

Professional Responsibility and Leadership in Engineering Education at the University of Texas at Austin and Peer Institutions: An Overview

Christene Moore and Hillary Hart

College of Engineering, University of Texas at Austin

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Purpose Statement

In an endeavor to foster leadership and collaborative skills and an awareness of professional responsibility in engineering practice, the Chair for Free Enterprise at the University of Texas at Austin (UT) has funded the PRIME project. The overall goal of the project is to compile and develop web-based teaching materials and pedagogical approaches that address issues in three learning areas: leadership, information ethics, and professional responsibility. A preliminary step to creating those materials is an evaluation of the state of pedagogical practice in these areas. Ultimately, that evaluation will involve a review of literature on those topics, a critical analysis of curriculum at peer institutions, and an assessment of which aspects of these curricula are most effective. Our goal at this moment is to determine, before we embark on the task of creating teaching materials, how the UT College of Engineering can best contribute to the field.

In this document, we take the first step in that preliminary endeavor by collecting initial data on curriculum at the University of Texas and several peer institutions. For this portion of the project we have compared curricula in the UT College of Engineering to curricula at eleven peer institutions. Our review of all the institutions has been based largely on information that can be located on the web such as curricular requirements and policies published by the registrar or departmental undergraduate offices and on course web pages. In this phase of the project we have tried first to determine some pedagogical trends and priorities by quantifying course requirements and offerings. We have identified two broad categories related to our areas of interest that are generally associated with courses and pedagogical endeavors in those areas. Those categories, which we have used as the foundation of our research, are as follows:

- Collaboration/Leadership
- Professional Responsibility

These categories are purposefully broad enough to encompass many sorts of courses and resources. Although we intend ultimately to make a critical and qualitative analysis of particular course offerings to determine the scope, emphasis, and importance placed on these topics, our research for the purposes of this document has been limited to a scoping study using simple quantitative measures. Hence, we have sought to identify courses offered at the University of Texas and peer institutions that involve those topics. We have further distinguished required courses from electives. This preliminary analysis will allow us to identify the priorities in our own institution and peer institutions and will guide us in the next phase of the evaluation which will be an investigation of specific courses and an analysis of pedagogical approaches to incorporating the broad topics of professional responsibility, leadership, and information ethics into engineering curricula. The report that follows is a bird's eye view of our research results.

Methodology

For information on UT, we relied on self-study documents from each engineering department as well as curriculum information from departmental websites. For information on peer

institutions, we used online materials exclusively, looking at the various engineering departments' curricular requirements, electives, and course descriptions. This study is limited to undergraduate curricula in engineering departments and those courses offered within engineering departments only. Additional resources available to, but not necessarily a part of, engineering departments are noted in the "Overall Evaluation" section below.

Table 1 shows the number of courses in each institution, both required and elective, that fit the two categories we have defined. Based on their titles and course descriptions, Professional Responsibility courses are those that focus on law, ethics, and the social implications of technological development. Collaborative/Leadership courses denote classes that teach the process of collaboration and effective team work, leadership skill and/or problem solving methods. While all of the institutions examined offer classes in which collaboration and leadership play a part, the courses surveyed in this evaluation are those that emphasize the act of group learning or leadership skills as a focus of the course objectives. Table 2 provides the names of the courses we counted under each category, while Table 3 presents a sample of departmental and course webpages that were surveyed for this project..

Professional Responsibility at Peer Institutions

Only four universities, Stanford, Georgia Tech, UC Berkeley, and Michigan, require a course in professional responsibility. All peer institutions have elective courses in this area, except Case Western, which offers no engineering courses that focus on professional responsibility. Sample course titles under this heading include the following: *Inventions and Patents* (MIT); *Technology, Law, and the Working Environment* (MIT); and *Ethics and Public Policy* (Stanford). This is by no means an exhaustive list. Stanford University offers the most elective courses on professional responsibility, with 16. Some of Stanford's elective courses include *Legal Context of Civil Engineering*; *Architecture, Urban Planning, and the First Amendment*; *Technology and the Evolution of Human Consciousness*; *Technological Visions of Utopia*; and *Computers, Ethics, and Social Responsibility*. See the complete list of courses in Table 2.

Collaboration and Leadership at Peer Institutions

Peer universities have no required courses on collaboration or leadership. Moreover, our findings indicate that the number of elective courses that focus on the art of group collaboration is small at peer institutions. Sample elective courses under this category include the following: *Group Studies* and *Group Research* (Berkeley), *Cases in Personality, Leadership, and Negotiation* (Stanford), and *Sophomore Participation in Engineering Projects in Community Service* (Purdue). Cornell, MIT, Purdue, Stanford, UC Berkeley, and Illinois are the only institutions that teach collaboration as a separate skill set. See the complete list of courses in Table 2.

At peer institutions, leadership and collaboration are not taught as a separate skill set in any required classes and are only featured in a few elective courses. Instead, collaboration and leadership are ancillary methods utilized but not developed as skills in design classes, labs, and engineering communication classes.

Overall Evaluation: UT in Relation to Peer Institutions

At UT, professional responsibility is addressed in the required *Engineering Communication* course, but it is not the focus. Additionally, several College of Engineering electives focus on

exploring the social and environmental implications of engineering innovations. Elective courses such as *Readings in Engineering, Technology and Society*, and *Legal Aspects of Engineering* probe specific professional and philosophical issues about the role of engineers in society. Not all engineering departments at UT, however, offer elective courses with a substantial social component, and students in Biomedical and Aerospace Engineering, for instance, must seek this training outside their home departments. None of the engineering curricula *require* a course in professional responsibility.

Like peer institutions, there is lack of collaboration and leadership courses at UT. However, a couple of courses, such as *Engineering Communication* and senior design courses, peripherally address these skills. In general at UT, collaboration is taught through activities and projects instead of a separate skill set and there are no courses offered that focus explicitly on the art of collaboration or leadership. Other resources that touch upon the themes of professional responsibility, collaboration, and leadership are the UT Engineering Portfolio Page and *Undergraduate Engineering Review* at UT.

Most institutions, including UT, rely upon resources outside the engineering departments to develop professional responsibility, collaboration, and leadership. MIT and Stanford, for example, offer programs in Science, Technology and Society (STS is actually a department at MIT). Using these other programs and departments, Colleges of Engineering at MIT and Stanford more actively integrate the humanities into their engineering curricula. UT has recently established an STS concentration within Liberal Arts, though these courses are not yet approved for engineering electives.

Case Western Reserve's On-Line Ethics Center, founded by Carolyn Whitbeck, is an expansive resource for engineering ethics and law. Moreover, Wisconsin offers a department in Engineering Professional Development where students can take courses such as *Intermediate Technical Japanese* and *Technical Communication*. And Cornell has its own Engineering Communication Program, which offers courses and assistance on professional development.

In conclusion, some peer institutions such as UC Berkeley, Michigan, and Stanford, have at least one required course in professional responsibility and also make available several electives, both within their College of Engineering and through affiliated departments. At UT, there is no required course in professional responsibility, and the number of degree-program electives is relatively small. UT should consider developing a required professional-responsibility course and should increase the number of acceptable ethics electives both within the department and through interdepartmental listings.

Note: The full report, of which this document is a summary, may be obtained by contacting Hillary Hart:
hart@mail.utexas.edu

Table 1. Summary of Coursework in Engineering Departments on Professional Responsibility, Collaboration, and Leadership at UT and Peer Institutions

<http://www.ce.utexas.edu/prof/hart/research.cfm>

University	# Required Courses on Professional Responsibility	# Electives On Professional Responsibility	# Electives on Collaboration or Leadership
Case Western Reserve	0	0	0
Cornell U.	0	6	1
Georgia Tech	1	5	0
MIT	0	9	1
Purdue U.	0	3	2
Stanford U.	1	16	1
UC Berkeley	1	2	1
U. Ill. at Urbana-Champaign	0	4	1
U. North Carolina	0	2	0
U. Michigan	1	7	0
U. Wisconsin	0	2	0
U. Texas at Austin	0	4	1

Table 2: Courses on Professional Responsibility and Collaboration at UT and Peer Institutions

	Required Courses on Professional Responsibility	Elective Courses on Professional Responsibility	Required Courses on Collab.	Elective Courses on Collaboration
Case Western Reserve	none	none	none	none
Cornell Univ.	none	Engr for a Sustainable Society; Engr Entrepreneurship, Management & Ethics; Technology in Society; Components and Systems—Engr in a Social Context; Engr in American Culture; Ethics and Technology	none	Project Management
Georgia Tech	One—May choose from a wide variety of courses both within and outside of the College of Engineering. See Appendix.	Engr Ethics; Legal Issues—Tech Transfer Study; Construction Law; Project Engr & Prof. Practice; Polymers Textile Fiber Engr—Safety and Ethics	none	none
MIT	none	Colossal Failures in Engr; Project Evaluation; Applications of Technology in Energy and the Environment; Materials in Human Experience; Inventions and Patents; Technology Development and Evaluation; Technology, Law, and the Working Environment; Management in Engr; Engr Risk-Benefit Analysis	none	Communication Skills and Human Relations
Purdue Univ.	none	Legal Aspects in Engr Practice; Environmental Law for Engineers; Legal Aspects of Surveying	none	Sophomore Participation in Engr Projects in Community Service; Junior Participation in Engr Projects in Community Service
Stanford Univ.	One—Technology in Society Requirement. See Appendix; Legal Context of Civil Engineering (Req. for Certain CEE majors)	Environmental Science and Technology; Fail Your Way to Success; Architecture, Urban Planning, and the First Amendment; The Coming of the Energy Revolution; Environmental Regulation and Policy; Technology and the Evolution of Human Consciousness; Technological Visions of Utopia;	none	Cases in Personality, Leadership, and Negotiation

		The Two Cultures—Bridging the Gap; Computers, Ethics, and Social Responsibility; International Environmental Policy; Work, Technology, and Society; Ethics and Public Policy; Energy and Environmental Policy Analysis; The Ethical Analyst; Technology and Work; Human Values in Design		
Univ. of California at Berkeley	One—May choose from a wide variety of courses both within and outside the College of Engineering. See Appendix.	Ethics in Science and Engineering; Ethics and the Development of Technology	none	Group Studies, Seminars, or Group Research
Univ. of Illinois at Urbana-Champaign	none	Decision and Risk Analysis; Executives in the Tech World; Human Factors; Engineering Law	none	Introduction to the Business Side of Engr
Univ. of Michigan	Professional Issues and Design (CEE)	Patents, Trademarks, Copyrights; Construction Law and Related Legal Issues; Legal Aspects of Engr; Water Resource Policy; Risk and Benefit Analysis in Environmental Engr; Ethics and Enterprise; Case Studies in Environmental Sustainability	none	none
Univ. of North Carolina	none	Professional Practice; Introduction to Engr Technology	none	none
Univ. of Wisconsin	none	Legal Aspects of Engr; Products Liability—Engr and the Law	none	none
Univ. of Texas at Austin	none	Readings in Engr; Technology and Society; Legal Aspects of Engr Contracts, Liability, Ethics	none	Engineering Cooperative

Table 3: Overview of Websites Related to Professional Responsibility at UT Austin and Peer Institutions

Example Websites Related to Professional Responsibility at UT		
	Course Name/Resource	URL
UT Austin	UT College of Engineering Online Portfolio	http://pf.engr.utexas.edu
	Undergraduate Engineering Review	http://www.engr.utexas.edu/uer/
	Department of Science, Technology, and Society	http://www.tlc.utexas.edu/
Example Websites Related to Professional Responsibility at Peer Institutions		
	Course Name/Resource	URL
MIT	Courses in the Department of Science, Technology, and Society	Http://student.mit.edu/catlog/mSTSa.html
Wisconsin	Department of Engineering Professional Development	http://www.eng.wisc.edu/edp/
Cornell	CEE 590—Project Management	http://courseinfo.cit.cornell.edu/courses/cee590
UC Berkeley	BioE 100—Ethics in Science and Engineering	http://bioeng.berkeley.edu/syllabus/100syllabus.html
Case Western Reserve	On-line Ethics Center	http://www.onlineethics.org
Illinois	GE 292—Engineering Law	http://www.ge.uiuc.edu/crsinfo/crsdesc/ge292.html
Stanford	Department of Science, Technology, and Society	http://www.stanford.edu/group/STS/
	STS 115—Ethical Issues in Engineering	http://www.stanford.edu/group/STS/115.shtml