Future Directions in Engineering Ethics Research: Microethics, Macroethics and the Role of Professional Societies*

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ABSTRACT: *Three frames of reference for engineering ethics are discussed—individual, professional and social—which can be further broken down into "microethics" concerned with individuals and the internal relations of the engineering profession and "macroethics" referring to the collective social responsibility of the engineering profession and to societal decisions about technology. Few attempts have been made at integrating microethical and macroethical approaches to engineering ethics. The approach suggested here is to focus on the role of professional engineering societies in linking individual and professional ethics and in linking professional and social ethics. A research program is outlined using ethics support as an example of the former, and the issuance of position statements on product liability as an example of the latter.*

MICROETHICS AND MACROETHICS IN ENGINEERING [1,2]

A number of authors have suggested that engineering ethics encompasses multiple domains. The ethicist John Ladd[3] subdivides engineering ethics into "micro-ethics" or "macro-ethics" depending on whether the focus is on relationships between individual engineers and their clients, colleagues and employers, or on the collective social responsibility of the profession. In each case Ladd seems to be concerned with what might be called "professional ethics," with micro-ethics focusing on issues for the most part internal to the profession and macro-ethics referring to professional responsibility in a broader, societal context.

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McLean,[4] an engineer, utilizes three categories in discussing engineering ethics: technical ethics, dealing with technical decisions by engineers; professional ethics, dealing with interactions among managers, engineers and employers; and social ethics, dealing with sociopolitical decisions concerning technology. McLean's notion of professional ethics is narrower than Ladd's, incorporating only those dimensions that Ladd describes as micro-ethics. At the same time, McLean has a broader overall notion than Ladd of the spheres of ethics that are relevant to engineering for he includes both individual and societal dimensions.

Another engineer, Vanderburg,[5] while employing terminology similar to Ladd's, seems to neglect professional ethics entirely while distinguishing between "microlevel" analysis of "individual technologies or practitioners" and "macrolevel" analysis of "technology as a whole", categories that track to McLean's technical and social ethics categories. Vanderburg's classification is similar to that of Devon,[6] another engineer, who suggests a new paradigm for engineering ethics, which he terms "social ethics", encompassing the "social relations of expertise" in connection with technology management and decision-making, in place of a focus on individuals.

De George,[7] an ethicist, distinguishes between "ethics in engineering," and "ethics of engineering". The focus of the former is on actions of individuals while the latter is concerned with both relationships internal to the profession and the responsibilities of the engineering profession to society. De George's notion of "ethics of engineering" thus incorporates both Ladd's micro and macro dimensions. In addition, the "ethics of engineering" specifically includes professional engineering societies.

As shown in Table 1 (opposite), when combing these various facets of engineering ethics, an interesting pattern emerges. Three frames of reference are apparent: individual, professional and social. Combining Ladd's and Vanderburg's terminology, "microethics" can be seen to include concern with individuals and the internal relations of the engineering profession, while "macroethics" applies to both the collective social responsibility of the engineering profession and to societal decisions about technology.

QUESTIONS FOR RESEARCH

Heretofore, most research and teaching in engineering ethics has had a micro focus either in the sense Vanderburg uses the term or the sense in which Ladd uses it. This state of affairs is lamented by political philosopher Langdon Winner,[8 (p.62)] who is critical of the overemphasis in engineering ethics on case studies of microethical dilemmas to the exclusion of larger issues relating to the development of technology:

> Ethical responsibility...involves more than leading a decent, honest, truthful life, as important as such lives certainly remain. And it involves something much more than making wise choices when such choices suddenly, unexpectedly present themselves. Our moral obligations must...include a willingness to engage others in the difficult work of defining what the crucial choices are that confront technological society and how intelligently to confront them.

Table 1. Microethics and Macroethics in Engineering

Source	Microethics		Macroethics	
	Individual	**Professional**		**Social**
Ladd[3] (1980)		**micro-ethics** professional relationships between individual professionals and other individuals who are their clients, colleagues and employers	**macro-ethics** problems confronting members of a profession as a group in their relation to society (i.e., social responsibility of professionals as a group)	
McLean[4] (1993)	**technical ethics** technical decisions and judgments made by engineers	**professional ethics** interactions between engineers and other groups (e.g. managers, engineers, employers)		**social ethics** technology policy decisions at the societal level
Vanderburg[5] (1995)	**microlevel analysis** of individual technologies or practitioners			**macrolevel analysis** of technology as a whole
Devon[6] (1999)	**individual ethics**			**social ethics** the "social relations of expertise" in connection with technology management and decision-making
De George as reported by Roddis[7] (1993)	**ethics in engineering** actions of individual engineers	**ethics of engineering** the role of engineers in industry and other organizations, *professional engineering societies*, and responsibilities of the profession		

Recently, scholars have begun to address macroethical issues in connection with engineering.[9,10,11] Yet to be developed, however, is a comprehensive framework for integrating microethical and macroethical approaches. One approach to developing such a framework is to focus on the role of professional societies in bridging microethical and macroethical concerns as suggested in De George's concept of the "ethics of engineering" (see Table 1). Beyond their role in promulgating codes of ethics, the role of professional engineering societies in the engineering profession has for the most part been ignored. A few authors, including Layton[12] and Unger,[13] have taken the role of professional societies seriously, but for the most part their work has focused on how professional societies bridge the internal and social responsibility

dimensions of professional ethics (although as noted below, Unger also discusses ethics support).

Beyond the role implied by De George's concept of "ethics of engineering", professional societies would seem to have the potential to serve as a conduit across the entire continuum of ethical frameworks indicated in Table 1; that is, professional societies also have an important role to play in linking individual and professional ethics and in linking professional and social ethics. In the former case, an obvious role of the professional societies would be in providing support for individuals who exhibit ethical behavior. In the latter case, professional societies ostensibly provide a link between the social responsibilities of the profession and societal decisions on technology through their issuance of position statements on matters of public policy. One such area engineering societies have been active in is product liability reform.

In broad outline, then, the research question proposed here is: what is the role of professional societies in linking individual and professional ethics and in linking professional and social ethics?

In each case, this question can, in general terms, be broken down into three component questions:

1. What *ought* to be the role of professional engineering societies in linking individual and professional ethics (and in linking professional and social ethics)?
2. How successful have the professional societies been in forming such linkages?
3. To the extent they haven't been successful, why are professional societies unable or unwilling to form such linkages?

In the remainder of the paper I'll attempt to answer these questions, and/or suggest a research program for answering them, using as examples the cases of ethics support and product liability reform as reflected in the experience of the largest professional engineering society, the Institute of Electrical and Electronics Engineers (IEEE).

In the case of ethics support the specific form of the questions to be addressed are:

1. What *ought* to be the role of professional engineering societies in providing ethics support?
2. How successful have the professional societies been in providing ethics support?
3. To the extent they haven't been successful, why are professional societies unable or unwilling to provide ethics support?

In the case of position statements on product liability reform the matter is more complicated since the professional societies have long been active in issuing such statements. It is an open question, however, as to whether such position statements are actually informed by consideration of professional and/or social ethics. The specific questions to be addressed are thus:

1. What *ought* to be the role of professional engineering societies in issuing position statements on public policy issues such as product liability?

2. In issuing position statements on public policy issues such as product liability, how successful have the professional societies been in incorporating consideration of ethics?
3. To the extent they haven't been successful, in issuing position statements on public policy issues such as product liability, why are the professional societies unable or unwilling to incorporate consideration of ethics?

WHAT OUGHT TO BE THE ROLE OF PROFESSIONAL SOCIETIES? [1,9]

The first question is normative, but for an answer we need look no further than the codes of ethics promulgated by the professional engineering societies. The code of ethics, after all, is the hallmark of a professional engineering society's stance on ethics. Nevertheless, many ethicists such as Ladd[3] are skeptical of the relevance and usefulness of codes which they argue are primarily designed to create a positive public image of the profession, largely self-serving, used to divert attention from macroethical problems, of little meaning when it comes to ethical reasoning, and a form of ethical conventionalism. Others, most notably Davis, consider codes, in effect, to be ethical "standards" of the engineering profession. Davis[14] gives several reasons why engineers should support their profession's code including: promoting a work environment that is supportive of ethical behavior and helping to make "their profession a practice about which they need feel no morally justified embarrassment, shame, or guilt." If we accept Davis' interpretation, then we should be able to infer normative positions from the codes in both the microethical and macroethical contexts.

While codes vary from one professional society to another, they typically share common features in prescribing the responsibilities of engineers to the public, their employers and clients, and their fellow engineers. All modern engineering codes state that the most significant responsibility of engineers is to protect the public safety, health, and welfare. Codes often also emphasize such characteristics as competence, trustworthiness, honesty and fairness.[13]

In both cases under consideration, the answer to the first question can be inferred from the primacy engineering codes of ethics give to protection of public safety, health and welfare. The codes would seem to imply that the professional societies *ought* to support individual engineers who act to protect the public safety, health, and welfare, and that the professional societies, when issuing position statements on public policy issues such as product liability, *ought* to consider the ethical obligation to protect the public safety, health, and welfare. To do otherwise would undermine the notion that protection of public safety, health, and welfare is of paramount significance.

Like most engineering codes of ethics, the first provision of the IEEE code, implemented in 1990, holds paramount the public safety, health, and welfare, by pledging its members "to accept responsibility in making engineering decisions consistent with the safety, health and welfare of the public, and to disclose promptly factors that might endanger the public or the environment." The IEEE code also includes language more specific to the two cases under consideration. The fifth provision of the Code pledges IEEE members to "to improve the understanding of

technology, its appropriate application, and potential consequences." Improving the understanding of technology would seem to encompass position statements on public policy issues such as product liability; the appropriate application and potential consequences of technology surely include matters pertaining to the public safety, health, and welfare. The tenth and final provision of the code directly endorses the concept of ethics support by pledging IEEE members "to assist colleagues and co-workers in their professional development and to support them in following this code of ethics."

ETHICS SUPPORT [9]

Engineers who have blown the whistle on unethical behavior or taken other action in accord with their code of ethics have often had to pay a high price for their ethical stance, including demotions, firings, blacklisting, and even threats to life and limb. Many argue that it is unreasonable to expect engineers to be "moral heroes" in this manner.[15] Indeed, a great deal of attention has been focused on providing support for ethical engineers, the notion being that members of society have a collective responsibility for nurturing ethical behavior.[16] Efforts to provide such support through corporate ethics offices and government regulation have, at best, been incomplete.[9] Professional engineering societies have been looked to as a counterweight to the pressures of the workplace on the conduct of engineers.[13]

How successful have the professional societies been in providing ethics support?

This is an empirical question; available evidence suggests that, beyond promulgating codes of ethics, professional societies seem unwilling or unable to sustain efforts in support of the ethical behavior of their members. The recent experience of the IEEE wherein long sought after gains in ethics support were crushed by a backlash from staff and volunteer leaders is illustrative of this situation.

The IEEE has two ethics-related committees at the Board of Directors level, the Member Conduct Committee (MCC) and the Ethics Committee. The MCC's purpose is two-fold: to recommend disciplinary action for members accused of violating the code of ethics, and to recommend support for members who, in following the code of ethics, have been retaliated against. The Ethics Committee, which was formed in 1995 as a result of efforts by members to elevate the prominence of ethics within the IEEE, provides information to members and advises the Board on ethics-related policies and concerns. Following its inception, the IEEE Ethics Committee established an Ethics Hotline in 1996, designed to provide information and advice on ethical matters to professionals in IEEE's field of interest. Cases brought to the attention of the Ethics Hotline included violations of intellectual property rights, falsification of quality tests, and design and testing flaws that could result in threats to public safety. In some instances, such cases were referred to and acted upon by the MCC.[17]

After less than a year of operation, the IEEE Ethics Hotline was suspended in 1997 by the Executive Committee of the Board of Directors. In 1998 the Executive

Committee rejected and suppressed a report of its own task force recommending reinstatement of the hotline.[17] Also in 1998, the IEEE implemented bylaw changes that reduced the terms in office of members of the Ethics and Member Conduct Committees, thus making them more vulnerable to replacement on political grounds, and, in apparent disregard of IEEE's own code of ethics, prohibited the Ethics Committee from advising members and other individuals.

The web page of the Ethics Committee[18] now bears the following notice: "The IEEE Ethics Committee will not be involved in the processing of personal complaints or in providing advice to individuals. Other resources both inside and outside of the IEEE are available to individuals upon request." The IEEE has also limited the role of the Member Conduct Committee in providing ethics support, as indicated by the disclaimer on the MCC web page:[19] "The Member Conduct Committee's role in disputes involving industry, academia, or government is generally limited to the restatement of the ethical precepts that guide the conduct of IEEE Members." Ironically, the provision of the IEEE Code of Ethics calling for ethics support has remained unchanged.

Why are professional societies unable or unwilling to provide ethics support?

While most opponents of ethics support within IEEE point to liability concerns, an argument persuasively refuted by Unger,[14,17] some additionally note that an ethics hotline puts IEEE in what them deem to be an undesirable position of mediating disputes between members and their employers. Indeed, corporate influence over professional societies is the traditional explanation for lack of ethics support by the societies

This influence is thought to derive from the relationship between engineering and business eloquently described by Layton,[12] who depicts the engineer as part scientist and part businessperson, yet not really either; that is to say, marginal in both cases. This situation, which resulted from the co-evolution of engineering as a profession and technology-driven corporations, sets up inevitable conflicts between the professional values aspired to by engineers and the business values of their employers. More than three quarters of all engineers work in the corporate world. This statistic stands in contrast to other professions such as law and medicine where the model has been, at least historically, for professionals to work in private practice, serving clients or patients as opposed to employers. Layton notes that professionals value autonomy, collegial control and social responsibility, while businesses value loyalty, conformity and ultimately, the pursuit of profit as the principal goal. This tension is exacerbated by the fact that the career path of engineers often leads them into management; engineers who hope to advance in the corporate hierarchy are expected to embrace business values early in their careers. That there is an inherent conflict between the engineer's employee status and professional autonomy is disputed by Davis.[14] The fact remains, however, as Layton points out,[12] that many of the leaders of the professional engineering societies are senior members who have moved from technical engineering duties into business management roles within their companies. In addition, many

companies fund and support the participation of their employees in the professional societies.

Another possible explanation for lack of ethics support from the professional societies, related to the first, is an engineering/business culture that highly values economic efficiency while downplaying engineering's societal context. Many authors have characterized "the engineering view" to one extent or the other as being focused mainly on technical solutions to problems. This characteristic of the engineering view may account for the reluctance of some engineers to stray into the uncharted waters of the social and ethical dimensions of engineering.[9] As I have noted elsewhere:[20]

> The prevailing engineering culture is readily recognized from both inside and out. Engineers are no-nonsense problem solvers, guided by scientific rationality and an eye for invention. Efficiency and practicality are the buzzwords. Emotional bias and ungrounded action are anathemas. Give them a problem to solve, specify the boundary conditions, and let them go at it free of external influence (and responsibility). If problems should arise beyond the work bench or factory floor, these are better left to management or (heaven forbid) to politicians.

Other factors potentially contributing to the reluctance of professional engineering societies to engage in ethics support that warrant investigation include: misguided efforts to uphold the public image of engineering by suppressing or limiting discussion of ethics cases and perceived complications resulting from the growing internationalization of professional engineering societies.

PRODUCT LIABILITY [2,9]

Product liability reform is a rich example of the involvement of professional engineering societies in the debates over public policy issues regarding the development and use of technology.[9] Critics of current US product liability law call for rollbacks often approaching the "buyer-beware" policies of bygone days. For example, in 1996 the US Congress passed legislation that would severely limit the effect of product liability litigation by placing a cap on punitive damages and enacting stricter requirements for holding manufacturers liable. President Clinton, as expected, vetoed the bill;[21] however, the debate over product liability reform has continued.

The proponents of product liability reform argue that the current system unjustly rewards plaintiffs and stifles technological innovation, resulting in a lack of competitiveness on the part of US manufacturers and decreased product safety. Supporters of the current system counter that it generally works as intended in discouraging the manufacture of defective products and compensating people injured by such defects.[22] To some, the debate over product liability reform is a classic business/consumer conflict. A *New York Times editorial*,[23] for example, described proposed legislation as "The Anti-Consumer Act of 1996".

Despite the arguments of both sides, the evidence appears to be mixed concerning whether product liability rewards result in improvements in product safety.[22] Evaluation of the product liability system and calls for its reform are clearly areas of great concern from the standpoint of social ethics. Given the primary responsibility of engineers for the public safety, health and welfare noted above, the product liability issue should also be subject to ethical scrutiny from the perspective of professional ethics. For example, the role of product liability litigation in creating an environment wherein engineers with safety concerns are given a hearing by their managers is worthy of consideration. As Ladd[16] and others have argued, corporations are not moral agents, their sole goal being to generate profits. In order to influence a corporation's behavior, it must be in their economic interest to do the right thing. On the face of it, product liability litigation would seem one mechanism for realizing such influence. It is therefore not unreasonable to expect that the connection between the threat of product liability suits and the ability of designers, quality control engineers, and others charged with product safety to raise and press safety concerns be carefully considered by the professional engineering societies when promulgating position statements on product liability reform.

In issuing position statements on public policy issues such as product liability, how successful have the professional societies been in incorporating consideration of ethics?

This is an empirical question; available evidence seems to suggest that while the professional societies have adopted policy positions on product liability these positions have not been subject to critical ethical reflection.

Engineers and engineering societies have tended to side with the proponents of product liability reform. A vice-president of engineering of a major US automobile company, for example, has argued that product liability restricts engineering practice by inhibiting innovation, discouraging critical evaluation of safety features, and preventing implementation of new or improved designs.[24] The position statement on product liability of IEEE-USA, a unit of IEEE concerned with professional issues in the USA,[25] issued in 1998, calls for stringent limits on product liability including holding the manufacturer blameless when existing standards are met, adequate warnings are provided, or the product is misused or altered by the user. Other engineering societies, such as the American Society of Mechanical Engineers,[26] have also actively supported product liability reform.

Within IEEE, the ethics-related committees discussed above have no formal interaction and little, if any, informal interaction with committees charged with drafting position statements on public policy issues. In fact, IEEE-USA represents only the roughly three fourths of IEEE members who live in the US and its position statements are often a source of controversy within the parent organization.

Beyond organizational barriers, there is little, if any, evidence to suggest that engineering societies promoting changes in the product liability system have considered the effect that decreasing the impact of product liability would have on

engineering ethics. It is not altogether surprising that the professional societies have not subjected calls for product liability reform to ethical scrutiny for, on the whole, the engineering community has paid little attention to the ethical implications of product liability. For example, a major 1994 study of product liability and innovation by the National Academy of Engineering,[24] which considered such issues as corporate practice, insurance, regulation, and the role of scientific and technical information in the courtroom, touched only briefly on ethics (in a chapter on the need to address public risk perceptions).[27] Even the ethics literature is equivocal on the issue of product liability.[28] In De George's well known essay on engineering responsibility in the Pinto case,[29] for example, he advocates stronger regulation and fines and imprisonment for corporate officials to achieve desired levels of safety, giving only passing notice to the role of product liability litigation.

In issuing position statements on public policy issues such as product liability, why are the professional societies unable or unwilling to incorporate consideration of ethics?

Possible explanations for the apparent uncritical acceptance of product liability reform by professional engineering societies mirror the potential reasons for lack of ethics support. In particular, minimizing liability (this time on the part of the engineering practitioner), bowing to business interests, an engineering culture that heavily values economic efficiency over social and ethical implications, and reluctance to admit engineering projects sometimes do preventable harm would all seem reasonable explanations for the motives of professional engineering societies.

CONCLUSIONS

While important work remains to be done with respect to microethical issues in engineering ethics, little work has been done in the area of macroethics, and still less in developing integrated approaches to addressing microethics and macroethics in engineering. As this paper has suggested, a fruitful avenue of research towards this end would be to investigate the role of professional engineering societies in both the microethical and macroethical realms; that is, their roles in linking individual and professional ethics and in linking professional and social ethics. Ethics support and position statements on public policy issues such as product liability are suggested as initial areas of study in the microethical and macroethical areas, respectively.

The discussion presented here is based in large measure on participant observation and reviews of both the scholarly and professional literature concerning the ethics activities of IEEE. Similar approaches can and should be taken to investigate the activities of the other major engineering societies, including non-US based societies where the role and institutional culture of professional societies may differ significantly from that in the US. When dealing with position statements on public policy, due consideration must also be given to the national context—e.g., product liability laws and norms differ from nation to nation.

To get at the heart of the questions raised here, however, especially the third question posed in each case, will require more structured research aimed at uncovering individual and institutional values and motives. The questionnaire and open-ended interview technique employed by Davis[14] and his colleagues in researching engineering and management attitudes and behaviors with respect to ordinary technical decision making is a method that merits serious consideration. In the cases discussed here, the interviews would need to be conducted with working engineers, rank and file members of the professional societies, volunteer leaders and staff of the societies, and other relevant parties. While there might be reluctance on the part of leadership of the professional societies to participate in such interviews, Davis's success in interviewing at ten companies, and results indicating much broader areas of overlap in the concerns and functions of engineers and managers than is widely assumed, offer some cause for optimism that the professional societies would be willing to participate.

A goal of the research programs discussed here should be to identify strategies for removing the barriers to ethics support on the part of professional engineering societies and barriers to introducing ethical considerations into the process of formulating position statements on public policy issues.

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