1 Introduction

This guide is written for advising undergraduate engineering students at Wichita State University matriculating in Fall 2007 or later. This document is intended to inform students and their advisors in understanding the structure and philosophy of the Engineer of 2020 program at Wichita State University. The college hopes that you will find the document helpful.

Students are expected to assume an active role in ensuring that, upon graduation, all program requirements are completed. The advising process is improved when the student is prepared for the advising session. With advice from the advisor, students should track their progress and plan their course work before the advising session. Students who anticipate problems in completing requirements or have special concerns should plan a special meeting with their advisor before the regular advising session. Finally, it should be noted that the advice in this document is not intended to replace existing advising guides.

2 Motivation

The College of Engineering (CoE) at Wichita State University (WSU) has launched a strategic initiative, *Engineer of 2020*, in order to prepare graduates for effective engagement in the engineering profession in the year 2020. This initiative is in part motivated by two reports from the National Academy of Engineering, of the National Academies, entitled *The Engineer of 2020* and its follow-on *Educating the Engineer of 2020*. These reports, written by two groups of distinguished educators and practicing engineers from diverse backgrounds, were developed in response to a concern that engineering students of today may not be appropriately educated to meet the demands that will be placed on the engineer of the future, without refocusing and reshaping the undergraduate engineering learning experience. In the first report, the group provided guiding principles that will shape engineering activities in 2020:

- The pace of technological innovation will continue to be rapid.
- The work in which technology will be deployed will be intensely globally interconnected.
- The population of individuals who are involved with or affected by technology (e.g., designers, manufacturers, distributors, users) will be increasingly diverse and multidisciplinary.
- Social, cultural, political, and economic forces will continue to shape and affect the success of technological innovation.
- The presence of technology in our everyday lives will be seamless, transparent, and more significant than ever.

The report also states that in order to successfully educate engineers who can effectively contribute in this changing landscape, engineering educators will have to produce graduates who will:

- possess strong analytical skills;
- exhibit practical ingenuity;
- be creative;
- have good communication skills;
- be mastered in the principles of business and management;
- understand the principles of leadership;
- have a strong sense of professionalism and ethical standards; and
- be lifelong learners.

In response to this challenge, the CoE at WSU wishes to establish its leadership in reshaping the undergraduate experience to prepare the engineer of 2020, and at the same time make the educational experience more meaningful to the student and the student more desirable to local and national industries. As such, the CoE now requires that to fulfill the requirements for an Engineering BS degree at WSU, each student will complete the program course requirements including at least **three** of the following six activities:

1. Undergraduate Research
2. Cooperative Education or Internship
3. Global Learning or Study Abroad
4. Service Learning
5. Leadership
6. Multidisciplinary Education

3 Definitions

Students must follow the process shown to ensure the successful completion and documentation of each criteria met.

Undergraduate Research: Students work under the supervision of a faculty member either as an undergraduate research assistant for one semester or perform an independent study. The faculty supervising the undergraduate research approves the activity and signs the form.

Cooperative Education/Internship: Students work 40 hours per week for two semesters or 20 hours per week for four semesters. Students may intern or have other work experience to meet this requirement. The activity is evaluated by the department and the department coop coordinator signs the form.

Global Learning/Study Abroad: Students participate in a global learning project within a class at WSU or complete credit bearing classes in a foreign country. The faculty teaching the global learning class or the Office of International Programs approves the activity and signs the form.

Service Learning: Students participate in a project in a credit-bearing class that serves the community's needs as part of the engineer's responsibility to society. The faculty supervising the service learning approves the activity and signs the form.

Leadership: Students participate in formal instruction and lead a project or have previous leadership experience. The student completes a project report and submits to the Director of Engineering Education.

Multi-Disciplinary Education: Students obtain a minor or second major outside their engineering discipline. The student submits a form to the Director of Engineering Education documenting completion of this criterion.

Detailed descriptions of each of the criteria is located in the appendix.

4 Process

Students are responsible to follow this process to ensure that activities meet the requirements of each criterion. The statements below describe who is responsible for approving each activity.

Undergraduate Research: The faculty supervising the undergraduate research approves the activity and signs the form.

Cooperative Education/Internship: The activity is evaluated by the department and the department coop coordinator signs the form.

Global Learning/Study Abroad: The faculty teaching the global learning class or the Office of International Programs approves the activity and signs the form.

Service Learning: The faculty supervising the service learning approves the activity and signs the form.

Leadership: The student completes a project report and submits to the Director of Engineering Education.

Multi-Disciplinary Education: The student submits a form to the Director of Engineering Education documenting completion of this criterion.

5 Advising Plan

Each student, in collaboration with their advisor, should prepare a plan for completing the requirements for graduation. This plan should explicitly describe the three criteria the student plans to complete and the method for satisfying the requirements for each criterion and the semester of completion.

A proposed approach is outlined in the steps below:

1) Determine which 2020 criteria are of most interest
2) Determine when the 2020 criteria are available
3) Complete the requirements

Some example plans are listed below:

2020 Plan for Student A (entering freshman Fall 2007)

1) In Fall 2008, begin Cooperative Education Track (sophomore year)
2) In Spring 2009, complete second cooperative education semester
3) In Fall 2009, complete third cooperative education semester (junior year)
4) In Spring 2010, complete fourth cooperative education semester [coop criterion completed]
5) In Spring 2010, complete the HNRS 152F class and submit a report on a completed project [leadership criterion completed]
6) In Fall 2011, complete a service learning senior project [service learning criterion completed].

2020 Plan for Student B (entering freshman Fall 2008)

1) In Fall 2008, complete a service learning introduction to engineering (ENGR101) project [service learning criterion completed]
2) In Spring 2010, complete an undergraduate research project [undergraduate research criterion completed]
3) In Spring 2010, complete the Manufacturing Engineering Minor [multi-disciplinary criterion completed]

2020 Plan for Student C (transfer student Spring 2008)

1) In Spring 2009, complete a semester abroad [study abroad criterion completed]
2) In Spring 2010, complete the Mathematics Minor [multi-disciplinary criterion completed]
3) In Fall 2009, complete a leadership class at the company the student is employed as an intern and complete a reflective report on a leadership project [leadership criterion completed]

6 Summary

The engineer of 2020 program at Wichita State University is an integral part of the graduation of engineers in high demand by industry. Planning for the completion of the criteria by each student will ensure the smooth implementation of the program.

- **Appendix A**

Engineer of 2020 - Criteria

I. Undergraduate Research

Undergraduate Research is defined as students working under the supervision of a faculty member, either as an undergraduate research assistant, for one semester, or performing an independent study.

To satisfy the Undergraduate Research criteria each student must complete one of the following:

1. One full semester as an undergraduate research assistant to a faculty member. The student must also submit/apply to undergraduate research symposium forum.

2. An independent study, under the guidance of a faculty member, performing a comprehensive and critical literature review of an emerging area of research (analysis/synthesis of the current state of knowledge in that area). Required documentation:

The proposal must be approved by the faculty advisor, contain a description of the research tasks including items from the discipline specific body of knowledge, and must identify one or more of the ABET criteria involved in the research task. The final report must include: problem statement, objectives, the method, possible solutions, selection of final recommendations, and engineering skills/techniques used. Students who wish to use this criterion will be encouraged to make contact with faculty in their desired area of research during their sophomore year.

II. Cooperative Education or Internship

Cooperative Education/Internship is, as its name implies, students obtaining practical experience working for an employer using skills and knowledge learned in coursework at WSU.

To satisfy the Cooperative Education or Internship criteria each student must complete one of the tracks listed below. Students who wish to use this criterion will be encouraged to contact the Office of Cooperative Education during the first semester of their sophomore year or during the summer immediately following their freshmen year. Students will complete the orientation process and will need to meet the program requirements established by the College of Engineering. Completion of the orientation requirements for the program will not guarantee job placement.

Employers who participate in cooperative education with WSU are asked to agree to a statement of understanding, provided in Appendix C of this document.

After the official co-op track is developed, as part of this strategic initiative, WSU will apply for accreditation through the Accreditation Council for Cooperative Education (ACCE) during the academic year 2007-08.

Cooperative Education Track

To successfully complete the co-op track, students will:

- Complete two to four semesters of co-op work sessions, including no more than two summer semesters using the following models:
  - Alternating positions require a multiple-semester commitment and 40 hours per week
    - Alternating placements: Full-time work placements alternating with full-time classroom study. Two semesters totaling at least 30 weeks.
  - Parallel positions require a multiple-semester commitment and 20 hours per week
    - Parallel placements: Half-time work placements coupled with at least half-time classroom study. Four semesters totaling at least 60 weeks.
  - Combination Alternating/Combination Parallel
    - Combination Alternating plans meet the defining features of full-time alternating models, in addition, they include one or more parallel components. Combination Parallel plans meet the defining features of parallel models; in addition, they include one or more periods of non-alternating full-time work. Combinations of parallel and full-time work-experience could be (1) full-time coupled with (2) part-time placements resulting in the approximate equivalent of 30 full-time workweeks.

- Enroll in one credit hour of co-op during each of the semesters
- Earn two to four hours of co-op credit that count toward their technical elective requirement
- Establish a relationship with a faculty advisor to ensure a connection between topics learned in the classroom and skills used on the job
- Complete co-op academic requirements, as established by each department**,** during each semester of enrollment
- Maintain the minimum GPA (3.0) established by the College during all four semesters. Students who fall below the GPA requirement will be placed on co-op probation and will have one semester to raise their GPA.

Students will be strongly encouraged to work for the same employer during all work sessions.

A co-op endorsement will be noted on a student's transcript if the University records satisfactory performance during all work sessions and the student meets all co-op requirements.

Internship Track

To successfully complete the internship track, students will:

- Complete at minimum two semester-long internships; summer counts as a semester
- Enroll in one credit hour of internship credit during each of the two semesters
- Earn two hours of internship credit to count toward their technical elective requirement
- Establish a relationship with a faculty advisor to ensure a connection between topics learned in the classroom and skills used on the job
- Complete internship academic requirements, as established by each department**,** during each semester of enrollment
- Maintain the minimum GPA (3.0) established by the College. Students who fall below the GPA requirement will be placed on internship probation and will have one semester to raise their GPA.

Students will be encouraged to intern at different employers during each semester.

An internship endorsement will be noted on a student's transcript if the University records satisfactory performance during the two work sessions and the student meets all of the internship requirements.

Combination Track

Some students desire the opportunity to have a variety of work experiences. The Combination Track will address these students' needs. To successfully complete the combination track, students will:

- Complete at minimum two semesters of co-op work sessions and a one-semester internship
- Enroll in co-op/internship course during each semester of work experience
- Earn three hours of internship credit to count toward their technical elective requirement
- Establish a relationship with a faculty advisor to ensure a connection between topics learned in the classroom and skills used on the job
- Complete co-op/internship academic requirements**,** as established by each department**,** during each semester of enrollment
- Maintain the minimum GPA (3.0**)** established by the College during all three semesters. Students who fall below the GPA requirement will be placed on internship probation and will have one semester to raise their GPA.

Students will be encouraged to spend their two semesters of co-op working with one employer and their one semester of internship working with a different employer.

An endorsement will be noted on a student's transcript if the University records satisfactory performance during the work sessions and the student meets all of the co-op/internship requirements.

Industrial Experience Track

Some students work with employers who have yet to form a co-op or internship agreement with WSU. The Industrial Experience Track provides these students a means by which to validate their industrial experience as fulfilling the co-op and internship criteria. A valid work experience will involve the application of engineering principles and must be approved by the student's academic department. This track does not provide academic credit hours toward degree. To successfully complete this track, students will:

- Submit a proposal, that identifies the work experience, to their academic department for approval
- Complete at minimum two semester-long (full time) or four semester-long (part time) approved work experience; summer counts as a semester
- Establish a relationship with a faculty advisor to ensure a connection between topics learned in the classroom and skills used on the job
- Complete internship or co-op academic requirements, as established by each department**,** during each semester.

III. Global Learning or Study Abroad

Global Learning/Study Abroad is defined as WSU student involvement with other students residing in a foreign country.

To satisfy the Global Learning or Study Abroad criteria each student must complete one or more of the following:

1. Successfully participate in a global learning project within an existing class; this will typically involve internet-based communications with students, teachers, and colleagues in at least one other country. Global learning projects must include at least one participant from outside the English-as-a-first-language world (e.g. Russia, Japan, China) to be eligible.

2. Successfully complete a study abroad component; this involves participating in a credit-bearing, university-approved study abroad activity in a foreign country.

   Note: Students possessing an F-1 VISA qualify for this criteria and must submit a form to the Director of Engineering Education.

3. Submit a previous global learning or study abroad experience; in this case, the student must prepare a two-page report outlining:

- Summary of previous experience, including dates and locations
- Description of the student experience (typically a reflective paper, though not restricted to this)
- Contact information of faculty/sponsors involved in the global learning experience

Global Learning

Global learning is defined as the combination of global reach, achieved with modern communication technology, and global perspectives arising from interaction between students living in different countries, to educate the global citizen.

Features of global learning include:

- An authentic and substantive goal, such as producing a design for a client or solving an engineering problem
- Working in a team with people living in other countries or with a client from another country
- A focus on requiring the students to learn more about culture through improving their intercultural communication competence
- Opportunities for professional presentation of the global learning experience

Integration of global learning into an engineering course involves changes to the learning strategy, taking it from a didactic/pedagogical approach to a heutogogical[1] approach that involves autonomous learning. Typically, students will need to learn in a team towards some substantive and authentic goal. In the process, they must be able to communicate effectively. That, in turn, requires them to understand the perspectives of each other and themselves, improving their intercultural communication competence.

Examples of global learning are:

ME 662. A senior design course in which students develop a design for a foreign sponsor or to work in multicultural teams for a foreign sponsor. Currently involves Russia and India.

IME767. Lean Manufacturing – students interacting with others from overseas institutions to improve the efficiency of a manufacturing line, using virtual reality

[1] Heutagogy (often interpreted as a theory of self-determined learning) recognizes that the learning environment needs to be flexible and provide conditions for self-directed (autonomous) learning. In the educational setting, to better meet needs of a learner, the teacher provides goals and resources but the actual course of learning is more flexible and negotiable. In the context of the WSU Engineer of 2020, providing choices for students (selecting three out of six possibilities) is a good example. Furthermore, current learning theories put more emphasis on experiential learning ("learning by doing"). That idea is integrated in the concept of "heutagogical learning" (Alagic, 2006).

software.

Robots Around the World – designed in increase interest in engineering and science in schools through a competition for LEGO robotics designs, extended to involve people in other countries.

Study Abroad

Study abroad is defined simply as participating in a program of study overseas. The program must be approved by the Office of International Education and the student's advisor, and any courses taken must be approved by the College of Engineering for course credit toward the student's academic program. In general, the course should be for-credit and should be one semester in length or equivalent.

IV. Service Learning

Service learning is broadly defined by the following:

1. It is an educational experience that is course-based and credit-bearing.
2. Is an organized service activity consisting of an intentional and thought-provoking application of classroom learning to active and engaging work by participating in a group project that meets identified community needs.
3. It includes structured reflection on the service activity to gain further understanding of course content, a broader appreciation of the discipline, and an enhanced sense of civic responsibility (Bringle & Hatcher, 1995; Totten & Pederson, 1997).
4. A *Community* is broadly defined and opportunities for service can address a wide variety of community needs.

To satisfy the curricular requirements of Service Learning, each student will complete one of the following:

1. A project that meets the criteria of service learning as a significant component of a one-semester, for-credit existing course. For example, two existing courses that could have service learning options are Engineering 101 and the Senior Design Class.

2. A one-semester, for-credit Independent Study course that meets the criteria of service learning. Each student will enroll in the Independent Study course of their major, and will work in multidisciplinary, cross-College teams. Each student will have a faculty mentor from their home department.

Request for Proposals

The process of selecting community service projects will include two major steps:

1. Solicitation of Community Service Project requests. A process for requesting proposals from the community will be developed, and will involve other campus

entities as appropriate. For example, the Cooperative Education Program and other campus entities (for example, the School of Social Work) can help identify potential community partners. Solicitation materials can include examples of the types of projects that would meet the goals of service learning.

2. Selection of Community Service Projects can proceed by way of committee review of proposals, with selection based on overall quality of the proposals in terms of:
    a. potential to meet a community need
    b. potential to further student learning
    c. feasibility in terms of skills and time required for completion

V. Leadership

Leadership is defined as the knowledge and practice of skills necessary to lead a team to accomplish a common goal.

To satisfy the Leadership criteria each student must:

1. Take some formal instruction on leadership
2. Propose and demonstrate a leadership experience
3. Submit a short report on the experience.

Leadership Instruction

Leadership instruction is necessary in order for the student to gain the skills necessary to be an effective leader. If a student had already demonstrated leadership in some role or activity and submitted a report documenting the experience, then this requirement could be waived. The course/workshop should have the following objectives:

Students will be able to:

1. Demonstrate the ability to communicate leadership knowledge verbally and in writing.
2. Critically examine, explore, and evaluate the usefulness of leadership concepts.
3. Demonstrate effective team leadership skills.
4. Regularly assess one's knowledge base and skills, and seek additional information to build leadership capability.
5. Recognize and value the role of life-long learning, self-assessment, and critical thinking in leadership development.

There are three present courses at WSU that will qualify:

1. PSY 346 (same as PHS 308), *Leadership in Self and Society*, which will count as a General Education SBS issues and perspectives course.

2. HNRS 152F, *Leadership: Personal and Organizational Challenges for Change*.
3. MGMT 360, Management and Organizational Behavior, which will need to count as a program TE (IME already does this)

Two more options should be considered as a future possibility:

1. Develop a leadership course within the College of Engineering that would count as a program TE.
2. Develop a leadership course for engineers outside the College of Engineering. Possibly College of Education or College of Heath Professionals.

Leadership Experience

This could be any activity or experience that demonstrates leadership and does not have to be confined to university activities. A wide variety of experiences exist including Eagle Scout projects, community or faith based projects, and leadership in student and professional societies. The experience must be first proposed in order to be sure that it qualifies. Note that a leadership position in a student professional society may qualify for this experience, but simply because a student is in a leadership position does not necessarily constitute a leadership experience. The student experience should include a demonstration of most of the following skills:

1. Effective Communication
2. Ability to Manage and Influence People
3. Organization
4. Planning
5. Critical Thinking
6. Decision Making
7. Team Collaboration
8. Life-Long Learning

Report

The report is necessary to document and validate the leadership experience – especially true if the experience is outside the university. The report should describe how the student demonstrated the skills outlined above and include a section on how the student thinks that the experience will benefit them in their future engineering profession.

For students claiming an outside leadership experience to satisfy the criteria, a reference letter must be included in the report. For students who are in a leadership role, a mid-semester report or check should be conducted in order to make sure that adequate progress toward the criteria is being met.

VI. Multi-Disciplinary Education

Students are multi-disciplinary if they grow academically in areas outside their engineering majors.

1. To satisfy the multi-disciplinary experience, each student will obtain a minor or second major[1].

Notes:

Obtaining a two year Associates Degree along with a Bachelor's engineering degree DOES NOT constitute a multi-disciplinary education