Guest Editors' Introduction

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Engineering Ethics: Continuing and Emerging Issues

Part II — Education

The last quarter of the twentieth century witnessed many notable changes in engineering education including growing recognition of the importance of ethics and social responsibility. Spurred in part by political controversy over nuclear weapons, environmental quality, and consumer rights, and changing educational standards promoted by the Accreditation Board for Engineering and Technology (ABET), engineering educators began to take seriously the challenge of educating professionals who are both technically competent and ethically sensitive. Engineering ethics has begun to make its mark in engineering curricula including: required courses in engineering ethics at a few prominent institutions; across-the-curriculum ethics initiatives; and numerous elective courses in engineering ethics, some of which are options under broader general education requirements [1].

Joseph R. Herkert

While the goals of engineering ethics instruction are the subject of continuing discussion [2], [3], there is general agreement with the sought-after outcomes described by Davis [4]:

> Teaching engineering ethics…can achieve at least four desirable outcomes: a) increased ethical sensitivity; b) increased knowledge of relevant standards of conduct; c) improved ethical judgment; and d) improved ethical will-power (that is, a greater ability to act ethically when one wants to).

Many of the ongoing developments in engineering ethics education are influenced by recent changes in ABET's accreditation criteria [5]. The Engineering Criteria 2000 promises to significantly alter the landscape of engineering education in the United States. One potential outcome of Criteria 2000 is increased attention in the curriculum to the ethical responsibilities of engineers and the societal context of engineering. The focal point of attention on Criteria 2000 has been Criterion 3, which specifies program outcomes and assessment. Among other outcomes, "engineering programs must demonstrate that their graduates have… an understanding of professional and ethical responsibility…[and] the broad education necessary to understand the impact of engineering solutions in a global and societal context [1]."

In this issue, as *IEEE Technology and Society Magazine* concludes its twentieth year of publication, we present the second of two parts of a special issue on continuing and emerging issues in engineering ethics. Part I published in September 2001 focused on research and analytical frameworks for engineering ethics. In Part II we turn to issues in engineering ethics education. Once again, thanks are due to all of the authors and reviewers of the special issue.

In the first article Karl Stephan asks "Is Engineering Ethics Optional?" In responding to this question Stephan compares the current state of engineering ethics education to the study of differential equations in early 20th century engineering ethics curricula. Stephan argues that engineering ethics has become essential to the practice of engineering ethics for many of the same reasons that differential equations became standard fare, i.e., both are required as a result of the growing complexity of technology and the growing sophistication of engineering practice. Stephan concludes with a brief

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discussion of methods for introducing engineering ethics into an already crowded curriculum.

In his article "Using History and Sociology to Teach Engineering Ethics," Ronald Kline, a former editor of this magazine, takes issue with conventional approaches to engineering ethics that focus on engineering disasters. More generally, he is critical of the tendency to present engineering ethics content and cases with little or no consideration of their historical and social contexts. He argues persuasively for integration of material from Science and Technology Studies (STS) with that of conventional ethics instruction. Interdisciplinary approaches such as that advocated by Kline stand to mutually strengthen engineering ethics and STS education while addressing in an integrated fashion the ABET outcomes concerned with professionalism and ethics and global and societal impact.

Addressing multiple ABET outcomes is an explicit focus of Michael Gorman in his article "Turning Students into Ethical Professionals." Gorman discusses a number of frameworks and methods for addressing the learning outcomes in ABET's Engineering Criteria 2000, including knowledge types, interdisciplinary teams, and integrative senior thesis projects. Gorman argues that a useful theme for linking these methods is the notion of "engineering heroes." (A critique of the concept of engineering heroes was included in Part I of this special issue [6].)

Marilyn Dyrud shows how engineering ethics material can be used effectively in general professional ethics courses in her paper, "Teaching Engineering Ethics to Non-Engineering Students." Dyrud finds this interdisciplinary experience to be of value to engineering and non-engineering students alike, as well as providing valuable lessons both to those who teach professional ethics courses and those who teach courses focused on engineering ethics.

It is significant that none of the authors in Part II are philosophers. Since it is unlikely that there will be many instances where courses in engineering ethics are required and taught by philosophers, it is incumbent upon the community of engineering educators —including those who teach humanities and social sciences to engineering students — to see that ethical problems, standards of conduct, and critical thinking skills are adequately developed in the engineering curriculum. For engineering ethics education to fulfil its promise, engineering educators must face head on the societal and ethical implications of engineering [1].

REFERENCES

[1] J. Herkert, "Engineering ethics education in the USA: Content, pedagogy, and curriculum," *European J. Engineering Education*, vol. 25, pp. 303-313, 2000.

[2] C. Glagola, M. Kam, M. Loui, and C. Whitbeck, "Teaching ethics in engineering and computer science: A panel discussion," *Science & Engineering Ethics*, vol. 3, pp. 463-480, 1997.

[3] W. Sweet, M. Davis, C. Harris, J. Herkert, M. Loui, I. Nair, M. Pritchard, M. Rabins, G. Sammet, Jr., C.M. Skooglund, Jr., J. Smith, V. Weil, and C. Whitbeck, "Educating ethical engineers," *IEEE Spectrum,* vol. 35, no. 6, pp. 51-61, 1998.

[4] M. Davis, "Teaching ethics across the engineering curriculum," *Online Proceedings of International Conference on Ethics in Engineering and Computer Science*, http://onlineethics.org/essays/education/davis.html, 1999.

[5] J. Herkert, "ABET's Engineering Criteria 2000 and engineering ethics: Where do we go from here?" *Online Proceedings of International Conference on Ethics in Engineering and Computer Science*, http://www.onlineethics.org/essays/education/herkert2.html, 1999.

[6] A. Adam, "Heroes or sibyls: Gender and engineering ethics," *IEEE Technology & Society Mag.*, vol. 20, no. 3, pp. 39-46, 2001.