Engineering ethics

An area in need of greater understanding

by Raja V. Ramani, Ph.D., P.E.

The origin of current codes of professional ethics is attributed to the Hippocratic Oath. Written almost 2,500 years ago, it is regarded as the earliest statement of moral conduct to be used by a physician. Though it has been modified through the ages, it is still the basis of the oath administered to graduating physicians. That several other professions have developed oaths emulating the Hippocratic Oath is a validation of its enduring significance. The Hippocratic Oath for Engineers (see box) captures many aspects that one aspires to achieve in a professional career, though a wholehearted agreement with all aspects can hardly be expected.

The Hippocratic Oath is an expression of understanding and commitment to moral beliefs and a right course of action by an individual. This personal code of ethics should be different than the code of ethics that professional societies have developed. Professional codes are framed in terms of personal moral traits, duties and responsibilities to the public, employers, clients, fellow engineers, the profession and to oneself. They prescribe fundamental canons, rules of practice and professional obligations. In a similar vein, organizations develop codes of business ethics and conduct that detail the company's values, policies and standards of professional conduct. The professional and organizational codes are really guides of conduct within the specific profession or organization and are not legally binding. One must always be wary of the not-so-distinct boundaries that may exist between unethical conduct and criminal behavior. What is ethical may be illegal and what is unethical may be legal. Further, broad, general statements are often not much help in complex, real world situations. Ethics are minimum standards and ethical conduct is much more than not breaking the laws with regard to ethics, or merely adhering to the ethics code.

Why discuss ethics now? again?

Engineers today are faced with issues that defy easy definition. They must find alternatives to resolve conflicting issues and choose the right course of action. There are real and perceived conflicts among the interests of the public, an employer, a client, a profession, colleagues and self. These conflicts transcend the traditional role of engineers as individuals who identify technical requirements and expected costs to construct a system or design a product. To compound matters further, the rapid career progression of engineers into positions of responsibility often exposes them to demanding environments, different and diverse culture, and difficult situations without an opportunity to develop extensive professional experience. At the societal level, fundamental questions are being raised about the quality of life, which has focused attention on the assumptions and consequences of industrial growth. While environmental management and ecological planning were some of the major themes for planning industrial activities in the recent past, today the objective is sustainable development. Further, one has to be aware of the growing complexity of the legal environment and keep pace with the accelerating developments in science and technology. Challenges to ethical behavior are present at all stages of an engineer's profession — in the planning, designing, engineering, organizing and monitoring, and controlling phases of an endeavor.

Engineers are not acting alone in attempting to find the right course of action. Professional ethics and organizational ethics are there to help in the process. One could reasonably assume that all three should make it easier to make the right choice among the various alternatives. Unfortunately, several high-profile corporate failures and horrific disasters

(Continued on page 65)

SME News contents

An Engineer's Hippocratic Oath

"I solemnly pledge myself to consecrate my life to the service of humanity. I will give to my teachers the respect and gratitude which is their due; I will be loyal to the profession of engineering and just and generous to its members; I will lead my life and practice my profession in uprightness and honor; whatever project I shall undertake, it shall be for the good of mankind to the utmost of my power; I will keep far away from wrong, from corruption, and from tempting others to vicious practice; I will exercise my profession solely for the benefit of humanity and perform no act for a criminal purpose, even if solicited, far less suggest it; I will speak out against evil and unjust practice wheresoever I encounter it; I will not permit considerations of religion, nationality, race, party politics, or social standing to intervene between my duty and my work; even under threat, I will not use my professional knowledge contrary to the laws of humanity; I will endeavor to avoid waste and the consumption of nonrenewable resources. I make these promises solemnly, freely, and upon my honor."

Charles Susskind, Understanding Technology, *Baltimore and London: The John Hopkins University Press, 1973, p. 118.*

(Continued from page 55)

affecting health and safety of an entire workforce and community have been traced to personnel and organizations not living up to ethical standards. All these point to the need for a better understanding of the codes and their application in the real world.

Teaching of ethics in colleges and universities

Developing skills in problem solving is one of the major objectives of education. We seek to develop the ability of the students to define a problem, to identify the choices to solve the problem, to analyze the consequences of the choices and to choose the right answer. Teaching of personal ethics should begin from early childhood. Aspects on which training can be started fairly early include working in teams, respecting one another, differentiating between right and wrong, and choosing the right course of action.

Engineering ethics involves individuals and organizations working in a complex, competitive environment in engineering and technological fields. Thus, engineering curricula have acknowledged the importance of teaching ethics, particularly engineering ethics. That a graduating engineering student demonstrate "an understanding of professional and ethical responsibility" is one of the student outcomes required under the current ABET criteria. When coupled with other required student outcomes specified by ABET, such as "an ability to design a system, component or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability and sustainability," and "the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental and social context," it becomes clear that engineering programs at universities must pay particular attention to several issues other than engineering. This brings into focus the need for faculty to be familiar with personal, professional and organizational codes of practice and to discuss, analyze and resolve specific ethical issues that engineering and technological solutions raise. The preparation of the student at this stage must be directed toward lifelong learning to seek out the ethical issues in all aspects of his or her work.

Ethics and licensing issues

The licensing process is a function of the state licensure boards. Therefore, one must check with the appropriate state board for the specific requirements. Requirements vary from state to state in details and specifics, though the licensing procedures may be similar. This is particularly true of the ethics requirements for licensure.

Ethics is an inherent part of the Fundamentals of Engineering (FE) and the Principles and Practice of Engineering (PE) examinations. The FE examination has about eight or nine questions, out of 120, covering such topics as codes of ethics of professional and technical societies, agreements and contracts, ethical versus legal, professional liability and public protection issues. The requirements for the PE examination are quite varied. Texas and Washington, for example, have a specific requirement that candidates must take and pass an ethics examination before they can take the PE examination. In the Mining/Mineral Processing Engineering P.E. examination, ethics is covered as a part of the universal considerations such as observance of laws and regulations.

Several licensing boards specify professional development hours (PDH) in their continuing professional competency requirements. In several states, as a minimum, one PDH in ethics training is required per renewal period. An engineer, aspiring to be licensed or wanting to continue to be in good standing with registration, has much independent learning to do with regard to engineering ethics.

The National Council of Examiners for Engineering and Surveying (NCEES) has a model rules of professional conduct that provide guidance and direction for licensed engineers and surveyors regarding ethical and moral conduct. While NCEES recommends that state licensing boards adopt these rules, states may have their own code of ethics. For example, the North Dakota code of ethics for the profession of engineering and land surveying states that, "it is designed to further safeguard the life, health, property and public welfare of the citizens of North Dakota and must be construed to be a reasonable exercise of the police power vested in the board of registration for professional engineers." State boards specify the process for and types of disciplinary actions, revocation or probation of license or reprimand, for violations of the code.

Professional societies and ethics

The development of professional codes of ethics is related to the identification of engineering as a distinct profession and to the separate professional societies representing the different engineering disciplines. Common to several of these codes is responsibility to consider the welfare, health and safety of the general public and the community, to perform work only in their areas of competence, to not to compete unfairly, to avoid deceptive practices, to be objective and truthful in public statements, and to advance the profession. There is also a requirement for specific personal traits such as integrity, fairness, faithfulness and honesty. As new engineering disciplines are developed and new professional societies formed, the development of ethics codes specific to that profession has also continued.

The code of ethics of a professional society is a living document, subject to amendments as progress in engineering, technology and practice create new situations and requirements. The Code of Ethics for Engineers of the National Society of Professional Engineers has seen extensive revisions since its first adoption of the Canons of Ethics for Engineers in 1946. Some of the earliest codes of engineering ethics in the United States are for fields of electrical (1912), mechanical (1914) and civil (1914) engineers. While AIME was founded in 1871 with the twin objectives of "the more economical production of the useful minerals and metals and the greater safety and welfare of those employed by the industry," to this date, AIME does not have a code of ethics. However, AIME was a major contributor in the development of professional ideals.

In 1943, the secretary of AIME, A.B. Parsons, wrote the document titled "Faith of the Engineer," which set out a

pledge for engineers, a forerunner to the modern Engineers Creed. SME has a code of ethics only for its registered members who are certified as qualified to carry out special mineral reserve reporting assignments. Several other professional organizations in the earth science and minerals engineering fields, such as the Mining and Metallurgical Society of America, the Association of Environmental and Engineering Geologists and the Society of Petroleum Engineers, have codes of ethics or guidelines of ethical behavior. When one is a member of a professional society, one is obligated to live up to the code or face disciplinary action according to a due process.

Corporate code of conduct and ethics

Corporate codes of conduct refer to a company's policies and statements of principles and standards of conduct. While there are no formal requirements that a specific document be produced in a specific format, companies generally prepare a document that details the corporation's social accountability, commitments to its constituencies, such as employees and stockholders, and the elaborations of the company's way of doing business. The codes and guidelines are applicable to all, from the chairman to the hourly worker, and are generally available for public review. Social accountability issues addressed can include sustainable development, environmental responsibility, product safety and marketing policies. The expected standards of conduct on issues such as workplace health and safety, employee privacy, confidentiality of employee records, protection of proprietary information and company assets, and dealings with suppliers and vendors can be specified. Organizational codes may also cover drugs, conflict of interest and trading practices as applicable to the company. As with professional ethics, the adherence to the corporate code of ethics is the duty and responsibility of the individual.

Ethics issues in earth resources engineering

Extraction and utilization of the earth's nonrenewable mineral and energy resources is one of the earliest of human activities. Mining is extracting materials from the ground and, therefore, has a major impact on all other earth resources — air, water, land, social and cultural. The threat to the health and safety of miners and mining communities has also been a major consideration. While much progress has been made on the health, safety and the environmental fronts, issues are always emerging. Currently, there are extensive debates on climate change, nuclear power safety and drinking water quality and supply, as well as on the ethical issues they raise. Mine disasters continue to occur and lead to questions on corporate culture and ethical behavior. The benefits and impacts of mining and a number of business practices have also been the subjects of critical examination and ethical analysis. In the absence of legal prescriptions or sound guidelines upon which to base decisions, the images and reputations of companies and individuals are likely to suffer on the ethicality of the decisions made. These are situations where personal, professional and organizational codes of ethics all come together and where great potential exists for a conflict of interest and a questioning of decisions on ethical grounds. The decision-maker has to have wider counsel in order to choose the right course of action. The growing globalization of business has ensured that companies operate across many borders and in many cultures and trade in several mined and processed commodities. Conditions for ethical lapses are ever present. Several mining companies have developed and published a fairly extensive code of ethics and business conduct with discussion on how the code is to be applied in practice.

An important point is that not all issues have the ethical complexity or challenge of, for example, the climate change issue, but each issue deserves the same careful consideration from an ethics point of view in decision-making. An engineer makes a number of decisions every day on several aspects that may not even be noticed or that come to light only when something wrong happens. The need for such decisions arises, for example, with the unit or auxiliary operations of mining, daily personnel actions or a review of a document. All these decisions have ethical implications. The manner in which these issues are handled has a big impact on the perceived honesty and integrity, and respect for the engineer. Doing the right thing when nobody is looking is an essential component of personal ethics. Not overlooking unethical behavior on the part of others is just as important.

Resources for ethics learning

Compared to the situation about four decades ago when the author was preparing for the P.E. examination in Pennsylvania, the resources today on ethics and case studies of ethical or unethical conduct are quite extensive. ABET criteria with regard to student outcomes has ensured that increased emphasis is placed on engineering ethics in engineering curricula. Research on ethics has accelerated in the liberal arts, science and engineering fields with increasing recognition that ethical considerations have significant nuances. This requires a greater understanding of moral and ethical issues and an interdisciplinary approach. The professional societies have done an excellent job of publicizing their codes, some even offering online courses. The state registration boards, as already indicated, have information on the applicable codes and requirements.

There is extensive online support for students, faculty, researchers and professionals on almost all ethical issues. The Online Ethics Center of the National Academy of Engineering (www.onlineethics.org/about.aspx) is one of the most extensive. The center was established in April 2007, and its stated purposes are to provide engineers and engineering students with resources for understanding and addressing ethically significant problems that arise in their work and to serve those who are promoting learning and advancing the understanding of responsible research and practice in engineering.

SME has just announced the availability of its first course in its new eLearning program, Ethics in the Mining Industry. The course, authored by Lee Saperstein, has a broad coverage of important topics in an easy understandable manner. The topics covered include ethics fundamen-

tals, ethics codes, evaluations of reports, management of environmental and safety compliance, rendering judgment, recognition of pitfalls, analyzing whistle-blowing and examples of ethical lapses. The course is of great value to students and faculty in engineering programs as well as to engineers aspiring to take the Fundamentals of Engineering and P.E. examinations. Practicing engineers would also find it useful and relevant to maintaining their continued professional competence. The educational and professional development of an engineer is necessarily intense in the scientific, engineering and technological aspects of the work. Yet the need for greater understanding of other areas, particularly engineering ethics, is becoming very important. Fortunately, opportunities for independent and lifelong learning in engineering ethics and for being part of the solution are within the easy reach of the engineering community.

The SME Foundation needs your support

The SME Foundation (SMEF) supports several efforts that directly relate to the professional development of students and young professionals in the mining, mineral processing and related fields. Specifically, SMEF supports the undergraduate educational process through its ABET accreditation programs for mining and related programs. Since 2004, the foundation has undertaken the financial responsibility for the professional licensure (P.E.) program.

Another major activity is the development of educational resources and sponsorship of booths at the National Science Teacher Association events. Barbara Arnold's column in the July issue of *Mining Engineering* (p. 87) refers to the foundation's "buckets" campaign and asks you to contribute to whichever bucket you choose. I am an enthusiastic supporter of the foundation and my favorite bucket is labeled "P.E." Without the support of the foundation and SME, it is doubtful that there would be a professional licensure examination for the mining, mineral processing and mineral-related fields. The annual cost of the licensure program is $35,000-$40,000, with revenues of about $1,000. The shortfall is covered by the SME Foundation from contributions and other income. Substantial contributions from members, mining companies and engineering consulting companies serving the minerals industry are required to put the P.E. program on a sound footing.

Please consider making a generous contribution to the foundation, specifically to the P.E. program. You can make your contribution online at www.smenet.org/foundation or by mail to SMEF, 12999 E. Adam Aircraft Cir., Englewood, CO 80112. If you have any questions or would like more information, contact Barbara Arnold, SMEF President, at 724-727-3439 or David Kanagy, SMEF Executive Director, 303-948-4210.


RAMANI

Raja V. Ramani, 1995 SME President and 2001-2004 SME Foundation President, is the director of the SME review course for the Professional Engineer Examination of Mining/Mineral Processing Engineers. ■

Personal News

(Continued from page 57)

Metals, Williamson spent 15 years with Phelps Dodge Mining, now Freeport-McMoRan Copper & Gold, where she led water quality-related permitting and compliance efforts and conducted comprehensive environmental compliance and environmental management system audits of the company's mining and manufacturing facilities. Ponczoch has overseen finance operations for numerous mining projects around the world. He has served as the regional finance director for Yamana Gold based in Santiago, Chile, where he was responsible for the finance and administrative activities for Chile, Peru, Colombia, Mexico, the United States, Barbados and the Cayman Islands. Ulrich has experience in employee and labor relations, change management and organizational redesign, compensation, performance management, succession planning and talent management.

Peabody Energy has named **CHARLES A. BURGGRAF** as senior vice president-global safety. He will manage a team of safety and compliance professionals at the company's 28 surface and underground operations in the United States and Australia. He will also guide the safety efforts at Peabody's as it expands into Asia. Burggraf will replace **DAVID A. BEERBOWER** (SME) who is retiring after 37 years of service in the mining industry, with 20 of those years at Peabody.

Eriez has promoted **DAVE HEUBEL** to the newly created position of director-North American sales. This follows Eriez' combination of its U.S. and Canadian sales organizations into a consolidated North American sales team. Most recently, Heubel served as national sales manager for the company's U.S. light and heavy industry markets. Heubel joined Eriez in 1990 as a technical sales representative and subsequently served as product manager-separation and marketing manager.

WARREN JOHNSTONE has rejoined Gemcom Software International as vice president of global services. Johnstone previously served as regional vice president of the company's Africa business unit from 2004 to 2007. He has also overseen its operations in Europe, Australia and Asia. Prior to returning to Gemcom, he established a mining consultancy in the United Kingdom and was a technical advisor to private clients in the resources sector.

BETTY MAHAFFEY was elected president of Women in Mining (WIM). A member of WIM's Denver Chapter, she replaces outgoing president **JANN HIGDEM** of Pinehurst, ID. Mahaffey has been an active member of WIM since 1980. She began her association with the mining industry as an employee of Amax Mining and then worked for the Colorado School of Mines for 15 years. ■