

INSTRUCTOR'S GUIDE ENGINEERING ETHICS

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INTRODUCTION

This module consists of three 50-minute sessions during which two ethical case studies are conducted and a professional code of ethics is developed from class input. Students are shown the necessity for ethical behavior and the concepts which govern ethics. Through class consensus (and without reference to existing professional codes of ethics), the students then develop their own code of professional ethics enumerating the engineer's ethical responsibilities to society, to his/her employer, to fellow workers, and to himself/herself. The students' code is then compared with the codes developed by professional engineering societies. This comparison serves three purposes — first, it makes the students aware of the professional society codes and shows students where they can obtain the codes, second, it illustrates common themes among the various professional codes, and third, it allow the instructor to mention that the codes will not cover all possible situations and that additional resources, such as ethics hotlines, exist for these situations. The instructor then shows the students how to find these additional resources.

STUDENT ACTIVITIES:

Student activities within this module are as follows:

1. Study the case of the Ford Pinto. Read materials concerning the case (homework, individual), answer a series of specific and general questions (homework, group), discuss general ethical issues and ethical issues arising from the case (in-class discussion), determine need for an engineering code of ethics (homework, group and in-class discussion), and draw conclusions (in-class discussion).
2. Develop a code of engineering ethics (homework, group), determine key elements within an engineering code of ethics (in-class discussion), and combine elements from each group's codes to produce a single, refined code for the class (in-class discussion).
3. After the refined code of ethics has been developed, compare it to two codes of ethics developed by professional organizations — examples include IEEE, ASME, ACS, ASCE, ACM, and National Society of Professional Engineers (homework, group). Discuss strengths and weaknesses of refined code for class and for each of the two codes of ethics reviewed (homework, group and brief class discussions).

4. Study the case of Wernher von Braun. Read materials concerning the case (homework, individual), answer a series of specific and general questions (homework, group), discuss ethical issues arising from the case (in-class discussion), and draw conclusions (in-class discussion).

OBJECTIVES

Students completing this module should be able to:

1. Discuss an engineer's professional responsibilities.
2. Discuss various engineering ethical codes.
3. Discuss the importance of engineering ethics in the career of an engineer.
4. Discuss the need for a professional code of ethics.
5. Discuss what an engineer should do when the employer's interest conflicts with the interests of the public.
6. Discuss resources and contact points that would be helpful in dealing with ethical dilemmas.
7. Given a scenario identify ethical concerns, describe the appropriate behavior, and discuss the ethical basis for these choices.

JUSTIFICATION

An engineer's work has a significant impact on society. The engineer must recognize his/her responsibilities to society, his/her responsibilities to an employer, responsibilities to fellow workers, and responsibilities to himself or herself. Ethical dilemmas arise when a situation produces conflicts in responsibilities to two or more of the above groups. Engineers need to understand their ethical responsibilities, to recognize that conflicts will exist, and to know how to satisfactorily resolve these conflicts. Satisfactory resolution involves knowledge of an appropriate code of ethics, an understanding of how to apply ethical principles to professional situations, and the ability to pursue additional resources if the problem appears novel, beyond the grasp of the individual, or if the individual desires corroboration.

PREREQUISITE KNOWLEDGE OR SKILLS:

The only prerequisite knowledge for this module is that students know how to access and print pages from the World Wide Web.

CLASSROOM REQUIREMENTS:

The classroom needs a large blackboard for the instructor to organize student responses to questions. This blackboard is especially needed for Session 2 — developing a code of engineering ethics. I do not believe that an overhead projector is a good substitute for a large blackboard, since the blackboard can simultaneously display considerably more material. There are no other special classroom requirements.

INSTRUCTIONAL MATERIAL:

The material is organized into three 50-minute sessions as follows. If the class meets for 75-minute sessions, the instructor can either divide Session 2 between the end of the first meeting and the beginning of the second, or else the instructor can use the first 50 minutes of each of three meetings.

Session 1: A Case Study of the Ford Pinto

In this session the instructor will introduce students to the methodology of case study, the students will read material concerning the Ford Pinto, and the instructor will lead students in a class discussion of the case of the Ford Pinto. Key concepts include an engineer's responsibility for public safety, cost-vs-benefit studies when public safety is involved, and the issues of informing management and the public of possible safety hazards. The need for a code of professional ethics will also be discussed. Additional concepts include an engineer's responsibility to his or her employer, gauging a company's culture to determine its commitment to public safety, and determining when whistleblowing is acceptable or even imperative. An instructor's guide to the discussions, a list of reading assignments for the students (and copies of all assigned web pages), and a brief, 5-minute exam to verify that the students have read the material is attached as Appendix A.

Session 2: Developing a Code of Engineering Ethics

In this session the students will work in groups to develop an engineering code of ethics. They are specifically told NOT to read any professional organization's codes prior to doing their work, but to develop their own codes based on the Session 1 case study (concerning large, societal issues) and based on their own experiences (concerning smaller personal issues). The instructor will then lead an in-class discussion to develop a class-wide consensus for a code. Key concepts for the discussion include the need for an ethical code, the fact that items in the code can be divided into classes of responsibilities — responsibilities to society, responsibilities to an employer, responsibilities to fellow workers, and responsibilities to self, and the concept that ethical problems arise when there are conflicts between responsibilities to two or more of the above classes. After developing a consensus code, the instructor will pass out ethical codes from two professional societies (examples include IEEE, ASME, ACS, ASCE, ACM, and National Society of Professional Engineers) and students will critique their consensus code and the professional codes. The instructor will conclude by providing students with resources they can use to help resolve any future ethical conflicts (e.g., the IEEE ethics hotline). An instructor's guide to the discussions, a list of professional ethical codes, and a list of additional resources is attached as Appendix B.

Session 3: A Case Study of Wernher von Braun

In this session the students will read material concerning Wernher von Braun and the instructor will lead students in a class discussion. Key concepts include the significant impact which an engineer's work can have on society, the ethical responsibility of an engineer to know and care about how a product or technology which he or she develops can be used, and how decisions concerning "small" ethical issues can snowball. Additional concepts include an engineer's responsibility to promote fair labor practices, the obligation of an engineer to be a

good human being in addition to being a good scientist, and how politics can motivate governmental and individual behavior which may not be ethical. An instructor's guide to the discussions, a list of reading assignments for the students (and copies of all assigned web pages), and a brief, 5-minute exam to verify that the students have read the material is attached as Appendix C.

ASSIGNMENTS

This module includes several types of suggested homework, including

- Reading material from World Wide Web pages for case studies
- Discussing case studies in groups
- Answering simple questions in groups
- Answering thought-provoking, essay type questions in groups
- Developing a professional code of ethics

As mentioned earlier, Appendices A - C contain lists of the suggested assignments in a format that the instructor can make directly available to the students.

GRADING INDIVIDUAL STUDENTS

Two different instruments are available for assessing individual students:

1) Grading Short Quizzes

As discussed in the instructor's guides for sessions 1 and 3 (see Appendices A and C), I suggest that the instructor give a short (5 minute) quiz before each of the two case studies (example quizzes have been included in the instructor's guides). I suggest that these be graded pass/fail merely to determine whether or not the student read and understood the general concepts discussed in the assigned web pages.

2) Grading In-Class Participation (see part B in "Grading Student Groups" below)

GRADING STUDENT GROUPS

Two different instruments are available for assessing student groups:

1. Developing a Code of Professional Ethics

The homework assignment preceding Session 2 is for each group to develop its own code of professional ethics (see Appendix B). As discussed in Appendix B, each group is to turn in their code of professional ethics at the beginning of Session 2 (they are instructed in the prior class to make copies so that they can retain a copy of their code for the subsequent class discussion). I suggest that the instructor grade these codes subjectively with emphasis on the development process, determining whether or not the students gave appropriate thought to the ethical issues which could arise in professional situations and whether or not their codes address these issues.

2. Discussion of Case Studies

As shown in Appendices A and C, students are given a set of questions for each case study which they should discuss in their group after reading the assigned web pages and prior to the class period in which the case will be discussed.

a) Written responses to the questions:

If the instructor wishes, he/she can request that the groups prepare written answers for each of these questions and that they turn in a copy of their answers prior to class (groups should also make copies of their answers which they can retain to aid in their discussion during class). The answers should be graded subjectively to determine whether or not students in the group read the material, understood the ethical issues involved, and applied appropriate ethical concepts in developing their answers.

b) Oral responses to the questions:

As outlined in Appendices A and C, the set of questions provided with each reading assignment will form the basis for a subsequent class discussion (this discussion being the key to the case study). During the two case studies, the instructor should make sure that each group has participated (and, if feasible, each individual). The group's (individual's) participation should be graded subjectively to determine whether or not students in the group read the material, understood the ethical issues involved, and applied appropriate ethical concepts in developing their answers.

OUTCOMES ASSESSMENT –EVALUATING MODULE EFFECTIVENESS

An instructor may wish to assess the impact of the module on the students' development by making a measurement before offering the module (or early within the module) and then after completing the module. This assessment may involve a pre-test and post-test of the students' understanding and application of the principles of engineering ethics.

Suggestions for appropriate tests are given below:

1. Ask students to individually write a code of ethics at the end of the module. Compare these codes to the code of ethics each group developed before the beginning of the second session.
2. Ask students to evaluate a small, hypothetical case study before and after the module (either individually or in groups). Review the student's evaluation to determine how well students can identify and apply appropriate ethical concepts and to show how well the students understand all sides of the appropriate issues.
3. Gauge quality of student contributions in first case study (session 1) versus second case study (session 3).

SOURCE MATERIAL

1. D. Birsch and J.H. Fielder, "The Ford Pinto Case, A Study in Applied Ethics, Business, and Technology", State Univ. of New York Press, 1994 (at UA Law School Library). This book has series of three essays (# 12 - #14) discussing whistle blowing.

2. L. P. Strobel, "Reckless Homicide?: Ford's Pinto Trial", AND Books, 1980 (at UA Law School Library).
3. F.T. Cullen, W.J. Maakestad, G. Caender, "Corporate Crime Under Attack - the Ford Pinto Case and Beyond", Anderson Publishing, 1987. (at UA Gorgas Library).
4. <http://lowery.tamu.edu/ethics/> This site contains links to many ethics case studies, articles, and essays.
5. <http://www.ieee.org/organizations/committee/ethics/ec-resources.html> This site contains links to many ethics resources.
6. <http://onlineethics.org> Another good ethics resource
7. M. Neufeld, "The Rocket and the Reich: Peenemunde and the Coming of the Ballistic Missile Era", Harvard University Press, March 1996, ISBN 0-674-77650-X
8. D. Piskiewicz, "The Nazi Rocketeers: Dreams of Space and Crimes of War", Praeger Publishing, November 1995, ISBN 0275952177

ATTACHMENTS

- Appendix A. Instructor's guide to Case Study #1 - the Ford Pinto. (Also contains student's reading assignments and short quiz.)
- Appendix B Instructor's guide to developing an engineering code of ethics. (Also contains URLs for codes of ethics from various professional societies and a list of ethics resources.)
- Appendix C. Instructor's guide to Case Study #2 - Wernher von Braun. (Also contains student's reading assignments and short quiz.)