams;
- e) an ability to identify, formulate, and solve engineering problems;
- f) an understanding of professional and ethical responsibility;
- g) an ability to communicate effectively;
- h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context;
- i) a recognition of the need for, and an ability to engage in life-long learning;
- j) a knowledge of contemporary issues; and
- k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

These are the learning outcomes for each student graduating from each program.

B.2. Program Support Provided by Other Units within the Institution

Most of the general education requirements that each student satisfies are provided by academic departments elsewhere in the university. The Mathematics, Physics, and Chemistry Departments provide significant numbers of courses to all three engineering programs. Relationship to the Existing Program

This program replaces the current mechanical engineering program, which is offered jointly with the University of Kentucky.

B.3. Will this be a 100% distance learning program? No

B.4. Alternative Learning Formats Utilized (**those that apply** shown in **BOLD**)

- Distance learning
- **Courses that combine various modes of interaction**, such as face-to-face, videoconferencing, audio-conferencing, mail, telephone, fax, e-mail, interactive television, or World Wide Web
- **Technology-enhanced instruction**
- Evening/weekend/early morning classes
- Accelerated courses
- **Instruction at nontraditional locations**, such as employer worksite
- Courses with multiple entry, exit, and reentry points
- Courses with “rolling” entrance and completion times, based on self-pacing
- Modularized courses

Delivery of the WKU engineering programs takes multiple forms while taking advantage of the growing technological tools available to the education community. The major focus is on the use of tools that help maximize student success and progress towards their degree, while emphasizing technologies implemented in the professional engineering environment.

The Western Kentucky University campus has multiple technological tools which can be utilized by faculty and students. The campus is fully wireless, allowing communication linkups in both academic and residential buildings. This can be used as a means of augmenting education including the use of Blackboard, Skype, online threaded discussion boards, and classroom instruction where students utilize their own laptop computers. By using both synchronous and asynchronous communication methods, a robust educational setting is established while mimicking methods used by the professional engineering community to maintain communication among far-flung groups.

Sharing of information using technology is a key component of the programs. Technology can facilitate meetings between student groups and project sponsors from industry when distance is too great to allow face-to-face meetings, thus improving efficiency. Already faculty and students from WKU have taken advantage of this for meetings spanning the country, from Florida to the state of Washington and places in between. Work in any engineering community involves operating on a global scale, so technology-mediated communication provides valid real-world

challenges for students in south-central Kentucky while engaging them in meaningful professional preparation.

Modern laboratory technologies are also used in the WKU engineering programs. The equipment in the WKU laboratories replicates many of the resources available in a professional engineering setting and allows students the opportunity to develop skills that are consistent with those needed by future employers. Laboratory experiences are used in multiple points of each curriculum to extend learning into the realm of modern engineering practice. These facilities are also available to support projects with industry.

Completion of realistic projects, creation of engineered systems, and design of products are key components of the programs. In today's engineering community there is much use of technological tools to accomplish these tasks. Computer-aided design and computer-aided manufacturing tools are implemented throughout the programs. Computer-assisted analysis tools such as Matlab and Mathcad and LabView, which are all widely used in industry, find use throughout the programs. Use of computer simulation packages to visualize and measure performance of designed systems are implemented as warranted. By guiding students in the use of professional full-strength technological tools, we provide a professional setting such that graduates are better prepared to enter the workforce ready to work as engineering practitioners. In this way greater efficiencies in student education and workforce productivity can be achieved.

One area to be evaluated for implementation in the future is the use of distance-taught courses. In a time when technology has progressed to allow for Massive Online Open Courses (MOOCs) and various online degree options, it appears a proper time to explore such technology with the aim of improving engineering course variety without compromising student educational needs. Engineering is somewhat restrained in the use of distance classes as compared to some other disciplines. A part of this can be attributed to the difficulty of conveying a practice-based class experience, though some examples exist where undergraduate engineering coursework is offered online. As example, North Dakota State University offers some of its undergraduate engineering classes online (www.distance.und.edu/engineering) owing to the vast distances that exist between some students and the campus. Other examples of colleges offering limited online undergraduate engineering courses include Arizona State University, Stanford, Drexel, and the Massachusetts Institute of Technology. At this time there are no accredited undergraduate degree programs available online, but there are a few graduate engineering programs offered largely by distance means.

Western Kentucky University has an infrastructure in place for delivery and reception of distance courses. The Division of Extended Learning and Outreach (DELO) at WKU facilitates the use of distance education. At present the most common forms are web/online courses, independent learning, and interactive video service (IVS)/teleconference courses (<http://www.wku.edu/dl>). The infrastructure that DELO provides allows the engineering programs to explore accessing course from universities both inside and outside of Kentucky as well as offering our courses to the wider world off campus. DELO can provide a means to expand the educational opportunities such that broader coursework is available to WKU engineering students while maximizing efficiencies of program delivery. In all cases the focus will remain on pedagogically sound methods that best serve the student educational and workforce needs.

B.5. Faculty Requirements

At this time, no additional full-time faculty members are required. Consolidating courses shared by different programs, combining small sections, adjusting scheduled offerings, and expanding the students' choices of electives allows for more effective utilization of existing faculty resources. Some part-time instructors will be needed.

Growth in student enrollment will necessitate additional faculty members in the future.

C. Program Demand/Unnecessary Duplication

C.1. Need and Demand

C.1.a. Student Demand

The WKU Engineering programs have consistently attracted a wide range of students since their inception in 2001. Initially the enrollment grew quite rapidly, and over the last seven academic years, enrollment has grown at a modest but steady pace.

Academic Year Ending	2007	2008	2009	2010	2011	2012	2013
Civil Engineering	137	140	139	154	162	160	191
Electrical Engineering	110	119	173	186	198	204	228
Mechanical Engineering	163	173	226	228	229	248	260
Total	410	432	538	568	589	612	679

Table 1: Enrollment in WKU engineering programs has steadily increased over the past seven academic years. source: WKU Institutional Research

Most of the students served by these programs come from the south-central Kentucky area, as shown in Figure 2. They perceive that their access to other engineering programs in the Commonwealth is limited. Students who choose to attend WKU engineering programs report that, without these programs, they would either choose a different major at WKU or seek an engineering degree outside the Commonwealth.

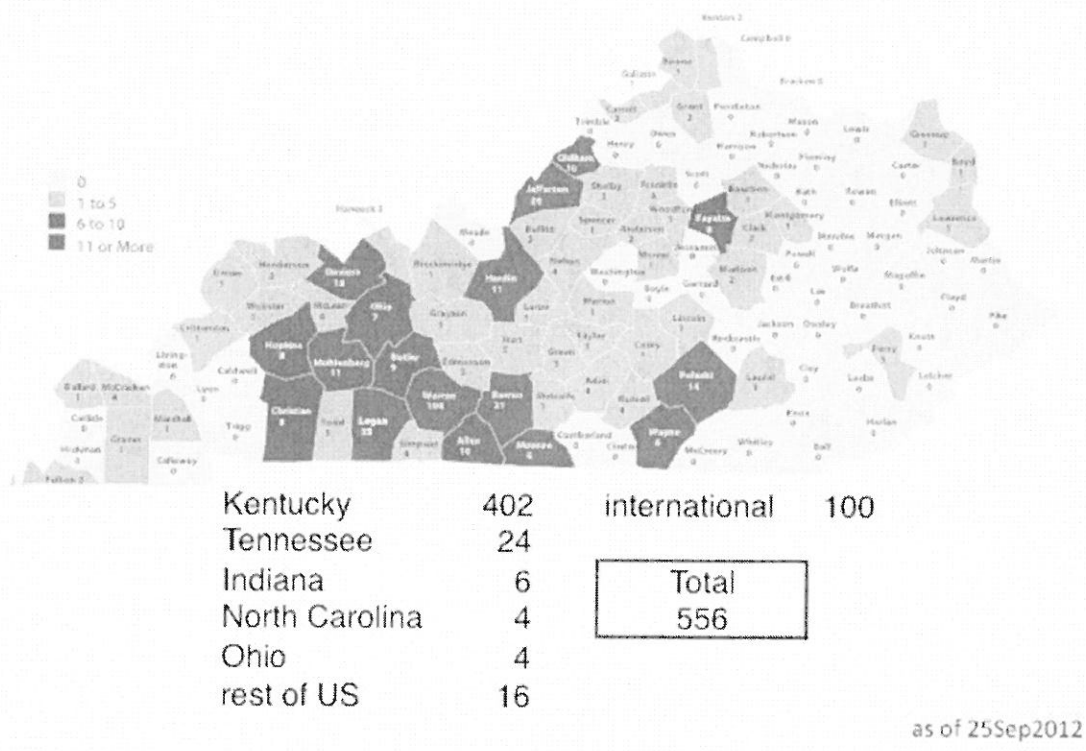


Figure 2: Origins of WKU Engineering students enrolled in Fa2012

Over the past ten academic years (academic years: 2003–2004 through 2012–2013), the three programs have produced 468 engineering graduates as shown in Figure 3.

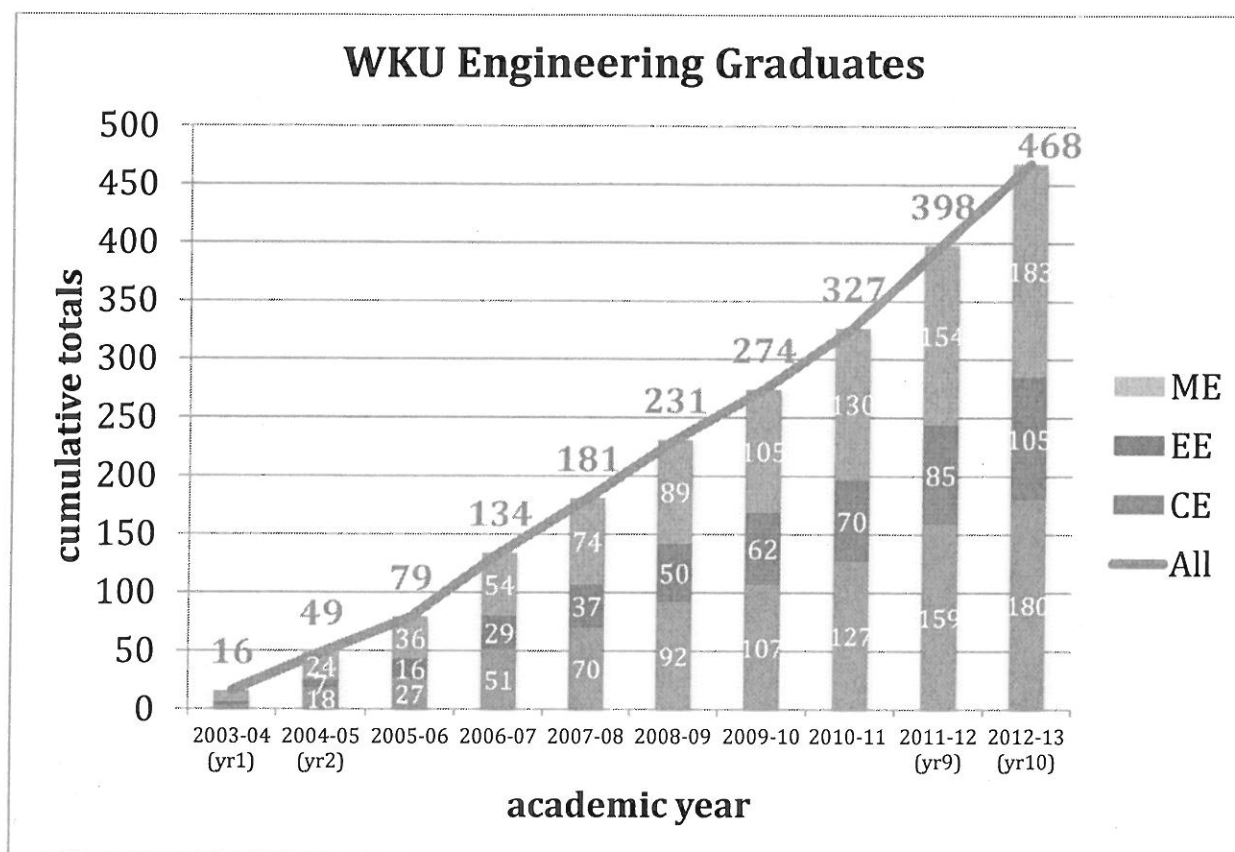


Figure 3: Cumulative WKU Engineering Graduates: Academic Years 2003–2004 through 2012–2013

We anticipate graduating another 58 engineering students during academic year 2013–2014, thereby producing a total of 530 engineering graduates from our three engineering programs over the past 11 years. Most of our graduates secure engineering employment by graduation or shortly after. The majority of our graduates are employed in the state of Kentucky, and in particular, the south-central region of Kentucky.

C.1.b. Employer Demand

When the WKU engineering programs were originally proposed, documentation was presented concerning the need for engineering graduates in south-central Kentucky. Many graduates from more urban areas are unwilling to pursue careers in rural areas such as Logan and Allen County, even though there are good employment opportunities there. . Since that time, it has been well documented that an insufficient number of engineering graduates are being produced by all the engineering programs across the Commonwealth to meet the current and future anticipated demand of the workforce. (Kentucky Council on Postsecondary Education) WKU's programs have responded to those needs, with the majority of our graduates finding permanent employment in the region.

For the two most recent academic years (academic years 2011–2012 and 2012–2013), our graduates have reported employment at 44 different employer locations (28 Kentucky and 16 out-of-state locations) [Berry, D. 2011–2013]. This data acquired via graduate survey provides a summary of employers and types of positions as reported by our engineering alumni.

Additionally, this graduate survey data is merged with data mined from our Alumni Services Office, which provides an employment summary with 114 (US Dept of Labor)ed employers from 154 alumni reports [Berry, D. 2002–2013]. At some locations multiple WKU engineering alumni are employed.

As indicated by this employment data, the demand for our graduates has been strong in spite of a difficult economic period over the past five years due to reduced manufacturing demand, particularly automobile manufacturing, which is a critical portion of our regional economy. Nationally, a decline in engineering employment occurred over this time period. To indicate sustained and future demand, several sources were consulted for information regarding engineering employment demand currently and through the current decade: 2010–2020. These sources included: United States Bureau of Labor Statistics, JobsEQ provided by the Bowling Green Chamber of Commerce, and surveys of regional industrial companies likely to employ our engineering graduates [BLS 2012–2013, Carpenter, M. 2013Q2, and Berry, D. 2013]. The U.S. Bureau of Labor Statistics provides demand data and statistical projections at the national and state levels. It indicates increased demand for engineering due to both new opportunities and net replacement of retiring and resigning employees. JobsEQ and surveys received from regional companies provide a higher fidelity regional indicator of employment demand for our graduates.

At its highest level, employment projections from the United States Bureau of Labor Statistics combine architecture and engineering occupation together. (US Dept of Labor) Their projections indicate that architecture and engineering occupations are projected to add 252,800 new jobs nationally between 2010 and 2020 as they grow by 10.4 percent. Engineers are the largest component of this major occupational group and will add the most new jobs at 160,400. Data for these projections, broken down by discipline, are shown in Table 2 below.

2010-2020 employment projections	US	% growth	Kentucky	% growth
Civil Engineering	51,100	19%	110	18%
Electrical Engineering	10,700	7%	60	15%
Mechanical Engineering	21,400	9%	110	6%

Table 2: US Labor Department projections for engineering employment

Regional projections are somewhat more optimistic. The Bowling Green Chamber of Commerce provided projections from JobsEQ. JobsEQ is a subset of data extracted from the U.S. Bureau of Labor Statistics and modified by regional and local factors. (Carpenter) These projections assist the Chamber in forecasting regional and City of Bowling Green growth. According to JobsEQ, for the most recent four quarters (ending 2013Q2) in the south-central Kentucky region, which includes the 10-county Barren River Area Development District (BRADD) shown in Figure C.2.2, the total number of engineering jobs (Standard Occupations Code 17-2000) is 1,081. The anticipated 10-year average annual growth including replacement demand is 3.24% for the region. The 10-year forecasted total number of job openings for engineers is 395 for the region, with 272 attributed to replacement demand and 123 to growth.

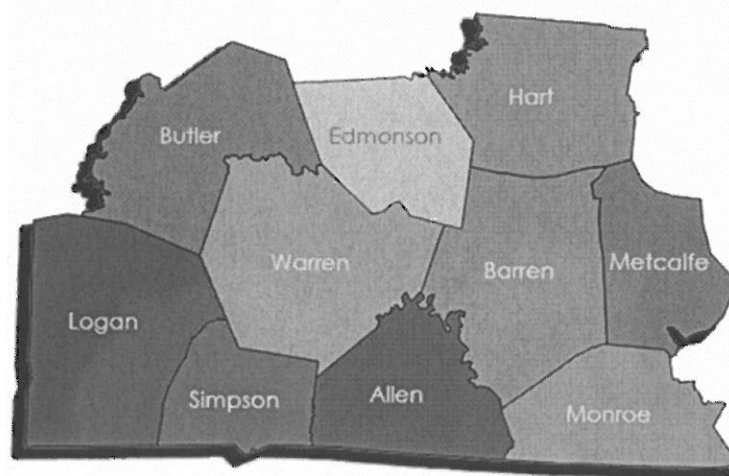


Figure 4: Barren River Area Development District (BRADD) counties are all within the WKU service area

Finally, surveys of regional industries were administered to gain insight into our primary employment base. The WKU Industrial Partnership members were the focus of these inquiries. The Industrial Partnership currently includes 10 member companies: GM/BG Corvette Assembly Plant, Fruit of the Loom, Logan Aluminum, MTD Products, Scotty's Contracting & Stone, J.M. Smuckers, Span Tech, Trace Die Cast, Stupp Bridge, and Sumitomo Electric Wiring Systems. The Industrial Partnership was originally funded by Logan Aluminum with a \$300,000 gift in 2010. Each of the partnership members has made a three-year commitment to pay membership fees of \$5,000 annually, which covers the operational expenses of the program. The outcomes of this program have been to enrich relationships and to promote opportunities among WKU engineering students, faculty, and local and regional industries. The industries are eager to actively engage with our engineering students to build meaningful relationships through mentoring, events, projects, and employment. The member industries benefit through dollars saved in recruitment costs and dollars saved by improved retention rates resulting from hiring local engineering students. They also benefit by involving the university and our students in research and development projects, which can save dollars and provide fresh ideas and solutions. Most of our partner industries provide internship/co-op opportunities to our students allowing them to gain hands-on, real-world work experiences which enhance their technical, professional, and communication skills. These internship/co-op students are a primary source from which many of our partner companies fill full-time engineering openings.

Demand for WKU engineering graduates is strong among this group. The 10 partner companies included in the survey currently employ 169 engineers of which 42 (25%) are WKU engineering alumni. The average annual growth for this group is 4.1%, which outpaces that of the region by 3%. Also, the anticipated replacement demand is strong as well. Replacement plus growth account for an annual number of 15 (8 from replacement and 7 from growth) positions from this group alone. We anticipate a large portion of that demand being filled by WKU engineering graduates.

Another strong indicator of the demand for engineering graduates is the number of students employed in internships/co-ops with regional, state, and national employers. A survey of student employment shows that 36 employers employed 55 students during academic year 2012–2013.

An additional demand indicator is total number of engineering job openings posted annually through the WKU Center for Career and Professional Development and through our Engineering Department. For academic year 2012–2013, a total of 237 engineering positions were posted: 194 full time positions and 43 internship/co-op positions. Additionally, over 20 engineering employers attended our Ogden Science and Engineering job fair in February 2013, and all had openings for engineering interns or full-time engineers.

Another attribute of employer preference for our WKU engineering graduates is the salary of the positions secured by our graduates. The most recent average starting salary data reported by graduates of our WKU engineering programs were as follows:

Average starting salaries	reported by WKU graduates	NACE 2013 salary survey	national percentile
civil	\$43,095	\$58,000	25th
electrical	\$58,508	\$62,500	50th
mechanical	\$58,100	\$63,900	50th

Table 3: Comparison of starting salaries for WKU graduates with national averages (National Association of Colleges and Employers)

This same NACE report found that as a group engineering majors earned the top starting salaries of all undergraduate majors, which were consistent with their 2012 results as well.

Employers surveyed also indicated a preference for baccalaureate of science degreed engineers from ABET-accredited programs rather than engineering technology or manufacturing science degrees. As indicated from the salaries above, employers are willing to pay competitive wages to secure WKU engineering graduates. The WKU engineering program curricula provide a rigorous series of science, mathematics, and engineering courses and integrate industry projects throughout the program to effectively bridge from the science to the art of engineering. We produce successful engineers with a desirable skill set that can benefit regional, state, and national industries.

Additionally, many of our graduates take and pass the fundamentals of engineering (FE) examination, which provides a path to licensure as a professional engineer (PE). This credential is often a requirement for a successful career in civil engineering. For the period 2004–2013, our civil engineering graduates sitting for the fundamentals of engineering examination passed this national norm examination at a rate of 58.1%. Similarly, our electrical and mechanical engineering graduates passed this exam at rates of 63.8% and 68.7% respectively. This is consistent with state and national averages. However, a more remarkable indicator of the practiced-based mission of our engineering programs is that a total of 409 graduates sat for these examinations, which represents 87% of our graduates. This is significantly higher than the national average. Finally, 49 civil engineering, 4 electrical engineering and 5 mechanical engineering graduates have become licensed professional engineers through at least 4 year of experience and passing the principles and practices of engineering (PE) examination during this same time period.

C.2. Distinctive Qualities

All three WKU engineering programs make extensive use of project-based learning, integrating a variety of project experiences at every level of the curriculum. Beginning with the first freshman class and progressing through the last senior class, engineering students at WKU engage in the practice of engineering under the instruction and guidance of degreed, practicing engineers. In building the foundation of basic engineering knowledge by working on realistic and real-world projects, students apply and integrate their traditional coursework into a unified body of theoretical knowledge, deepened and enriched by practical experiences. By learning to complete projects within time and materials budgets while meeting performance specifications, our students begin to think and work like engineers do.

Engineering at WKU differs from most other institutions because its faculty is dedicated exclusively to undergraduate engineering education and to engaging students in the practice of engineering without the requirement of supervising graduate research. All faculty members in the WKU Department of Engineering are required to obtain and maintain licensure as professional engineers in the Commonwealth of Kentucky. Many studies have shown that the educational methodologies employed by engineering faculty at WKU are not only the most enjoyable and interesting for students; they are also a more effective way to learn engineering.

All three WKU engineering programs focus on the needs of the region, in terms of educational offerings and applied research.

C.3. Relationships to Similar Programs in the Commonwealth

The University of Louisville and the University of Kentucky have civil, electrical, and mechanical engineering programs. Graduate and undergraduate programs exist at both institutions. The WKU engineering programs were developed with a focus on undergraduate project based curricula. These programs were originally developed as joint programs, with the University of Louisville and the University of Kentucky providing a portion of the more traditional coursework.

Since 2001, the WKU Department of Engineering has been offering joint degrees with the University of Louisville and the University of Kentucky. During that time, almost 500 students have graduated from these programs. Each student has been required to take at least 16 credit hours from the partner institution. The proposed programs will not include this requirement. But new reciprocal relationships could be worked out. It is anticipated that the partner institutions could continue to offer courses to WKU students in areas in which their faculty have special expertise. Additionally, WKU faculty could also offer courses in their areas of expertise that could be taken remotely by students at other universities across the Commonwealth. Reciprocal relationships could add flexibility to course offerings at all the institutions, creating more responsiveness in our programs collectively in order to produce more engineering graduates for Kentucky.

The WKU Department of Engineering has been a pipeline to the University of Kentucky and the University of Louisville for graduate students. This relationship should continue and expand over time. We anticipate that removing the 16-credit-hour requirement from all students will allow the students who are most interested in pursuing graduate school to choose technical electives offered from the research universities, improving the quality of student experience and leading to even more students choosing the University of Kentucky and the University of Louisville for graduate study. Asynchronous web-based courses could greatly enhance the success of this

approach and increase the number of Kentucky undergraduate students entering this pipeline to graduate work at Kentucky's research universities.

Through projects and applied research, collaborative relationships have existed for some time between engineering faculty at WKU, UK, and Louisville. These relationships have grown out of common research interests and should continue to flourish.

D. Advanced Practice Doctorates

Does not apply

E. Cost and Funding of the Proposed Program

Funding sources and costs of the proposed program are identical to those of the existing program.

The existing program is funded through WKU's internal allocation from the General Fund, with no additional federal or state sources. Private support for special projects, professorships, and faculty development is in the WKU Foundation.

Breakdown of Budget Expenses/Requirements	1 st Year (based on 2012-13 budget)	2 nd Year (assuming 2% salary increases annually)	3 rd Year	4 th Year	5 th Year
Staff (salaries only):					
Executive, administrative, and managerial					
New					
Existing (1/3 of dept)	51,932	52,971	54,030	55,111	56,213
Other Professional					
New					
Existing (1/3 of dept)	62,048	63,289	64,555	65,846	67,163
Faculty					
New					
Existing	425,758	434,273	442,959	451,818	460,854
Fringe Benefits (34%)	183,511	187,181	190,925	194,743	198,638
Graduate Assistants					
New	n/a				
Existing					
Student Employees					
New					
Existing	18,133	18,133	18,133	18,133	18,133
Equipment and Instructional Materials					

New					
Existing	46,732	46,732	46,732	46,732	46,732
Library					
New	n/a				
Existing					
Narrative Explanation/Justification: Library expenses supporting this program are contained within the library budgets.					
Contractual Services					
New	n/a				
Existing					
Academic and/or Student Services					
New	n/a				
Existing					
Other Support Services					
New	n/a				
Existing					
Faculty Development					
New					
Existing					
Narrative Explanation/Justification Faculty development is typically funded through WKU Foundation funds allocated to Engineering.					
Assessment					
New	included				
Existing					
Narrative Explanation/Justification Assessment is part of the regular workload of all members of the staff and not separately accounted. No additional external expenses related to assessment are anticipated.					
Student Space and Equipment (if doctorate)					
New	n/a				
Existing					
Faculty Space and Equipment (if doctorate)					
New	n/a				
Existing					
Other					
New	n/a				
Existing					

A. TOTAL					
New					
Existing	788,114	802,579	817,333	832,383	847,733

F. Program Review and Assessment

All three engineering programs at WKU are accredited by ABET, and have been since their inception. The first accreditation was received in 2004, and the programs successfully conducted a second accreditation review in 2010. The programs are currently in the third accreditation cycle. Continued accreditation by ABET is of the highest importance to our programs, and the ABET process is the heart and soul of the programs' review and assessment.

ABET requires a continuous improvement approach to assuring quality. Criteria that must be satisfied concern the background of incoming students, the appropriateness of the program's educational objectives and outcomes, the effectiveness of the curriculum through which those are achieved, the adequacy of faculty and staff members in terms of numbers and qualifications, the suitability of facilities and space, the strength of the institutional support, and the process for revising and adapting the program in response to changes, including growth. The full and current version of ABET's criteria for engineering programs is available from the ABET website. <http://www.abet.org> [ABET, 2013]

Aligned with the continuous improvement approach required by ABET, each of the WKU engineering programs follows an annual system of reviewing student performance as evidence of attaining the program's educational outcomes. Student attainment of those outcomes is evaluated in their coursework, on the FE exam, and as entry-level employees. Particular assessments in most courses are mapped to particular outcomes, and student work on those assessments is evaluated using rubrics identified for different developmental levels for each skill set. For instance, the electrical engineering program uses levels of novice, apprentice, proficient, and exemplary. The rubrics are used to evaluate the following: fundamental knowledge; math and science knowledge; design skills; experimental skills; teamwork; professionalism and ethics; written, visual, and graphical communications; and oral and visual communications. In addition, student performance on the Fundamentals of Engineering exam is considered as evidence of how well each program is meeting some of its educational objectives. Finally, recent graduates and their employers are surveyed with regard to their ability to perform effectively in their positions as practicing engineers. This combination of evaluation methods provides a range of perspectives from which the program can be evaluated and adjustments and improvements can be designed.

Another form of review and assessment utilized in the WKU engineering programs is an annual review of each course relative to its prerequisites and courses on which it depends. Once a year, the program faculty meet to review the learning objectives of each course, the activities and assessments used in the course, and the strengths and weaknesses of that year's implementation of the course. This discipline and collaboration among the program faculty provide a level of cooperation and integration that is unusual in modern higher education. The results of this review are used to tune the operational details of the courses in order to strengthen the program, to improve student success, and to make the project-based learning approach sustainable.

ABET is not the entire story however; WKU and the CPE have interest in other aspects of the

program, as outlined in the institutional template for academic program review. Areas of interest there that are not explicitly called for in ABET are the places graduates went, the relationships with other institutions in Kentucky, allocation and productivity of faculty resources and success with regard to extramural funding. All these factors are already being tracked as important areas of our collective and individual performance, and they will be incorporated into the annual program and departmental review conducted each year anticipating the academic program review for the engineering programs in 2015-2016.

G. Works Cited

- ABET. "2014-2015 ABET-EAC Criteria." ABET. Nov 2013
<http://www.abet.org/uploadedFiles/Accreditation/Accreditation_Step_by_Step/Accreditation_Documents/Current/2014_-_2015/E001%2014-15%20EAC%20Criteria%2010-26-13.pdf>.
- Carpenter, Maureen. regional engineering employment projections per JobsEQ Debra Berry. 30 Oct 2013.
- Kentucky Council on Postsecondary Education. "Kentucky's STEM Imperative - Competing in the Global Economy." Task Force Report. 2007.
- . "Stronger By Degrees: A Strategic Agenda for Kentucky Postsecondary and Adult Education." February 2011. Kentucky CPE Planning. November 2013 <<http://goo.gl/zAiPjX>>.
- National Association of Colleges and Employers. "September 2013 NACE Salary Survey Report." 2013.
- National Science Board. Science and Engineering Indicators. National Science Foundation. Arlington, VA, 2012.
- US Dept of Labor. Occupational Outlook Handbook (2012-2013 Edition). 2013. Nov 2013 <<http://www.bls.gov/ooh/architecture-and-engineering>>.
- WKU. About WKU. Nov 2013 <<http://www.wku.edu/about>>.
- . "Challenging the Spirit, WKU Action Plan 2011-12 to 2017-18." Western Kentucky University, n.d.

Dates of prior committee approvals:

Department of Engineering	<u>January 14, 2014</u>
Ogden College Curriculum Committee	_____
Undergraduate Curriculum Committee	_____
University Senate	_____