ETHICAL ISSUES CONFRONTING STUDENTS AND PRACTITITIONERS

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Abstract

Engineering Ethics may be defined as the study of moral topics in engineering. In fact, according to some ethical philosophers, engineering may be conceived as a social experiment involving human subjects.

In general, engineering students with minimum work experience were found to rate, with three exceptions, the frequency and seriousness of ethical issues lower than students with engineering work experience, members of the Texas Registration Board and Engineering Deans Council, and practicing engineers. The three exceptions: improper political or community involvement, alcohol and drug abuse, and failure to protect the environment are in the frequency category. Among the twelve ethical problems studied, four issues: technical incompetence or misrepresentation of competence; failure to protect public health, safety, or welfare; alcohol or drug abuse; and poor quality of work, are considered serious by engineering personnel.

It has been claimed that ethics cannot be taught to college students or adults. However, there is evidence that formal/informal presentations are well received. In fact, numerous universities now offer courses in ethics and professionalism. Also, industry has found that clear standards of ethical conduct are required in its day-to-day operations.

I. Introduction

Engineering organizations, both academic and industrial, have long been interested in the application of professionalism and engineering ethics. Recently, however, these topics have received increasing attention and numerous conferences have been held, and articles and books have been written on the subject[1,2]. In addition, universities have expanded their course offerings in the area[3, 5]. Industry has also established offices/departments that assist their employees with dealing with professional and ethical dilemmas before they become problem areas[4, 10].

This paper presents a definition of engineering ethics and reviews guidelines that may be followed to promote ethics and professionalism in the work place. In addition, various resources available to assist faculty teaching courses involved with engineering ethics/professionalism are referenced. Also, the paper presents the results of a survey of engineering students concerning engineering ethics and professionalism and compares the findings with a previous study involving engineering practitioners.

II. Engineering Ethics in Industry

According to Martin and Schinzinger[6] engineering ethics may be defined as "the study of the moral issues and decisions confronting individuals and organizations involved in engineering." It also includes "the study of related questions about moral conduct, character, ideals, and relationships of people and organizations involved in technological development."

These authorities also perceive that engineering may be conceived as a social experiment involving human subjects. The subjects of the "experiment" may be considered as clients and the public. As subjects it is thought that clients and the public have the right to be informed concerning the risks to which they will be subject. As participants, engineers are expected to respect these rights and have the freedom of action such that supervisors and managers cannot force them to violate their conscience. Nevertheless, supervisors and managers have the authority to guide engineering work but must also respect the moral convictions of engineers working on projects they supervise.

In this regard, it has been claimed that ethics cannot be taught to college students and adults. However, there is evidence that formal/informal presentations are well received and numerous industrial firms and universities are now stressing the study of engineering ethics and professionalism in their organizations. In particular, industry has found that a course in engineering ethics will result in the following[2]:

1. An increased awareness of ethical theories, public concerns and potential conflicts;
2. A greater familiarity with codes of conduct;
3. An appreciation for the frequency with which ethical dilemmas are encountered by engineers in their work experience;
4. A heightened ability to recognize ethical dilemmas;
5. A better understanding of one's own values, and, most importantly;
6. An enhanced ability to resolve ethical dilemmas by applying traditional engineering inquiry methods of getting the facts, listing options, testing the options, making a decision and acting.

Hopefully, the application of the foregoing principles will result in an ethical conduct that will increasingly assist practicing engineers in being recognized by the general public and their employers as truly ethical professionals.

III. Ethical Issues for Engineering Students and Practitioners

The trend in engineering in the United States appears increasingly to be to conduct business in a team-oriented manner. For this approach to be successful, graduates are needed who have been educated to assume a broad range of responsibilities. Among the subjects, of which additional knowledge is recommended, is engineering ethics and professionalism. In fact, it is perceived by some engineers that the public recognizes that traditional morality is not sufficient to guarantee

ethical conduct and protect the public welfare and safety.

In order to increase and disseminate knowledge of engineering ethics and professionalism, the Murdough Center for Engineering Professionalism at Texas Tech University has been awarded a development grant from the Texas State Board of Registration for Professional Engineers[8]. In this regard, one of the activities of the Murdough Center has been to distribute a survey of twelve ethical issues which may confront practicing engineers. The findings of the survey, which was developed by Dr. W.P. Vann, Texas Tech University and Dr. P.A. Vesilind, Duke University, was included in the newsletter of the Murdough Center[1]. A similar survey was also distributed to students enrolled in an engineering ethics/professionalism seminar at Lamar University. The findings are shown in Table 1 and are based, in part, on the responses obtained from the 20 students enrolled in the seminar class. The results include students who have and have not had considerable engineering work experience. Those who have held jobs in engineering firms were requested to base their replies on the work environment. In the tabulation, the students' perceptions are compared with those of conventional practicing engineers and a select group composed of members of the Texas Registration Board and Engineering Deans Council. The latter data was compiled by the Mudough Center. In the table, higher numbers represent higher frequency or greater seriousness. For example: for low frequency or seriousness, n=1; for high frequency or seriousness, n=7.

Table 1 indicates that the rating in the seriousness category tends to be greater than that for frequency. This may indicate that serious ethical problems may not frequently occur. Table 1 also shows that students with minimum or no work experience tend to rate ethical issues lower than students involved with the engineering work environment. However, full-time students rate the frequency of issues number 7, 10 and 11 (improper political or community involvement, alcohol and drug abuse, and failure to protect the environment) equal to or higher than those students with on-the-job experience. This variation may possibly be due to a number of reasons such as a different lifestyle, interest, or environment of students with and without engineering work experience.

A review of the data also indicates that students with limited engineering work experience do not perceive that ethical problems are serious. For example, their rating is below 5 for each issue in the tabulation. Students with experience, practicing engineers, and members of the Registration Board and Engineering Deans Council, however, have a different perception. As shown in Table 2, nine issues have been rated with a seriousness index of 5.0 or above. In fact, four ethical issues: technical incompetence or misrepresentation of competence; failure to protect public health, safety or welfare; alcohol or drug abuse; and poor quality control or quality of work, are considered serious by all three groups under consideration.

The aforementioned ethical findings (shortcomings) should be a matter of concern for the Engineering profession. In fact, in order to solve this problem, universities, as discussed in the following section, are investigating methods to increase the emphasis on engineering ethics and professionalism in the curriculum.

TABLE 1. ETHICAL ISSUES FOR STUDENTS AND PRACTIONERS

Ethical Issue	Students Min. Egr. Experience	Students With Egr. Experience	Practicing Engineers	Regis. Board & Deans	
1. Tech. Incompetence/Mis-representation of Competence	3.21 4.79	3.39 5.31	3.41 5.74	3.42 4.96	Frequency Seriousness
2. Conflict of Interest	3.14 4.29	3.38 4.62	3.51 4.68	3.50 4.32	Frequency Seriousness
3. Discrimination, Favoritism, or Harassment	3.00 4.36	3.15 5.00	3.27 4.80	2.46 3.96	Frequency Seriousness
4. Misuse of Company or Client Resources	2.71 3.36	3.23 4.69	4.41 4.12	3.88 3.60	Frequency Seriousness
5. Failure to Protect Public Health, Safety or Welfare	2.50 4.71	2.54 5.46	3.07 5.95	2.96 5.54	Frequency Seriousness
6. Improper Relations with Clients, Contractors, etc.	2.64 4.36	3.31 4.85	3.10 5.01	2.88 4.44	Frequency Seriousness
7. Improper Political or Community Involvement	3.00 3.85	3.00 3.86	3.08 4.79	3.19 4.20	Frequency Seriousness
8. Mishandling Sensitive Information	2.43 4.21	2.85 4.85	3.23 5.23	2.77 4.56	Frequency Seriousness
9. Failure to Reconcile Employee Concerns	3.21 4.64	3.46 5.31	3.59 4.84	3.50 4.84	Frequency Seriousness
10. Alcohol and Drug Abuse	2.93 4.71	2.15 5.54	2.53 5.79	2.69 4.96	Frequency Seriousness
11. Failure to Protect the Environment	2.79 4.43	2.69 4.69	3.37 5.44	3.73 5.16	Frequency Seriousness
12. Poor Quality Control or Quality of Work	2.86 4.86	2.92 5.08	4.10 5.43	3.50 5.12	Frequency Seriousness

Note: For frequency, 1 = never, 7 = very frequent. For seriousness, 1 = not serious, 7 = extremely serious

TABLE 2. SERIOUS ETHICAL ISSUES FOR ENGINEERING STUDENTS WITH EXPERIENCE AND PRACTITIONERS

Ethical Issue	Ethical Issues with a Seriousness Rating of 5 and Above: Students With Engineering Experience	Practicing Engineers	Registration Board And Deans
Technical Incompetence or Misrepresentation of Competence	5.3	5.7	5.0
Discrimination, Favoritism or Harassment	5.0	-	-
Failure to Protect Public Health, Safety, or Welfare	5.5	6.0	5.5
Improper Relations with Clients, Contractors, Etc.	-	5.0	-
Mishandling Sensitive Information	-	5.2	-
Failure to Reconcile Employee Concerns	5.3	-	-
Alcohol or Drug Abuse	5.5	5.8	5.0
Failure to Protect the Environment	-	5.4	5.2
Poor Quality Control or Quality Of Work	5.1	5.4	5.1

IV. Engineering Ethics in the University

Numerous university professors and practicing engineers have called for an increased focus on ethics in the teaching of engineering. It is believed that students should be made aware of ethical problems and learn to recognize them[11]. This includes "investigating the facts, formulating and evaluating options, gathering support, and acting responsibly when facing ethical dilemmas."

To assist in this effort various case studies are being developed by numerous organizations. For example, teaching aids are available for general use and include instructor's guides, student handouts, and overhead transparencies[9]. In addition to the above, the Murdough Center for Engineering Professionalism at Texas Tech University has developed a course on Engineering Ethics and Professionalism[7]. This is taken by both students and professionals.

In review, the principal goal of ethics instruction is to increase the students' awareness of and ability to recognize ethical problems. The secondary goal is to present the concept that engineers are moral agents for society and must be ethically responsible for the effects of their products.

V. Summary and Conclusion

Engineering ethics, in a limited sense, may be considered a discipline dealing with an obligation to confirm to a set of rules such as an engineering code of ethics. However, it should also include elements to promote ethics and integrity in the work place as well as in the general community.

The findings of this study suggest that students with limited engineering experience do not perceive that ethical problems may be serious. Nevertheless, they are concerned with the frequency of improper political or community involvement, alcohol and drug abuse, and failure to protect the environment.

Students with engineering work experience consider six ethical issues to be serious. In fact, four issues: technical incompetence or misrepresentation of competence; failure to protect public health, safety, or welfare; alcohol or drug abuse; and poor quality control or quality of work, are considered serious by students with work experience, practicing engineers, and members of the Texas Registration Board and Engineering Dean's Council. These findings should be a matter of concern for the Engineering Profession.

It has been claimed that ethics cannot be taught to college students and adults. However, there is evidence that formal/informal presentations are well received and numerous industrial firms and universities are now stressing the study of engineering ethics and professionalism in their organizations. The information gained may be used by individuals to strengthen their ability to recognize moral issues and be sensitized to alternative moral perspectives. Hopefully, the application of these concepts will assist engineers to be increasingly recognized by the general public as true professionals.

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