COLLEGE OF SCIENCE AND ENGINEERING
Strengths, Challenges, Opportunities and Threats

January 2017
The college periodically reviews operations and practices to maintain an ongoing sense of its strengths, challenges, opportunities and threats (SCOT). This SCOT analysis is an update of the 2014 analysis. The mission, vision and strategic plan for CSE were revised over the 2014-2015 academic year.

The mission of the College is:
To serve the science and engineering needs of Washington State and the global community by advancing scholarship and educating thoughtful leaders and problem solvers.

The vision of the College is:
To be the premier institution in the region for undergraduate education and for select masters programs in science, math, and engineering.

The 2014 analysis referred to the central role the college plays in the delivery of Western’s liberal arts and sciences core, its central role in bringing science, mathematics and technology expertise to the wider community, and the challenges involved in delivering science, mathematics and engineering education appropriate to our state’s and nation’s rapidly changing needs in an environment of significant growth in majors and increasing access issues. These central roles and challenges remain in place. The 2014 SCOT has been revised in this document but not substantively changed.

STRENGTHS
The strength and reputation of CSE programs is the result of a college-wide commitment to excellence in all areas of endeavor, an exceptionally strong cadre of tenured, tenure-track and non-tenure track faculty, staff and students, a commitment to faculty-mentored student research, student-centered teaching and a progressive and innovative curriculum. Clearly identifiable strengths are:

Faculty, Staff, and Students
- Faculty excellence in classroom and research instruction. Demonstrated by the high frequency of teaching and research national awards won by many faculty, their commitment to improving pedagogy and the success of our students upon graduation.
- High quality of faculty scholarship. Many faculty publish their research in the top journals in their field. Faculty are highly effective in obtaining external funding; CSE active grants in 2017 exceed $18.3 million (about 40% of the university total).
- Strong professional and classified staff contributions. Experienced, well qualified staff provide high levels of professional support for college and departmental activities.
- Excellence in student scholarship. Shown by the large number of student co-authored publications and awards won and scholarship projects presented at regional and national conferences and professional meetings.
- Good achievement in post-graduate studies. CSE undergraduates are accepted at a high rate and excel in subsequent graduate and professional school studies.
• **Strong employer satisfaction with graduates.** Surveys of alums and employers of CSE graduates show students are well-prepared in current and timely areas. Employers appreciate our students’ ability to think critically and analyze data.

### Curriculum

- **Solid core/major curricula in various programs.**
- **Commitment to interdisciplinary studies.** CSE supports many innovative courses and programs, eg. SMATE (science/math education), materials science (AMSEC) and the Institute for Energy Studies (IES), that involve interdisciplinary work among CSE departments and with other colleges.
- **Support for undergraduate scholarship.** Departments emphasize and support independent undergraduate scholarship.
- **Emphasis on student-centered learning.** Curriculum stresses active learning in laboratory, field, and project based settings, the best platforms for introducing and reinforcing critical analysis and quantitative reasoning. Active learning is supported by the Change at the CORE initiative and professional development workshops for new STEM faculty and Teaching Assistants.
- **Instrumentation and software instruction.** In many lab courses and research experiences, students learn how to operate state-of-the-art instrumentation, software and computational tools eg. CAD in engineering, GIS in geology, Mathematica in Math.
- **Science and mathematics education programs.** Instruction involves essentials of both disciplinary and pedagogical training. The science education program is a national leader in engaging CSE faculty to produce the next generation of effective science and math teachers, and these efforts are expanding to computer science education.
- **Innovation in the curriculum.** Faculty continually strive to meet new and emerging demands of the state and its employers, for example in engineering, geophysics, energy studies and computer security.
- **Commitment to staying up-to-date.** Students are often provided experience with state-of-the-art instruments and exposure to current topics in course work.
- **Commitment to effective GUR courses.** Support for active-learning and innovation in laboratory science and lecture courses enhances student engagement and success in the general education program, and form a vital part of the liberal sciences and arts education all students receive at WWU.
- **Many accredited and certified programs.** Where available, professional association external accreditation or certification is attained by CSE departments.

### Departmental/College Structure

- **Collegial departments and supportive administration.** Within departments and among departments, there exists good-will and a culture of cooperation in addressing challenges.
- **Staff integration in CSE programs.** Expert staff, integrated into activities of the departments and college, provide input on, and quality support of technical and administrative functions.
- **Integrated, interdependent and interdisciplinary curriculum.** Most CSE majors take a minimum of 9 required courses from other CSE departments outside their home department. Additionally, CSE has many interdisciplinary courses and programs which
span multiple departments, like AMSEC, SMATE and geophysics where faculty have joint appointments.

Graduate Programs

- **Essential role in curriculum.** Graduate teaching assistants play an essential role in laboratory instruction and in high enrollment introductory courses. This experience as teachers/aides is of great benefit to the graduate TAs.
- **Support for faculty scholarship.** Strong graduate programs provide vital support of faculty scholarship, an important component in faculty recruitment and retention. Many research active faculty depend upon graduate students for research productivity.
- **Provide mentorship and research and learning opportunities for undergraduates.** Graduate students guide undergraduate research projects and act as peer mentors for undergraduates in lab settings. Undergraduates have access to graduate classes.
- **Good employment prospects.** Graduates are in high demand by regional and national companies and institutions.
- **High acceptance rates into doctoral programs:** Graduates have a high success rate in acceptance into doctoral programs in their field of study.

Facilities and Equipment

- **Access to good equipment in most cases.** Although some needs exist, the general level of basic equipment is good. CSE departments and shared instrumentation centers in AMSEC and SCITECH house key state-of-the-art instrumentation to support research and teaching for both undergraduate and graduate programs.
- **Access to research lab spaces for most programs.** Although some may be small and outdated, most research active faculty have access to designated research lab spaces, where appropriate. The exception is in Engineering and Industrial Design.

Commitment to Community and Region

- **College and department outreach.** Lectures, seminars and workshops on current and timely subjects are delivered to community audiences at on- and off-campus venues.
- **Support of local enterprises.** Faculty, staff and students bring expertise to area and regional organizations, e.g., Technology Development Center (TDC), CAP program.
- **College Advancement Board.** Involves alums and supporters of CSE and its departments from the northwest area and nationally.
- **Leadership in science and mathematics education.** Programs within CSE, in collaboration with Woodring College, are leaders in STEM teacher training in the State. For example, the new Next Generation of STEM Teacher Preparation in Washington State project funded by NSF is a collaboration between WWU and colleges across the state designed to improve STEM teacher preparation for all students.
- **Outreach to local schools.** Faculty, staff, students and student clubs are engaged in professional development workshops, mentoring, science fairs and other activities in the community and area schools.

CHALLENGES
The College faces challenges; while some are rooted in departmental and campus culture, most are due to limited resources and pressure from dramatically increasing enrollments in STEM majors. Areas where challenges exist are:

**Faculty Recruitment, Retention and Development**
- *Need to increase diversity.* To better serve the citizens of the state and nation, the diversity of our faculty needs to be increased and we need to better foster a culture of tolerance, respect and appreciation to all.
- *Need to increase salaries.* Faculty salaries are not competitive with the private sector and other universities in most disciplines, providing recruitment, morale and retention challenges.
- *Need more significant startup packages.* New faculty in experimental science and engineering require support for specialized equipment, software, computers, and supplies and materials. Space needs and renovation of existing space is a challenge for some programs. Startup packages must be competitive for recruitment of the best faculty and for the success of their research programs.
- *Need more and better staffed shared instrumentation facilities.* Faculty need access to state-of-the-art instrumentation whether housed and maintained in departments or shared facilities to provide increased access to additional equipment not available to individual researchers through start-up. In some departments and in Scientific and Technical services, there is insufficient staff to adequately support instrumentation. Likewise, there are budget constraints to maintaining instrumentation.
- *Excessive time commitments.* Faculty who are awarded nationally-competitive external grants, such as the National Science Foundation (NSF) or the National Institutes of Health (NIH), have grant related responsibilities in addition to their normal load of teaching and service. Freeing time to support this research can conflict with class scheduling needs and service commitments. Likewise, in some programs, involvement in undergraduate and graduate student research is done as an overload, which is unsustainable as a workload long-term. If Western values faculty-mentored student research, we need to find ways to account for this in faculty workload.
- *Need more space.* We need more space for faculty research labs and offices
- *Need more consistent evaluation guidelines.* There are significant variations across the college in T and P standards, particularly in relation to scholarship.

**Staff Recruitment, Retention and Development**
- *Need to increase salaries and raise partial FTE appointments.* Although we have a dedicated staff committed to the university, salaries are comparatively low and raises infrequent, leading to significant recruitment and retention issues. Many staff are on partial (<1.0 FTE) appointments. This results in issues with scheduling, safety and coverage which are detrimental to department function and compensation related issues which reduce retention due to personal financial pressures.
- *Need more resources to support professional development.* To retain quality professional and classified staff, effective and sustainable mechanisms for additional training and advancement need to be put in place. Resources for these development activities are needed.
• **Need to increase diversity.** To better serve the citizens of the state and nation, the diversity of our staff needs to be increased.

**Student Support**

• **Inability to meet increased student demand in most programs.** Due to dramatically increased enrollments, there are significant access issues across most departments with significant waitlists for some courses.

• **Need more undergraduate support.** Higher levels of student scholarship funding, internship support and programs to help under-prepared students through good, area-specific tutoring are needed to help retain students in the STEM fields, particularly for under-represented and high-achieving students. This need is amplified for diverse students wanting to pursue an elementary or secondary STEM education degree and career. Another effective means of providing undergraduate support that builds on strengths is to provide more internally funded undergraduate summer research stipends.

• **Need improved admissions programs.** CSE departments overall need to have a better working relationship with the admissions office and a focused plan to help identify, recruit and retain talented students to our programs, particularly under-represented minority groups. The current partnership with Whatcom Community College and CSE/WWU to promote the success of STEM interested transfer students is a good start.

• **Need increased graduate TA and undergraduate LA stipends.** Stipends are lower than those of our competition, making it difficult to keep graduate programs strong and to attract the highest-quality graduate teaching assistants and undergraduate learning assistants. This also adversely impacts the quality of undergraduate instruction. Differential stipends between CSE departments is unhealthy and not justified – this historical practice should be eliminated.

• **Need more graduate tuition waivers.** Research assistants supported by external grants do not receive tuition waivers and out-of-state students face higher tuition rates, making it more difficult to attract top graduate students.

• **Need resources for increased support for professional development.** Increased funding is needed to support more students’ attendance at professional meetings and to support and sustain annual STEM teaching assistant and learning assistant development on student-centered inclusive learning..

• **Need more spaces for student-centered teaching.** More space is needed for larger lecture classrooms to enable course access and also for more spaces conducive to student-centered active learning techniques.

• **Need improved communication with community colleges.** Need improved communication with community colleges to enable better student transfer outcomes.

**Space**

• **Need increased office space for faculty and staff**

• **Need improved space allocations for faculty research.** Should be defined by the college and its departments.

• **Need more lab space to overcome enrollment limitations.** If enrollments are to be increased in our laboratory science departments, additional space for laboratory courses, lab prep, secure storage and research activity will be needed. Problems exist in most departments.
• **Need to upgrade buildings for some programs.** The classroom, office and laboratory spaces for geology and other departments need to be upgraded.

• **Need improved computational infrastructure.** The computing infrastructure for the college needs to be expanded and upgraded to support continued enrollment growth and technological advances.

• **WWU lacks a unified policy for staffing and supporting high-end laboratory facilities, including equipment repair – whether those that are housed in departments, or those that are multi-user facilities.**

• **Need a regular lab safety and audit/inspection process.** There needs to be an improved culture of safety and a regular lab inspection process.

**Diversity**

• **Need improved recruiting of under-represented groups.** Our faculty, staff and student body do not reflect the increasing demographic diversity of the state and nation.

• **Need increased support for minority students.** To attract and retain underrepresented students into STEM areas, more targeted scholarships, research stipends, advising, mentoring and support services are needed. For STEM education majors, this support might also include loan forgiveness programs (from the state) to support students’ teaching in high needs rural and urban schools.

**Curriculum Adequacy**

• **New engineering program will likely result in increased student numbers.** The new electrical engineering program at WWU is resulting in significantly increased student numbers. This will require front-end planning to ensure sufficient courses and class seats and student satisfaction and retention.

• **Offering limited upper division and graduate courses in some programs.** High student enrollments in several departments result in minimal offerings in upper division and graduate course areas and insufficient research and capstone course opportunities.

• **Need more faculty to provide increased depth in sub-disciplines.** Additional faculty are needed in selected areas to provide desired area coverage.

• **Too few small-course, student-centered approaches.** Increasing enrollments, limited faculty resources, and too few classrooms designed to promote group work, limit our opportunity to facilitate innovations in student-centered learning and thus maintain Western’s reputation for excellence in student-centered teaching and learning.

• **Need more new equipment/instrumentation and software.** To allow students to experience science and engineering at the “frontiers,” it is necessary to constantly upgrade and introduce new equipment, instrumentation and software.

• **Under prepared students.** There is a nationwide trend for students to be less adequately prepared for college level coursework in mathematics, sciences and engineering and design, requiring more remedial CSE courses to be offered and more faculty to support these courses, in addition to developing innovative approaches and partnerships with schools and community colleges.

**Program Financial Support**

• **Need increased external funding.** Many CSE needs, e.g., student stipends, travel support, require increased funding from grants and donors.
• **Low staffing levels in some areas.** Significant budget reductions resulted in low staffing levels and more part-time positions, weakening instructional programs.

• **Need to direct increased resources to high-demand programs.** It is difficult to reallocate university-wide internal resources to areas with significantly increasing enrollments, like CSE, from areas with flat or decreasing enrollments.

**OPPORTUNITIES**

Because of the rapid advances in STEM areas and the high demand for graduates in these areas in the State and country, there will be exciting and numerous opportunities for CSE to be innovative. As State needs for science, mathematics and engineering, and mathematics and science education training increases, CSE will pursue opportunities at targeted and decision package funding eg., additional support to offset access issues, new interdisciplinary programs in data mining and statistics, or collaborative programs in engineering and computer science at satellite campuses, and development of Computer Science and Engineering endorsements for K-12 teachers. Activities for CSE to pursue are:

**Students**

• *Increasing opportunities for our students through better job placement and more internships, industry-sponsored senior projects and service learning opportunities.*

**Curriculum**

• *Increased interdisciplinary programs and intercollege collaborations.* Given the expertise we have, development of more interdisciplinary programs should be pursued eg., computational science minor.

• *Development of interdisciplinary upper division courses.* There are opportunities to develop upper division electives or graduate courses that could serve multiple majors across CSE eg. a course in electron microscopy.

• *Expanding interdisciplinary participations in emerging areas like the Institute for Energy Studies and the Marine Sciences program.*

• *Development of new graduate programs.* Potential to introduce professional science masters programs, an area of growing need regionally and nationally, and 3+2 joint undergraduate/masters programs at WWU eg. a BS in Physics or Chemistry and a Masters in Electrical Engineering.

• *Adoption and integration of a formative assessment culture, including alum and employer feedback.* Will provide needed input to support refinement and development of timely and modern curriculum.

• *Make student-centered, inclusive learning the “norm” in CSE and at WWU.* With C-Core we have begun the process of building a critical mass of STEM faculty and TAs in each CSE department engaged in student-centered, inclusive learning. With continued support for New Faculty and TA workshops, plus policy and practice changes at the College and Department level we have the opportunity to become one of the first universities in the nation where student-centered, inclusive learning is the norm. There should be more engagement in active learning techniques by faculty across the college to improve student learning outcomes.

• *Increase culture of globalization.* Engage CSE students in understanding and working with complex systems in an interconnected world. Integrate diverse perspectives and
ways of thinking (e.g. economic, environmental, and societal) into science and engineering curricula.

- **Increased student retention.** Revision of introductory courses and adoption and implementation of research-based, high impact practices and student-centered pedagogies to improve retention of STEM majors.
- **Consistency in teaching load assignments.** Establish a more uniform and equitable model of course credit for courses and labs across CSE to increase teaching effectiveness and research productivity.
- **Teaching credit for research supervision.** To enable faculty to engage in more research with students, we need to find a way to account for this type of teaching work into teaching workload calculations. This may include establishing minimum expectations for student outcomes across the college.

**Resource Development**

- **Development of a matching fund pool.** A pool of matching or challenge funds for new equipment could provide significant dividends.
- **Grow research/scholarship culture.** CSE will provide support to build a culture that includes a reasonable level of scholarship and publication by all faculty, within a teacher-scholar model.
- **Increase faculty participation in external funding.** Support faculty to write proposals and generate increased external support to increase student involvement in research. With funding from multiple colleges, greater return on ICR funds, and development of a long-term business/sustainability plan, a Center for Education Research, Evaluation, and K-16 Professional Development could provide this support to CSE faculty as well as Huxley, Woodring, and other WWU faculty.
- **Increase indirect cost recovery and overhead.** Increased return of ICR funds from external grants from RSP to CSE, its departments and PIs, and examination of appropriate overhead costs to more closely align with current practices at other institutions.
- **Identify naming opportunities for CSE facilities.** CSE will identify various facilities within the College that could be named for contributors of significant gifts.
- **Engage in increased development.** CSE will reach out to the community to raise increased funds for programs like student research and travel.

**Community Outreach**

- **Develop off campus programs.** In partnership with community colleges.
- **Develop more open houses and service learning opportunities.**
- **Support the Technology Development Center (TDC).** Working in concert with the Port of Bellingham, Bellingham Technical College and Whatcom Community College, CSE can develop a working shared research space that supports innovation and community partnerships, and provides new scholarship opportunities for students and faculty eg., a joint plastics and composite lab and curricular programming.
- **Support science and mathematics education programs.** With the Next Generation of STEM Teacher Preparation in Washington State (NextGen-WA) project we are expanding our programs and reach, building new collaborations with our sister
institutions of higher education, and taking on increased leadership in STEM education reform and professional development for STEM educators in the region and state.

**Diversity Enhancement**
- *Develop more programs with community colleges and high schools.* Through development of recruiting programs, cooperative mentoring efforts and targeted transfer programs with community colleges and high schools, we can better access traditionally underserved students. Examples include the 2+2 program in Cybersecurity with Whatcom Community College, potential 2+3 engineering programs with Bellingham Technical College and student exchanges with Northwest Indian College.
- *Improve advising.* Through improved communication and working relationships with advising programs at community colleges and high schools, ensure prospective STEM students are math-ready when they come to WWU and community college transfer students have taken the AST degree and not the AA or AA-DTA degree (which does not prepare them to be junior level STEM majors).
- *Increase student mentoring systems.* Increased involvement of CSE students in programs developed to recruit students from underrepresented groups into science, mathematics and engineering and design, for example the Compass to Campus Program. To improve student retention, upper level CSE students could be recruited to mentor struggling lower level students.
- *Increase other services for students.* Connect students to peer study groups, the tutoring center, and student organizations like SACNAS.

**THREATS**
CSE faces threats that are both external and internal. State revenue shortfalls and the resulting potential reduction of funding to Western pose the most serious threats to our programs. Other threats include new engineering programs at other institutions in the region. The current internal funding model at WWU that does not increase resource allocation to programs with increasing enrollments is an internal threat. Reduced funding decreases the quality of our educational programs and student success rates through:

- **Number of tenure track faculty and staff positions not keeping pace with enrollments.** This would result in increased time to graduation, reduced student research opportunities, limited access to the majors, lack of departmental rejuvenation/rebuilding, reduced new interdisciplinary program initiatives, reduced time for scholarship, fewer grants and publications, reduced labs and advising support.

- **Non-competitive faculty salaries and start-up.** If we are to compete with the best comprehensive universities, we need to continue our efforts to bring faculty salaries to more competitive levels. New faculty in experimental science and engineering require support for specialized equipment, software, computers, and supplies and materials. Our inability to fund competitive startup packages will reduce our ability to recruit new faculty into areas like biology, chemistry, geology, engineering and physics.

- **Obsolete and inadequate instrumentation and software.** This hinders our ability to attract and retain the best faculty and negatively impacts the students’ experience.
• Reduced library journal holdings

• **Weakened graduate program due to low graduate student stipends and out-of-state tuition for grant funded RAs.** This would result in
  - **Reduced quality of introductory courses.** The quality of introductory courses with laboratories will be significantly diminished if there are high enrollments with fewer graduate teaching assistants, as departments will first attempt to preserve the quality of curriculum in the upper level courses. Introductory labs will become less hands-on and less able to teach critical analysis and quantitative skills.
  - **Reduced faculty research.** Many CSE faculty depend upon graduate students for sustaining research. Another aspect is that many of the quality faculty we recruit come to WWU to participate in a quality graduate program – without this, we would not be as competitive for faculty in certain fields.
  - **Reduced undergraduate research.** Many undergraduates are directly involved in research projects with graduate students.
  - **Lower recruitment of under-represented groups.** Fewer opportunities for recruiting first generation college students, as near-peer graduate students can act as more accessible mentors than many faculty. In some programs, such as Geology, the MS students, who are recruited nationally not internally, are more diverse than the undergraduate population.

• **Inability to recruit and retain qualified professional and technical staff**
  - **Low salaries.** High quality staff are essential to any well-functioning department. If our goal is to compete with the best comprehensive universities nationally, it is necessary that our staff be offered more competitive salaries.
  - **Staff travel/professional development.** If our staff are to be current in their fields, we must provide adequate support for travel to conferences or training participation/attendance.
  - **Increasing workloads.** As staffing budgets continue to be cut or stay stagnant, staff workloads increase and quality and safety can be at risk.
  - **Maintenance of vital/expensive equipment and computational tools.** Not having trained professionals to maintain and supervise use of key equipment/instrumentation could compromise student safety and equipment availability in laboratories. Lack of maintenance on equipment puts us at risk for great expense for equipment replacement, which cannot be accommodated by current operating budgets.
  - **State classification system.** As interpreted by WWU’s HR, this makes career advancement difficult for staff.

• **Inadequate space for growth and weakened infrastructure**
  - **Disconnect between capital space planning and operating/academic budget plans and processes.**
  - **Ability to recruit faculty.** If we cannot supply modern space for faculty to conduct teaching and research, we cannot recruit and hire competitively.
• Acquisition of instrumentation/equipment and software. To have state-of-the-art programs in laboratory, instrumentation, and computer intensive areas, we must provide support for high quality and modern facilities housing modern instrumentation and associated computational tools.

• Reduced ability to maintain laboratory equipment. A reduction in operating budgets for departments and CSE will impact our ability to maintain and repair instrumentation in teaching and research laboratories.

• Reduced teaching capacity. Insufficient lab space will result in limited access to lab classes and increased time to graduation.

• Lack of diversity.
  o The changing demographic breakdown of the state and country results in the concomitant need for CSE and WWU to adapt to a changing student body through increased diversity of the faculty, staff, curriculum and campus.