TEACHING ENGINEERING ETHICS
"AN ANNUAL RENEWABLE RESOURCE"

Philip L. Brach, Ph.D., P.E., F-NSPE, Ahmet Zeytinci, Ph.D., P.E.

Distinguished Professor, Emeritus / Professor
Engineering

University of the District of Columbia
Washington, D.C.

Abstract

We live in a troubled, confused global society; one need only look at the lower west side of Manhattan and the absence of what was once there is a "monument" to the failure of values in our world. The engineer is a critical player in the modern technological society. His or her values and how he or she participates in the global economy is and will be a critical component of the well being of our society. As engineering educators we have a special role to play in forming the ethical values of the engineers of the future and tempering them in the application of ethics to their practice of the profession of engineering.

This paper presents a brief overview of two resources from the National Society of Professional Engineers (NSPE) that are excellent tools for the instruction of engineering students in the ethical practice of their profession. One is a short video presentation that poses an ethical dilemma for a young engineer. This presentation, called "Gilbane Gold," deals with an environmental issue for a small town and its major employer, an electronics firm. How this "Case Study" is used in the teaching of Ethics for Engineers is highlighted. The second resource, the Milton F. Lunch Annual Ethics Contest, involves a case study in engineering ethics that was prepared by the Ethics Committee of the NSPE. Solutions are solicited from the State Societies of NSPE together with engineering students. These are excellent resources for distinguishing between ethics and morals and for molding the knowledge, skills and aptitudes (KSAs) of young engineers in the ethical practice of the profession of engineering. Since a new situation requiring the application of the Engineer's Code of Ethics is presented each year, this is a "renewable resource" for the instruction of engineering ethics. The paper explains how these resources are used for the teaching of Ethics at the University of the District of Columbia (UDC).

Introduction

A civilized society requires acceptable habits and customs if it is to survive anarchy. Historically the prohibitions of unacceptable practices were through the sanction of either law or religion. Less serious offenses were usually dealt with by socially ostracizing the offender.

Today our customs are divided into moral or ethical issues. Dan H. Pletta [1] defined morals as the principles or the standards of right or wrong conduct involving voluntary action, and ethics as more the study of human actions as being right or wrong.
The focus of this paper will be on that aspect of acceptable human behavior known as ethics: precisely, the ethical behavior expected of engineers in the practice of their profession. At The

University of the District of Columbia (UDC) in our senior course, which addresses this topic, we use two resources.

The first one is a video dramatization on engineering ethics entitled "Gilbane Gold [2]". This is a case study in ethics prepared by the National Society of Professional Engineers (NSPE). The second one is the annual Milton F. Lunch Ethics Contest of NSPE. This is a renewable resource since it is a new case every year.

Gilbane Gold, A Case study in Engineering Ethics

Gilbane Gold is a byproduct of the wastewater treatment plant for the city of Gilbane. It is sold as commercial fertilizer resulting in an economic saving of approximately $300 per year per resident of the city of Gilbane. A computer components manufacturer, Z-CORP discharges small amounts of lead and arsenic into the city's disposal system. The core of this case study is an ethical dilemma that puts at odds the town, the corporation, and a young engineer concerning changes in the discharge of contaminants into Gilbane's sewage system.

The beauty of "Gilbane Gold" is that at first reading, the "ethical" thing to do appears quite obvious. But upon insightful review the professor and the students discover that it is not so easy a problem to reconcile. As is true in real world situations, it requires thoughtful analysis and the balancing of competing social /economic objectives.

This case study provides the engineering students the important experience of considering both positive and negative outcomes of their decisions. For example, in the case of Gilbane Gold, obviously the contamination of the sludge is unacceptable. However, the ramifications of action to ameliorate this problem become very complex. The manufacturing plant could be closed. What impact this would have on the economy of the community? The sludge as a commercial fertilizer could be removed from the market, increasing the tax burden on the residents.

The most important aspect of this case is how a young professional engineer exercises his duty to protect the health and well being of society (as required by his professional licensure). In this case the young engineer is a small cog in a large corporate environment. In this respect, the case study involves a spectrum of engineering influences. A university professor, an engineering consultant, the hierarchy of management personnel and their impact on the young engineer's decision are examined. The ethical dilemma that confronts the young engineer is whether or not he should go public with his concerns over the handling of an increase in discharge of contaminants due to new precise testing procedures and an expected increase in production at the plant.

At UDC we use this case study for the students to address this problem from both perspectives. First, the video of Gilbane Gold is shown and then the case is briefly discussed. Each student is instructed to decide the ethical merits of the young engineer going public (whistle blowing) or seeking further administrative remedies to his concerns. They present their decision with reasons in a short paper. An additional feature of our senior course is a requirement that the students prepare five short papers, called single concept papers (SCP). Each paper is on a single precise

topic. The papers are intended to improve the students' writing skills and to "hone" their presentations to be succinct.

The pièce de résistance is after the students have presented written papers defending their position, they are then assigned a second paper in which they have to defend the opposite position. This second assignment forces the students to examine critically all facets of a complex ethical issue.

The Milton F. Lunch Annual Ethics Contest

Each year NSPE publishes a question of ethics. NSPE members and engineering students have the opportunity to answer the question and submit their arguments in support of their answer to the question. There is a $1000 prize to those that submit the best analysis and defense ($500 to the authors and $500 to the sponsoring State Society of NSPE, in our case DCSPE). The format of this competition includes a paragraph articulating the facts to be used in answering the question. The engineers and the students decide on the ethics of the question using the NSPE Code of Ethics (NSPE-COE). The code can be accessed on line at: http://www.nspe.org (once on the site follows the "ethics" option until you get to the code).

After deciding the ethics of the question and referencing the appropriate canons of the code, the students must defend their position in a discussion/conclusion format not to exceed 750 words.

At UDC we use the annual ethics case in the following format:

The ethical question is presented to the students with the facts of the case. Then the students are assigned the task of determining which sections of NSPE-COE might be relevant to the ethical issue in question. Then collectively in class a discussion among the students is held to arrive at a consensus of which canons will be used to determine the ethics of the case and to defend their answer to the question. Figure 1 shows a portion of a condensed spreadsheet (Excel) that is used to arrive at the consensus.

As Figure-1 illustrates, there is variance between the opinions of students. But after discussion a list of canons to be used for the case is agreed upon. This is shown in the first set of columns labeled "**C**". In the event that it is difficult to reach a consensus, then two groups, one for each opinion, prepare their arguments with the class deciding which position will be submitted as the official entry to the competition. You can see from figure 1 that the final canons agreed upon do not represent the initial thought of many of the participants. This illustrates the value of the group discussion and the fact that we learn much from each other.

Following are abstracts of two recent cases that were submitted by our engineering students to the Milton F. Lunch Annual Ethics Contest:

A professional engineer applies for a professional engineering position with an engineering firm. Previously, he was the owner of a fire sprinkler-contracting firm, which was required to have a contractor's license. On the engineering firm employment application, there is a question asking whether the engineer "has ever been disciplined in the practice of professional engineering or

had his license suspended or revoked?" He responds in the negative on the employment application. Later, the engineering firm learns that while his engineering license was never revoked or suspended, he did have his contractor's license revoked because he allowed an unlicensed individual who was unrelated to his contracting firm to use the contractor license number on another project. The question was: Did the Engineer have an ethical obligation to report on the employment application the revocation his contractor's license?

In summary our class found that while it may be perceived that the Engineer violated certain cannons of the code of ethics, upon careful study he did not. He had no *ethical* obligation to report on the employment application the revocation of his contractor's license. He had been penalized, justly so, for his indiscretion in permitting the inappropriate use of his contractor's license and a review of the governing statues found no requirement for divulging the loss of the contractor's license. Whether his past indiscretions have any impact on his abilities, as a professional engineer is an unanswered question.

The official answer accepted by the NSPE Committee was:

> "It was ethical for Engineer A to correctly answer a direct question on a written job application. It was unethical for Engineer A to deliberately withhold relevant information having to do with his contractor's license during the entire job application process. Engineer A violated the basic law of trust and integrity with his employer, thus violating both the letter and spirit of the Code."

Illustrating that even the most careful review can result in conflicting answers, an excellent learning experience for all.

The second example, a situation where a licensed engineer advertised on the internet that he would "seal" drawings for a fixed price, our class found the ad to be unethical as did the NSPE Committee. An abstract summary of our class discussion follows:

> The NSPE Code of Ethics indicates under professional obligations, "Engineers shall conform with state registration laws in the practice of engineering" (III.8a). The question here is, to which state is he going to conform, if his service is designed to meet with every local or state requirement. This is impossible to accomplish as regulations and laws differ from one state to another. Therefore, in this case, Engineer A's website is an exaggeration of his ability to provide services in areas where he is not licensed.
>
> Finally, the website is unethical because Engineer A is charging a nominal fee for sealing any project and this is absurd. Charging a nominal fee for sealing a project does not make sense. It is impossible to know how much work is required to perform an adequate review of the required documents to assure that they conform to every applicable engineering standard. Engineer A also overlooks the potential for complicated designs in pursuit of attracting customers, which could lead to unsafe consequences. The Code of Ethics states "Engineers shall not promote their own interest at the expense of the dignity and integrity of the profession (III.1.e). Engineer A's strategy of attracting customers by promising

> cost effectiveness [why do you have "cost effectiveness" in parentheses here and in a larger font?] promotes his own interests instead of the integrity of the engineering profession.
>
> Engineer A does not have the right to develop a website in this manner because by doing so, he is violating the Code of Ethics for Engineers. The role of engineers in our society is very important and that is the reason why high expectations are always placed upon them. After all, the first Fundamental Canon of the Engineering Code of Ethics states that: "Engineers should hold paramount the safety, health and welfare of the public" and avoid any behavior or act that will hurt the profession.

In the first example the decision arrived at by the class was contrary to that of NSPE's judges. In the 2nd case it was in agreement with NSPE.

These opposing examples are presented to illustrate the challenge that ethical issues present to the engineering profession and the value of formal education in ethics in our engineering and technical programs. Failure to do so will be more than an oversight, just look at the void on the lower west side of Manhattan and you will see the absence of ethical behavior.

Conclusion

It is important to realize that right or wrong is an essential aspect of behavior, however in our class on ethics our primary goal is to expose the students to a process for arriving at an ethical decision. As with the adage "*Beauty is in the eye of the beholder*" so also is the issue of ethics a function of culture and background.

The important goal at UDC is to assure that our students have experienced the process of critically examining how to judge their professional behavior in accord with established ethical norms.

Over the years, this approach of using these resources has proven to be very productive and beneficial.

References

[1] *The Engineering Profession, Its Heritage and Its Emerging Public Purpose,* by Dam H. Pletta, PE, University Press of America, 1984

[2] *Gilbane Gold: A Case Study in Engineering Ethics*, NIEE, NSPE

EXCEL ANALYSIS OF RELEVANT SECTIONS OF NSPE-COE

NSPE 2005 Ethics Contest Students		**C**			K H			S B			L Y			A B	
II Rules of Practice		**A**	**N**	**M**	A	N	M	A	N	M	A	N	M	A	N	M
			A			A			A			A			A	
1	a		**X**			X			X			X			X	
	b			**X**			X			X			X	X		
	c	**X**				X			X			X			X	
	d			**X**			X			X			X			X
	e	**X**			X			X			X			X		
	f		**X**			X			X			X			X	
2	a	**X**				X			X		X			X		
	b	**X**			X					X	X			X		
	c	**X**			X			X			X			X		

A= Applicable
NA=Not Applicable
M= Maybe (Not Sure)
C=Consensus

Figure 1.