Teaching Engineering Ethics across National Borders

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Abstract

Recently there has arisen an increasing world−wide emphasis on teaching ethics within the engineering curriculum. Much of the teaching has relied on the use of an American model emphasizing autonomy and professional identification. This paper argues that this model is inadequate when engineering is seen in a global perspective, because different cultural values are dominant throughout the world, some of which stand in sharp contrast to traditional Western values based on the primacy of the individual. A new global engineering ethics thus needs to be constructed which takes into account a variety of different cultural values and local circumstances, but which is able to serve as a uniting ethical foundation for engineers throughout the world. The paper suggests that the development of a global code of engineering ethics would be a fruitful way to pursue such a strategy.

Key Words: engineering ethics, global engineering, Japanese values, culture, professionalism, international code of ethics.

I. Introduction

Over the last several decades, during which courses in engineering ethics have become a more common feature of engineering curricula in the U.S., a standard model for teaching it has emerged, primarily due to the publication of a number of textbooks with a similar focus. The main features of this model are an emphasis on professional autonomy, use of codes of ethics and moral theory as the basis for decision-making, and the centrality of the case study approach. The two primary early examples of texts which became influential in the emerging discipline, going through a number of editions, were Unger (1982) and Martin and Schinzinger (1983).

More recently a focus on issues in engineering ethics has begun to spread outside of the U.S., a least in part due to the adoption of U.S. style accreditation procedures, which itself reflects a growing trend toward establishing an international set of qualifications for engineering practice. For example, the 1989 Washington Accord signed by a number of English speaking countries, was aimed at establishing the equivalency of accreditation systems in the signatory countries. As another example, in 1995 a NAFTA Forum held in Puerto Vallarta, Mexico, approved a set of “Principles of Ethical Conduct in Engineering Practice Under the North American Free Trade Agreement.” The European Union is also working on establishing equivalency for qualifications to practice in member countries. While a more global educational concern with issues in engineering ethics is to be applauded, for a number of reasons it is less clear that the model used in American teaching of the subject is appropriate on a global basis. Furthermore, the American model may itself no longer be completely suitable for American engineers. Engineering has become a global activity, but the teaching of the ethical concerns that engineers need to be aware of in their professional practice have not kept pace with the challenges posed by the complexities of contemporary design and use of technology.

As a consequence of such concerns, in this paper it is proposed that teaching and research in engineering ethics begin to move toward a more globally founded model of the subject, a perspective which may be especially appropriate in light of the growing fears regarding U.S. cultural influence throughout the world. Using the example of current initiatives to establish an educational framework for engineering ethics in Japan, it is argued that application of a national model of engineering ethics is both impractical and potentially dangerous. Failure to take account of differing cultural conditions can lead to important dimensions of engineering ethics being ignored, with deleterious consequences for public safety. In particular, the paper shows that American restrictions on engineering ethics in terms of scope, individual accountability, and professional orientation are not applicable to countries based on value structures like those of Japan. Global engineering ethics therefore demands that the American model of engineering ethics and of its teaching be modified to fit a transnational perspective. Finally, the paper briefly indicates a possible set of core elements of engineering ethics suitable for its teaching in a global context.

Ⅱ. Engineering Ethics in the U.S.

As a way of establishing the contrast to other perspectives, the following constitutes a brief description of the central elements of the dominant model of teaching engineering ethics in the U.S. The overall focus is on the duties of individual engineers as professionals. Within this framework, engineers are morally accountable for their own actions, as well as for actions of others, in circumstances when they are aware that such actions pose a hazard to the safety of the public. That is, they must be able to justify their actions by giving an explanatory account of them based on the provision of reasons. In this process, engineers' decisions are to be guided by the fundamental proposition at the core of most American codes of engineering ethics, such as the following citation from the National Society of Professional Engineers' (NSPE) code: "Engineers, in the performance of their professional duties, shall hold paramount the safety, health and welfare of the public." (NSPE 2006) In fulfilling their responsibilities, engineers are not only accountable, but also need to be granted professional autonomy as a necessary correlate. Autonomy requires engineers be able to exercise independent authority regarding the appropriateness of technical decisions, as well as about the moral implications of those decisions.

When making moral judgments, engineers have two explicit, and one implicit, sources on which to rely. The explicit sources are the professional codes of ethics and moral theory. The implicit source is the engineers' cultural background in the form of moral beliefs which engineers absorb from their families and education. Codes of ethics are historically evolving documents which reflect agreed upon standards within the engineering community about such matters as safety, competence, confidentiality, and honesty. Moral theory, from the Western philosophical tradition, provides decision-making models for actions, especially in circumstances when there may be some doubt about the appropriate ethical course of action in a particular situation. In both the use of theory and the codes, engineers are expected to exercise their own professional judgment, since both instruments are general in their nature. A significant part of education in engineering ethics consists of students gaining familiarity with these decision-making instruments and becoming more adept in their use. Moral intuitions, while they are frequently appealed to in life and carry with them a conviction and specificity often missing after an analysis using the formal instruments, are heavily dependent on the particular background of an engineer and are not susceptible to public scrutiny.

In relying on codes of ethics for decision-making, American engineering reflects a tradition of professional identification. Professions are public institutions which are expected to, and often are legally empowered to, regulate the ethics of their membership as part of a social contract with the larger society. Professions determine educational requirements, admission to membership, technical standards, and the continuing right to practice. They are seen by the public as being accountable for the technical competence and ethics of their members. Individual professionals therefore are able to use their identification with the profession as a means of justifying a particular course of action in the face of possible pressure from an employer or a component of the public. While in some respects engineering does not fulfill all of the characteristics of the traditional professions, educational practice clearly sets out professionalism as an ideal to which all engineers should aspire. (Luegenbiehl,1983)

For engineers, in particular, the model of professional identification raises an issue of conflict of loyalties. Most engineers are employed by corporations. As employees, they are required to be loyal to their employers, as made explicit in the codes of ethics. The NSPE Code, for example, states: “Engineers, in the fulfillment of their professional duties, shall act for each employer or client as faithful agents or trustees.”(NSPE 2006) However, as professionals they also have duties of loyalty to the engineering profession and to the public. In the final analysis, their obligation to protect the public safety is supreme or “paramount.” The result is that the issue of external whistle blowing is a major and pressing theme in American engineering ethics, and is emphasized in its teaching, since protection of the public can require that it be informed of a danger which is being caused or is ignored by one’s employer or by other employees. While external whistle blowing may actually benefit a corporation in the long run, it is almost uniformly perceived as the strongest possible evidence of disloyalty to an employer and to one’s fellow employees.

The teaching of engineering ethics in the U.S. reflects the above mentioned emphases. While students are asked to become acquainted with professional norms and the codes of ethics, they are not subject to indoctrination into the rules of the profession. (Luegenbiehl, 1996) Instead, the typical instrument for learning is the use of case studies. In looking at cases, students are encouraged not simply to replicate a previously determined solution, but rather to analyze a case on their own, to make their own determination about the best possible course of action or to make their own judgments about decisions which were made in the case. They are reminded that they will be held individually accountable for their actions as professionals and will be required to provide justification for their decisions. Looking at case studies becomes an exercise in the use of moral imagination, whereby various possible alternatives, decisions, and outcomes are analyzed in a manner similar to arriving at a solution to a complex engineering problem. Disagreement among students, as well as between students and professors, is encouraged as a means of stimulating further reflection in preparation for analogous situations they might encounter in their professional lives.(Harris, et. al, 2004)

Ⅲ. Questions About the U.S. Model of Engineering Ethics

Many questions can be raised regarding the validity of the American model of teaching engineering ethics. Here are raised only a few which impact the overall thesis of this paper. First, there is the issue of the scope of such an approach. The model is restricted to individual engineers carrying out their professional duties, primarily in the context of work performed for an employer or client. Engineers are thus held accountable for their own actions or, in some cases, for those of others they encounter in their professional capacity. However, engineers can also bring a wealth of expertise to public discussions regarding technological developments in a broader context. When codes of ethics address this issue, they take the narrow view of encouraging engineers to enlighten the public about the benefits of technology. (NSPE 2006) But specific technological innovations and the ever increasing dependence of society on technology require the same kind of critical analysis that engineering students are being asked to consider about their own work. It is questionable whether the moral neutrality that engineers have been asked to adopt in relation to public issues concerning technology is an appropriate model for the future. It should also be noted that some texts are beginning to address this issue. (Mitcham and Duval 1999)

Second, the core emphasis in American engineering ethics is on individual professionals and their duty to decide on ethically appropriate courses of action. This emphasis almost ensures situations of conflict among engineers and between engineers and employers. As independent moral agents, engineers are required to maintain their moral convictions in the face of any opposition. Compromise is not an acceptable solution in Western ethical discourse, since it is the individual who will ultimately be held accountable and responsible. It is interesting that in the teaching of engineering design, for example, much stress has recently been placed on the importance of teamwork, which is also a core feature of most professional activity, but that this has not been seen to be relevant to the context of professional ethics, since embedded in the very concept of being a professional is the ideal of independent judgment of the individual. Thus, for example, in the Accreditation Board for Engineering and Technology Engineering Criteria 2000, an emphasis on teamwork as one of the well publicized elements a-k of Criterion 3 is laid out as a core requirement for accreditation of engineering programs. (ABET 2005)

Finally, questions can legitimately be raised regarding the normative status of the American engineering ethics. The three sources for decision-making are ethical theory, codes of ethics, and moral intuitions. One of the major reasons for disagreements in ethical judgments, however, is that competing ethical theories exist in the Western tradition and therefore the particular moral perspective of an engineer, in part at least, will depend on which theory he or she finds most compelling, even in cases when use of theory is not explicit. As for utilization of the codes of ethics, it has frequently been pointed out that the different engineering organizations do not all use the same code, which raises questions as to their normative force when an engineer belongs to more than one professional organization.(Luegenbiehl,1983) Further, it needs to be recognized that codes of ethics are political documents which come into existence as a result of a series of compromises and thus do not necessarily reflect a consistent perspective or all necessary ethical requirements. Moral intuition derived from an individual's cultural background is also notoriously difficult to use as a final arbiter, since it depends on the particular background of the individual and is not subject to debate.

Ⅳ. The Need to Globalize Engineering Ethics

Despite such concerns about the U.S. model of teaching engineering ethics, it may still be suitable for a strictly American context of engineering practice, because it is in harmony with such fundamental American values as individualism, independence, diversity, and equality. Even the conflict among different solutions to ethical issues is acceptable within a framework of discourse based on the provision of reasons. However, in reality it is questionable whether a strictly American context for engineering practice still exists, even for engineers who practice solely in the U.S. We live in an era of global inter-dependence which is reflected in the working environment of typical American engineers. Often these engineers work for multinational corporations which employ engineers from a variety of cultural backgrounds, both here and abroad. Even if that is not the case, their employers are likely engaged in contractual or trade relationships with companies in other countries. Further, the mobility of contemporary engineers makes it increasingly likely that during their career they will work for a foreign employer, either in the U.S. or abroad.

Perhaps most important to consider however, is not simply the career path of the engineer, but the nature of modern technology. Engineers design and produce technology for a given context. However, the rapid global diffusion of technology in the contemporary world may well mean that technology appropriate for one cultural context will inappropriate or even unsafe in another context. It is becoming increasingly important to be aware of the ethical implications of the technology one produces in a global technological environment.

Consequently, education in engineering ethics needs to take on a more global character. The structure in which American engineering ethics is embedded cannot easily be applied globally. Traditions of independent professions, universal moral theory, and autonomous decision-making are currently dominant in only a few cultures, primarily in the West. Even there, they are not as widely disseminated as much of the teaching of engineering ethics in the U.S. assumes. The French tradition, for example, does not reflect the emphasis on profession that most American engineers are familiar with. (Didier, 2002). It is when we turn to a consideration of Asian cultures, however, that the differences in cultural values which impact ethical considerations become most obvious.

Ⅴ. The Japanese Context

The Japan Accreditation Board for Engineering Education (JABEE) was founded in 1999 as a result of the desire to harmonize standards of engineering education with international norms. While some aspects of the accreditation standards established by the board differed from existing ABET standards, the requirement to consider ethics education was carried over. This resulted in an immediate interest in engineering ethics in Japan, which had no independent tradition in the subject. Within a span of three years at least six American texts on engineering ethics were translated, including those by Harris, Pritchard, and Rabins (2004),Martin and Schinzinger (1983), Vesilind and Gunn (1998), and Whitbeck (1998). These formed the basis for teaching of the subject in Japan, which then of necessity reflected much of the American approach discussed above. (Iino, 2001) However, this approach does not fit well with the existing cultural conditions in Japan, specifically as they apply to the three emphases in American engineering ethics discussed above.

Japan, unlike the U.S., is a group based society. Social practices are structured to reinforce harmony within the group, with one of the most common sayings being "the nail that sticks out will be hammered down." The emphasis on individual autonomy and the assumption of individual responsibility so prevalent in American engineering ethics texts therefore has difficulty resonating with Japanese engineering students. Given their identification with their employer, Japanese engineers also have difficulty even conceptualizing the possibility of whistle blowing on their "group". This divergence from the American model could be overcome based on a model of professionalism. However, like a number of other countries, Japan does not have a history of professions. Identification is with the employer rather than with an external group, so that professional independence is not currently seen as an option for initiating action.(Clark, 2000) The typical Japanese engineer will identify himself as a "Toyota man," for example, rather than as an engineer.

Second, Japan does not have a tradition of universal moral theories like those used in the West to analyze moral problems. The moral framework is best characterized as one of ethical relativism, depending on a particular group context, where decisions are most often consensus based. It is thus unreasonable to expect Japanese engineering students to be able to analyze ethical problems from an abstract, universal perspective. American students have been inculcated with universal principles, even if they are not aware of these explicitly. Japanese students have not.

Finally, the model used to teach engineering ethics in the U.S., which is based on discussion of cases, with the result being the arriving at independent judgments, is currently not workable in the Japanese educational system, which is based on the authoritative voice of the instructor. Students are expected to receive the transmitted wisdom, not to arrive at their own conclusions. It is extremely difficult to have them discuss even factual issues, and almost impossible to do so with normative questions. (Luegenbiehl, 2004)

The cultural conditions in Japan, here used only as a brief example, thus make the teaching of engineering ethics on the American model an extremely difficult task. While the subject-matter is clearly important, using an inappropriate model may actually have the negative effect of inuring students to issues in engineering ethics. The underlying assumption that all cultures share American cultural values needs to be guarded against, especially in matters which affect human “safety, health and welfare”. A large part of what distinguishes cultures from one another is, in fact, the difference in the fundamental values among them. To the extent that a particular model of engineering ethics relies on a given society’s core values for its acceptability, a straightforward transmission of the product of such values is bound for failure.

Ⅵ. A Global Approach to Engineering Ethics

The current practice of teaching engineering ethics thus faces a twofold difficulty. On the one hand, as has been pointed out, there exist some problems in the current American model of teaching engineering ethics. On the other, the model itself is inappropriate for at least some cultural contexts, especially ones in Asia. Given the current state of engineering practice, the solution to these difficulties is not to be found in educating students about other specific cultural contexts in with which they might have to interact in the future, because that would be an almost endless task. Rather, what is needed is a new model for teaching engineering ethics. This model will take a global approach to engineering ethics, based on a set a common themes, rather than focusing on those appropriate only to particular cultural conditions.

Contemporary engineering occurs in a context which is not bounded by national borders, nor in the bilateral relationships between nations. Engineering practice is, and will continue to be, a global activity. The increasing trend toward multinational corporations, foreign suppliers and customers, foreign ownership, and engineers working in countries other than their homeland, demands that an entirely new model for engineering ethics be developed which will be applicable no matter what one’s country of origin or country of employment. The design, development, and use of technology transcends all national boundaries.

Required, therefore, is an ongoing dialogue which will take account not only of different cultural values, but also of different conceptions of professionalism, as well as different teaching and learning styles. The final goal is a global consensus, expressed in an international code of engineering ethics, which engineers everywhere can use to found their practice and which can be used as a universal teaching tool. Such a code will cover some of the topics dealt with in U.S. codes, but will need to focus more explicitly on the development of conceptual issues, since many of the moral and professional terms used are subject to cultural interpretation. Also, it will need to omit specific national references as well as topics on which no consensus is foreseeable. It should not be expected that the code can completely reflect the moral intuitions of one society. Finally, just as various U.S. engineering organizations are able to extend and specify aspects of the same code model, room for national perspectives must be left in an international code. The basic aim of the code would thus be to delineate fundamental areas of agreement and point students to possible hazards in cross-cultural engineering practice.

The development of an international code of engineering ethics will take years, and, if it is to reflect a consensus, it must do so. As basis for further discussion, here is a brief indication of what themes might be included in such a code. The individual entries are discussed more extensively in a separate paper. (Luegenbiehl, 2003)

1. Giving priority to the safety of those affected by the products of technological development, both those of their own making and those of others. Since engineers are the creators of technology, they much also assume responsibility for ensuring its safety.
2. Emphasis on the competence of engineers in professional practice as a moral requirement. Incompetent engineering produces unsafe technology, which would violate the requirement of safety.
3. The importance of the public's reliance on the honesty and objectivity of engineers. Since the work of engineers is opaque to members of the general public, the public must be able to trust engineers and be able to rely on what they are told by engineers.
4. The avoidance of conflicts of interest whenever possible. Engineers have a primary, but not absolute, duty to further the interests of their employers and to not let irrelevant concerns guide their decisions.
5. Keeping confidentiality when so required, but being prepared to break it when the public is endangered. Engineers have a duty of loyalty to their employers to preserve proprietary information, but this does not entitle them to violate the requirement that the public be kept safe.
6. Acting on the basis of merit and fairness. Again, public trust of the work of engineers requires that decisions not be based on irrelevant considerations such as personal biases.
7. Respecting human rights as they have been established in international forums. This is an especially important theme an international context, since the work of engineers

in the future will more and more often occur in contexts which may not equally recognize the dignity of human beings.

8. Recognizing that engineers need to have their rights respected if they are to be able to engage in ethical practice. Past ethical discussions have emphasized duties of engineers. Their rights are, however, equally important in situations where otherwise their ability to protect the public and work in a competent fashion might be compromised.
9. Engineers' responsibility to positively contribute to a sustainable global natural environment. As the leading experts on technological fixes to environmental problems, engineers by nature of their knowledge and abilities have a responsibility to be leaders in an area which has the potential to negatively affect the safety of all humans.
10. Explicit consideration of the property rights of engineers, especially of intellectual property. The idea of intellectual property is currently still in flux on a global basis. If engineers are to be motivated to contribute to the technological stock of the world on a global basis, they need to believe that their right to property will be respected.
11. The duty of engineers to consider the societal and global ramifications of their engineering decisions. Engineers have often focused on narrow issues of technical safety of individual products. Their knowledge base, however, brings with it the responsibility to consider the long-term and global impacts of their activities.
12. The obligation of engineers to participate in public discussions regarding the future uses of technology. Engineers should not aim to be technocrats, that is rulers of society, but they should participate in public discussion of technology's future much more extensively than they have in the past, given their disciplinary expertise.

These requirements are neither complete nor fully enunciated. They are intended to give only a small indication of what future discussions will be necessary as a global perspective on engineering practice becomes more pressing.

Ⅶ. Summary

The traditional approach to teaching engineering ethics which emphasizes individual autonomy, use of moral theory as a basis for decision-making, and the examination of case studies, may no longer be appropriate for the current global environment of engineering practice. What is needed for that environment is a global understanding of engineering ethics which can be used to educate engineering students throughout the world. The most suitable way of instantiating such a common approach is to develop a document to be used in common by both practicing engineers and engineering educators, most likely an international code of engineering ethics.

[A c k n o w l e d g e m e n t]

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