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Engineering, Engineers and the Public Good

F. A. Kulacki

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THE FUTURE OF CALLINGS—AN INTERDISCIPLINARY SUMMIT ON THE PUBLIC OBLIGATIONS OF PROFESSIONALS INTO THE NEXT MILLENNIUM:

ENGINEERING, ENGINEERS AND THE PUBLIC GOOD

F. A. Kulacki†

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I. INTRODUCTION

Ever since the modern practice of engineering and the teaching of engineering in formal university courses of study took form some 200 years ago, a great number of articles have appeared to explain both the professional and technical nature of the field. Indeed, professionalism as a topic is not routinely presented in the last year of undergraduate study in United States engineering schools. However, few attempts have been made to discuss the profession in the context of a "calling" and the future of that calling. Thus, I look upon the occasion of The Future of Callings conference of Spring 1998 and this issue of the William Mitchell Law Review as providing rare opportunities to open a new arena of discussion for the field.

More specifically, I examine the relation of the engineering profession and engineers to the public good. My goal is to provide the basis for future discussion and scholarship within a larger framework than is usually constructed for the engineering profession. The extent to which this is achieved can only be measured by the eventual reactions of the engineering community and the general public. Concurrently, I wish to demonstrate that issues of serving the public good present themselves in much the same context as for other learned professions.

There is a growing notion that the public interest and the public good are not well served by the traditional professions and the newly professionalized vocations. For the former, the issue can be reduced to the actions and behaviors of mature crafts versus those that pertain in the learned professions. The public interest is and should be the object of all professions. However, that interest is intuitively conceptualized and spelled out in particular laws, regulations, and formed by education. John Seigenthaler made this point elegantly with respect to journalism in his remarks at the start of

this conference. The public good is an altogether different matter, and here the larger concept of the public good in the sense of William May's description is needed. His concept of the public good is, moreover, the appropriate basis for our discussion of engineering's public service roles.

Thus the issues and areas that need to be developed for engineering are similar to those of all of the learned professions. These include: the expectations of the profession for voluntary public service of its members, the underlying values of the profession that define it and create these duties, the social and economic forces that impact the engineer's public duties, and the ever changing regulation of the profession.

On another level, we should also consider whether engineering is moving toward a different set of values that relate to its public service duties and the consequences to society if the profession either ceases to provide public service or develops a different collective position with respect to service. More broadly, it is necessary to consider what steps the profession needs to take to continue to meet its transitional commitment to serve the public good, however that may exist today and in the future.

II. WHAT IS ENGINEERING?

There is not a product, industrial process, or professional service today that either is totally apart from, or that lies completely outside, the reach of modern engineering and the work of the engineer. Society, machines, and biology are now so convergently developed and interdependent that the term biosoma has been introduced to describe their interactions and interdependence. Biosomatics, the study of this complex system, has been identified as a field for future scholarship.

Engineering and the engineer are uniquely responsible for the "machines" in this amalgam, and society generally views engineer-

4. See id.
6. See id.
ing with this special meaning. I use the term "machine" here very generally to apply to any aspect of the built environment and devices that use and transform energy and materials. Thus, the artifacts of life and the means by which we judge our quality of life are the results of engineering. Judgments on the modern "practice" of engineering, however, are usually never made because that generally lies beyond simple explanation and easy comprehension, just as in the case of most professions based on specialized education and hands-on art. But public judgments of the engineer and the engineering profession are made, and it is often the behavior and attitudes of individuals in isolated situations and special circumstances that are visible and become remembered. Rightly or wrongly the profession tends to be characterized in this way.

The profession of engineering had its start in ancient times, well before the Christian Era. The pyramids of Egypt (3100-2200 B.C.) are lasting reminders of an early age of structural engineering and probably the first "mega-engineering" projects. By the time ancient Greece rose to its zenith in the fourth century B.C. and was overtaken by the Roman Empire (second century B.C.), engineering was a distinct activity. One only needs to see the Acropolis in Athens and the remains of the aqueducts and public plumbing systems in Turkey, Italy, and Egypt to get an idea of the ingenuity and intuitive understanding of elementary physical laws that were routinely applied to practice. In those days, engineering was based on craft work, the apprentice system, and some mathematics, notably geometry. More formal structural engineering principles

7. See R.G. Weingardt, Forks in the Road-Impacting the World Around Us 7 (1998). See also William H. McNeill, The Rise of the West 41 (1991). The development of rudimentary technologies related to water resource management, agriculture, and metallurgy occurred concurrently with the rise of early civilizations in the Nile and Euphrates valleys. See id. at 254-55. Most historical tests generally do not discuss technological developments in much detail. However, the presence of "technique" in all phases of organized society, the advance of craft-based devices to aid commerce and agriculture, and the fruits of structural engineering are clearly seen in most thoughtful historical accounts of western civilization. The great structural works of the pre-Christian Era are mentioned as much by historians and engineers as evidence of a developing sense of engineering and use of simple machines, e.g., pulleys and the inclined plane, in all spheres of life. See Weingardt, supra.


10. See id. at 56-57, 74.
11. See id. at 21.
arose at this time, and these were used in the building of the great cathedrals and stone bridges of Western Europe and the United States.\textsuperscript{12}

From these origins, the practice of engineering has transformed itself, first very slowly and then more rapidly since the start of the first industrial revolution in the eighteenth century (circa 1750).\textsuperscript{13} Today, more often than not, practical applications of scientific laws follow very shortly after their discovery, and totally new consumer products and technologies arise immediately thereafter. This has been especially the case since 1970 as the tools of engineering design and information technologies have rapidly advanced. Automated assembly lines, laser-based technologies, biotechnology, man-made materials, solid state electronics, and modern computers are but a few examples. Just as in the bygone era, cutting edge engineering depends on ingenuity and innovation. The new feature, however, is the reliance on fundamental science and mathematics to do engineering work and to reach technical goals that were thought impossible even one generation ago.

But as much as the profession has been transformed by the sciences, the conceptualization and general understanding of engineering have remained very much the same over the present century. Julius Stratton of MIT said in his commencement address in 1958:

[Engineering] . . . includes the highly skilled art of the modern technician; it encompasses managerial occupations requiring the consummate knowledge of human behavior; and it has been pushed forward now into areas of systems design—with its array of problems that can be mastered only by the most sophisticated methods of modern sci-

\footnotesize{\textsuperscript{12} See id. at 122, 143, 149-53, 179-84. I do not wish to minimize the great technical and engineering achievements that occurred in the Orient in antiquity. The Chinese irrigation technologies of the twentieth century B.C., sophisticated civilizations that developed by the thirteenth century B.C., and the application of Indian scientific advances by the third century B.C. are evidence of extensive engineering activity. See McNeill, supra note 7, at 217-31. However, it is the westward movement of the concept of engineering and its development in the United States that concerns us most here. The roots of this movement began in antiquity with the development of the European nations. See id.}

\footnotesize{\textsuperscript{13} See Garrison, supra note 8, at 161.
ence and mathematics . . . . Our great professional societies, such as the institutes of mechanical and electrical engineers, chose to group these activities together in a few large categories. But the fact is that within any of these traditional branches there is a vast range of professional qualification. The term "electrical engineer" no longer describes adequately the occupation . . . [and] at the same time the electrical field is fusing into the mechanical, and it becomes increasingly difficult to distinguish one profession from the other. 14

He went on to emphasize that:

[F]or all the common ground, engineering is not and never will be science. There is inherent in the profession a whole set of attitudes and concepts completely foreign to pure science. The engineer must have a feel for materials, a concern for cost, and understanding of the factors of size and width, an appreciation of the problems of maintenance and replacement, and above all, an unfailing sense of responsibility toward his client and the public good. 15

III. ENGINEERS IN THE UNITED STATES

The first engineers in the United States either came from western Europe or were self-proclaimed engineers, usually land surveyors in the early 1800s. By 1816, there were two self-proclaimed engineers in each state. Formal schooling was spotty, and either self-taught individuals or those first classically educated were the first engineers in the new republic. The rise of the field to that of a profession paralleled that of other fields, notably medicine, during the nineteenth century. The advance of technology, mostly driving by industrial development, the evolution of a universally understood and accepted system of schooling, and the adoption of a national system of registration and licensing were the key

15. Id. at 29.
Early American engineering schools were little more than vocational institutes that taught current industrial practice following a pedagogy that had been developed a century earlier in France, the Czech Republic, and Germany. Before that, technology was learned via craftwork training. At the time, mathematics and science resided in the province of natural philosophy, and existing universities were oriented toward the humanities, law, and medicine. A key difference between the European and nascent American systems of technical education was that the national governments in the former provided support and required national accreditation of engineering schools. The high degree of social status accorded to engineers and engineering schools was proof of strong governmental support. As a result, newly graduated engineers entered a well-defined and respected path toward professional status that was regulated by the central government. This was not the case in the United States and remains so today.

The curriculums of the first United States engineering schools, namely the Norwich Institute, the United States Military Academy and Rensselaer Polytechnic Institute, were based on the educational programs of the Ecole Polytechnic system that was established in eighteenth century France. Between 1840 and 1890, educational specialization began, the "professional engineer" emerged, and the number of engineering schools expanded dramatically, especially with the passage of the Morrill Acts. By 1900,

18. See id.
19. See id.
20. See Noble, supra note 16, at 22; see also W.E. Wickenden, A Professional Guide for Young Engineers 7-8 (1949).
21. The Morrill Acts of 1862 and 1890 provided public lands for the states on which colleges of agriculture and mechanical arts were to be established. See Morrill Act, ch. 130, 12 Stat. 503 (1862) (codified as amended at 7 U.S.C. §§ 301-308 (1994)); Morrill Act, ch. 841, 26 Stat. 417 (1890) (codified as amended at 7 U.S.C. § 323 (1994)). These colleges have become a mature system of publicly supported doctoral research universities that account for more than two-thirds of the engineering baccalaureate degrees awarded annually. The applied nature of the land grant colleges was further strengthened with the passage of the Hatch Act of 1887, which established the agricultural experiment stations and the basis for direct application of knowledge and technology to public need. See Hatch Act, ch. 314, 24 Stat. 440 (1887) (codified as amended at 7 U.S.C. §§ 361a-361i (1994)).
engineering schools awarded about 4,500 baccalaureate degrees per year, the essential form of the undergraduate curriculum was established, and post-graduate programs in engineering education were established. The transformation of the content of the engineering curriculum to a mathematical and applied science basis began in the 1940s, largely as a result of the war effort. Beginning in 1945, the number of engineering students increased dramatically, and the number of baccalaureates awarded from some 300 engineering colleges has reached 65,000 to 75,000 though the 1990s.

The professional status of engineering was uplifted by the formation of several national societies between 1880 and 1912. However, the support and promulgation of engineering was largely the responsibility of the individual states and the school themselves in the case of private colleges, with loose oversight and occasional assistance provided by the professional societies. Standards for accrediting the educational program were developed and strengthened from 1930 to 1980 through largely voluntary work in the societies in conjunction with the Accreditation Board for Engineering and Technology. The relation of the educational program to the licensing process was both defacto and de jure put in place across the country. A national system of examinations to qualify individuals for an engineer's license (the "Professional Engineer", or "P.E.") was developed and is administered in the private

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23. The transformation of the engineering curriculum began slowly. By the end of the nineteenth century, the introduction of required physical science and mathematics courses was widespread. See NOBLE, supra note 16, at 25. The pace of change was slow, and engineering curricula retained a highly empirical focus. See generally WICKENDEN, supra note 20. The demonstrated successes of government sponsored development projects at universities in support of the war effort (1941-1945) made a lasting impact on engineering education and the schools. See NOBLE, supra note 16, at 43 & n.*.

24. See ENGINEERING IN SOCIETY, supra note 1, at 52.

25. The first professional engineering society, the American Society of Civil Engineers, was founded in 1852. See GARRISON, supra note 8, at 222, tbl. 12.1. Soon thereafter followed the American Institute of Mining Engineers (1871, now called the American Institute of Mining, Metallurgical and Petroleum Engineers), the American Society of Mechanical Engineers (1880), American Institute of Electrical Engineers (1884), the Institute of Radio Engineers (1907), and the American Institute of Chemical Engineers (1908). See id. The electrical engineering societies combined in 1963 to form the American Institute of Electrical and Electronic Engineers.

sector under the auspices of state boards of registration. In both
areas, the roles of the engineering schools in concert with the work
of the engineering societies cannot be underestimated.

It is worth mentioning at this point the distinction between a
guild as it existed in post-medieval Europe and the modern engi-
neering society of the twentieth century. Although technology and
industry were the ultimate focus of the guilds, members of the
guild bear little resemblance to the members of engineering socie-
ties. Guilds carefully regulated membership as a means to maintain
the economic vitality of the craft and assure standards of practice.
The engineering societies of today are voluntary organizations that
exist for the furtherance and benefit of the profession (usually a
branch or discipline of engineering), and have an indirect influ-
ence at best on business practices in the larger commercial sphere.
Engineering societies have been generally successful in developing
and assuring industrial standards, but they do not regulate practice
by members and non-members for the benefit of the civil society as
a whole. To my knowledge, there is no legally binding regulation
pertaining to individual members that has been legislated to engi-
neering societies on either the national or state level.

Formal schooling for engineering today comprises four years
of study beyond secondary school. The baccalaureate degree is
awarded at this time, and this is considered an adequate basis for
entrance into professional practice. While other professions have
increased the number of years of university-level study as a basis for
professional practice, engineering has maintained the four-year
model. Full admission into practice as a Professional Engineer (or
“P.E.”) is obtained only after the passing of two examinations and a
specified period of employment in which substantial engineering
work is done. Licensing, or registration, is done by state boards of
registration, and the principle of reciprocity between these boards
permits engineers to hold licenses in more than one state after ob-
taining the initial registration. There is also an expectation of
education beyond the baccalaureate, but that is now viewed as
largely the responsibility of the individual within the jurisdiction of

27. See NATIONAL SOCIETY OF PROFESSIONAL ENGINEERS, BECOMING LICENSED AS
how.html>.

28. See, e.g., MINN. STAT. § 326.02, subd. 3 (1996).

agreements in engineering).
a particular state board or registration. As of 1998, only twelve of the states require mandatory continuing education of registered engineers, and twelve additional states have enacted enabling legislation.\textsuperscript{30}

While this framework for professional practice in engineering is well understood and well regulated in the United States, most engineers are employed in private-sector industries where licensing is neither needed nor required. Of the 65,000 students who receive baccalaureate degrees annually, about twenty percent take the first step toward professional licensing.\textsuperscript{31} Civil engineering graduates are the majority of this group owing to the roles they will play for consulting and contracting firms, which do the bulk of the public works projects. The largest portion of engineering employment is for electrical/electronic and mechanical engineers who are generally unlicensed because they work for corporations or federal and state agencies. The number of Professional Engineer licenses in the United States is approximately 685,000 out of 1.6 million degree-holding engineers currently employed.\textsuperscript{32}

IV. THE PUBLIC INTEREST AND PUBLIC GOOD

The public duties of the engineering profession are collectively embodied in the \textit{Code of Ethics} published by the National Society of Professional Engineers.\textsuperscript{33} The \textit{Code}, which is appended, includes fundamental cannons, rules of practice, and professional obligations mainly for the individual.\textsuperscript{34} As such, the \textit{Code} addresses directly the expectations of the profession in the realm of the public interest and implicitly its expectations in the larger realm of the public good.

The Fundamental Canons generally address the behavior of engineers as it affects the “public interest” rather than the “com-
mon good" as William May defined it. As such, they neither define nor limit public behavior, and in this context, any issues relating to other professions also apply to engineering. However, the notable difference for engineering is the absence of a developed culture that includes pro bono work, such as is expected in the practice of law. There are several historical reasons for this, including the development of engineering from the seventeenth and eighteenth century crafts, the relatively recent shift to a scientific and mathematical basis for modern practice, and how the majority of engineers are employed. The manner in which engineers have been socialized into both the commercial and professional sphere are factors as well. For example, professional organizations for engineering are a relatively recent development, as noted above. They do not have antecedents seen though rules of practice, technical standards, and accepted business practices have emanated from them.

In meeting societal needs, engineering is deeply involved, as perhaps no other profession, in serving the public interest. The formal work of engineering is to meet such needs through the design of products and processes for industry and government. Such work is the result of a "market pull" that establishes a feedback between advancing technology via the application of science and the expression of consumer needs through the market demand. With respect to the public good, the engineering profession has no formal requirement of its members. While certain values are stated explicitly in the Code, e.g., honesty, fairness, integrity, and truthfulness, it steers away from prescriptions on how the engineer is to apply a larger set of values in both professional and private life. However, the protection of the public health, safety, and welfare in meeting society's needs is at the center of the Code. This defining statement implies that ethical standards and moral judgments are simultaneously implicit in engineering work and in an individual's voluntary actions outside the commercial and professional spheres.

Engineers who serve in advisory roles to local, state and national government make an effective collective contribution to the public good. Such advisory groups often are involved at the policy

35. See May, supra note 3.
36. See ENGINEERING IN SOCIETY, supra note 1, at chs. 1-2.
37. See NATIONAL SOCIETY OF PROFESSIONAL ENGINEERS CODE OF ETHICS FOR ENGINEERS, supra note 33.
38. See id.
level in developing technology safety requirements for automobiles and industrial machines, setting broad technical standards, or setting guidelines for design that are later embodied in legislation and regulatory activities. Activities of this kind are generally not compensated beyond the cost of participation and thus fall into the category of pro bono work. When engineers are involved as volunteers within the professional societies, they also act in a pro bono capacity. The professional societies notably define, update, and codify the technical basis for standards that ensure public and industrial safety, determine design standards for product development, and recommend and standardize manufacturing methods. In many cases, such standards become part of state and national laws\textsuperscript{39} and are a basis for setting limits of liability in the insurance industry. In this context, legislation and regulatory activity at the governmental level are intimately linked to the work of the societies and the individual engineer.

The professional societies promote and support largely voluntary professional service to the extent that it matches the society's mission and supports the profession. Broadly based pro bono public service performed by individuals is generally rare for both legal and cultural reasons. There is, for example, no equivalent to pro bono work as in the legal profession that can be performed by engineers who are salaried by a corporation or governmental agency, and salaried engineers are the majority of the engineering workforce. But, on occasion, private engineering firms and independently employed consultant-engineers will perform pro bono work in support of community projects. Faculty members of the engineering schools are extremely active through their professional societies, local engineering organizations, etc. and provide a type of pro bono work that is considered part of their public service mission with academe.

\textsuperscript{39} Examples are the Boiler and Pressure Vessel Code of the American Society of Mechanical Engineers (ASME) and the structural engineering codes that have been developed by the American Society of Civil Engineers (ASCE) and the American Iron and Steel Institute. Standards for all fasteners in the United States have been developed by the American National Standards Institute (ANSI) and are commonly applied in all aspects of product design. The National Institute of Standards and Technology (NIST) maintains standards of measure (time, weight, and length). These organizations are served by a variety of volunteer panels and committees that are linked to the larger engineering community and industry.
The Engineering Value System

Engineering is a vital part of the wealth creation process, whether a product is designed or public works projects are carried out. Thus, the product of engineering technology is the value added to the nation's economy. The values that support this framework are those of the competitive marketplace and, in many cases, ownership of proprietary knowledge held by corporations. Thus, the engineer is generally not at liberty to use the fruits of his or her labor and knowledge freely. Most employers who depend on the application of science and engineering to sustain their businesses generally do not permit freelance pro bono work by their engineers and scientists. I cannot find fault with this approach, as we in the profession have de facto allowed a mix of employment practices to coexist and do not generally require licensing of individuals who do engineering work. A result of this is the blurring of the meaning of “engineer” in the public’s mind (e.g., highway engineer, knowledge engineer, stationary engineer, design engineer, etc.). Another result is that one’s designation as a Professional Engineer does not carry with it the same meaning and social status as, say, its equivalent in Europe or Canada.

On another level, the participation of salaried engineers as volunteers in the work of the professional societies and as advisors to governmental agencies is supported by private industry, particularly when such work has an industry-wide benefit. Here also the result is a service to the public interest but not necessarily to the public good. From a purely economic perspective, most employers do not include public service as an element in the expected annual work plans of their engineer employees. This is a result of the project-based cost accounting system by which engineering services are purchased and how the corporation’s profits and return on investment are determined. The aforementioned intellectual property issue is also a factor.

40. Here, we will not make a special case of the 20,000 or so engineering faculty members in the United States. These individuals enjoy extraordinary freedom to teach, do research, and to serve the public. Most do all three and via their professional associations, public position, and scholarship have the opportunity to serve the public good. Faculty members also enjoy the privilege to work part time for private organizations as consultants. This privilege is part of the accepted employment practices in both public and private colleges and is generally viewed as one means by which the engineering schools maintain relevancy in their programs and relations with industry.
Over the past generation, the public perception of the engineer has not changed very much. Engineers are generally regarded highly in public opinion surveys for their honesty, integrity, and hard work. If anything, engineers are sometimes avoided in the legislative process and in public affairs because of a tendency to approach subjective matters from a technical viewpoint and to use rigorous methods of analysis in arriving at recommendations and decisions (sometimes too much objectivity in human affairs is neither a good thing nor needed). Thus, if engineering as a profession were to adopt a more proactive posture with respect to pro bono work, to voluntary public service, and to promote the involvement of engineers who have a flair for public work, the public perception of engineers and engineering will continue to remain high whether or not there is an increase of visible public involvement by members of the profession. I do not see this situation changing much in the near term given the dependence on advanced technology that exists in the United States and other industrialized nations.

V. PROSPECTS FOR THE FUTURE

I do not see a dramatic movement toward a new set of defining values and ethical frameworks for engineering in the near term. The current education-to-practice-to-continuing education pattern of the engineer is well defined, socialized, and constrained in a variety of ways. To change the engineer’s value system would require a universal requirement for some form of professional registration, possibly formally linked to the educational process, and a national reformation of the accreditation process for the schools. Employment practices in the private sector would also need to be reformed under a universal registration system. Until engineers are perceived either to abuse their privileges or to become ineffective in serving the public interest, not much of a movement will develop toward either a different set of values or a framework for practice.

I should add, however, that the engineering schools are coming under increased pressure, chiefly from industry, to reform themselves so as to educate an engineer who is able to serve many more masters over the next generation. The notion that a “new engineer” needs to be graduated has taken hold, and accreditation guidelines have been modified to reflect this type of thinking. While it is not clear which way the debate and action on this will take us, it is apparent that engineering education is on the edge of
a sea of change in educational philosophies and educational methods that will play out in the first generation of the twenty-first century. The good thing in all of this is that the schools will eventually embrace various models of engineering education, and students will be offered a wide variety of choices for their education. American industry will also benefit, as it will be able to more easily fill a range of engineering needs across a wider spectrum of technical and managerial activities. This expansion of the educational spectrum and employment patterns of engineers will, in the long run, work toward changing the values of the engineering profession and its public involvement. Hopefully engineers in the future will be prominent professionals who are viewed as vigorously serving both the public interest and the public good.

For the long-term, I believe that engineers will maintain their values with respect to voluntary public service both in the civic sense and professionally. There are not trends apparent in the professional societies and in the larger society that would indicate either the engineers’ commitment to public service or forces that would significantly alter ongoing patterns of public service, individual pro bono work, and the work of the professional societies. The restrictions that I mention above on pro bono work for engineers will, however, remain a significant factor in determining the extent to which engineers can expand their personal role in volunteer and public activities.

Most of what the engineering profession needs to do in the immediate future points to the actions that can be taken by engineering colleges to inculcate a public mindedness in their graduates. This requires putting the curriculum and the overall educational experience in a framework and context that include all of the engineer’s responsibilities with respect to the public interest and the public good. While I have noted that the schools encourage participation of students and faculty in professional activities, much more can be done. The greatest impact on the profession with respect to the serving the public good can be made by simply adding the appropriate language to the state statutes that regulate registration. A formal reminder to holders of engineering licenses of their larger public obligation can go a long way toward turning the professional culture toward a different future. Lastly,

41. See, e.g., MINN. STAT. § 326.02 (1996) (governing employment licensed by the state—architects, engineers, surveyors, landscape architects, geoscientists, and interior designers).
the employers of engineers need to be made aware of the larger context for engineering practice and the multiple obligations faced by all of their technical employees. The commercial sphere will likely be the most difficult to impact, but even a small change over the next generation will make a significant difference to the corporation and to the engineer as a salaried professional.
VI. APPENDIX: NSPE CODE OF ETHICS FOR ENGINEERS

Preamble.

Engineering is an important and learned profession. As members of this profession, engineers are expected to exhibit the highest standard of honesty and integrity. Engineering has as a direct and vital impact on the quality of life for all people. Accordingly, the services provided by engineers require honesty, impartiality, fairness and equity, and must be dedicated to the protection of the public health, safety, and welfare. Engineers must perform under a standard of professional behavior that requires adherence to the highest principles of ethical conduct.

I. Fundamental Canons.

Engineers, in the fulfillment of their professional duties, shall:
1. Hold paramount the safety, health and welfare of the public.
2. Perform services only in areas of their competence.
3. Issue public statement only in an objective and truthful manner.
4. Act for each employer or client as faithful agent or trustees.
5. Avoid deceptive acts.
6. Conduct themselves honorably, responsibly, ethically, and lawfully so as to enhance the honor, reputation, and usefulness of the profession.

II. Rules of Practice.

1. Engineers shall hold paramount the safety, health, and welfare of the public.
   a. If engineers’ judgment is overruled under circumstances that endanger life or property, they shall notify their employer or client and such other authority as may be appropriate.
   b. Engineers shall approve only those engineering documents that are in the conformity with applicable standards.
   c. Engineers shall not reveal facts, data or information without the prior consent of the client or employer except as authorized or required by law or this Code.
   d. Engineers shall not permit the use of their name or associate in business ventures with any person or firm that they believe is engaged in fraudulent or dishonest enterprise.
   e. Engineers having knowledge of any alleged violation of this
Code shall report thereon to appropriate professional bodies and, when relevant, also to public authorities, and cooperate with the proper authorities in furnishing such information or assistance as may be required.

2. Engineers shall perform services only in the areas of their competence.
   a. Engineers shall undertake assignments only when qualified by education or experience in the specific technical fields involved.
   b. Engineers shall not affix their signatures to any plans or documents dealing with subject matter in which they lack competence, not to any plan or document not prepared under their direction and control.
   c. Engineers may accept assignments and assume responsibility for coordination of an entire project and sign and seal the engineering documents for the entire project, provided that each technical segment is signed and sealed only by the qualified engineers who prepared the segment.

3. Engineers shall issue public statements only in an objective and truthful manner.
   a. Engineers shall be objective and truthful in professional reports, statement, or testimony. They shall include all relevant and pertinent information in such reports, statement, or testimony, which should bear the date indicating when it was current.
   b. Engineers may express publicly technical opinions that are founded upon knowledge of the facts and competence in the subject matter.
   c. Engineers shall issue no statements, criticisms, or arguments on technical matters that are inspired or paid for by interested parties, unless they have prefaced their comments by explicitly identifying the interested parties on whose behalf they are speaking and by revealing the existence of any interest the engineers may have in the matters.

4. Engineers shall act for each employer or client as faithful agents or trustees.
   a. Engineers shall disclose all known or potential conflicts of interest that could influence or appear to influence their judgment or the quality of their services.
   b. Engineers shall not accept compensation, financial or oth-
erwise, from more than one party for services on the same project, or for services pertaining to the same project, unless the circumstances are fully disclosed and agreed to by all interested parties.

c. Engineers shall not solicit or accept financial or other valuable consideration, directly or indirectly, from outside agents in connection with the work for which they are responsible.

d. Engineers in public service as members, advisors, or employees of a governmental or quasi-government body or department shall not participate in decisions with respect to service solicited or provided by them or their organization in private or public engineering practice.

e. Engineers shall not solicit or accept a contract from a governmental body on which a principal or officer of their organization serves as a member.

5. Engineers shall avoid deceptive acts.

a. Engineers shall not falsify their qualifications or permit misrepresentation of their or their associates' qualifications. They shall not misrepresent or exaggerate their responsibility in or for the subject matter of prior assignment. Brochures or other presentations incident to the solicitation of employment shall not misrepresent pertinent facts concerning employers, employees, associates, joint venturers, or past accomplishments.

b. Engineers shall not offer, give, solicit, or receive, either directly or indirectly, any contribution to influence the award of a contract by public authority, or which may be reasonably construed by the public as having the effect or intent of influencing the awarding of a contract. They shall not offer any gift or other valuable consideration in order to secure work. They shall not pay a commission, percentage, or brokerage fee in order to secure work, except to a bona fide employee or bona fide established commercial or marketing agencies retained by them.

III. Professional Obligations.

1. Engineers shall be guided in all their relations by the highest standards of honesty and integrity

a. Engineers shall acknowledge their error and shall not distort or alter the facts.

b. Engineers shall advise their clients or employers when they believe a project will not be successful.

c. Engineers shall no accept outside employment to the det-
riment of their regular work or interest. Before accepting any outside engineering employment, they will notify their employers.

d. Engineers shall not attempt to attract an engineer from another employer by false or misleading pretenses.

e. Engineers shall not actively participate in strikes, picket lines, or other collective coercive action.

f. Engineers shall not promote their own interest at the expense of the dignity and integrity of the profession.

2. Engineers shall at all time strive to serve the public interest.

a. Engineers shall seek opportunities to participate in civic affairs; career guidance for youths; and work for the advancement of the safety, health, and well being of their community.

b. Engineers shall not complete, sign, or seal plans and/or specifications that are not in conformity with applicable engineering standards. If the client of employer insists on such unprofessional conduct, they shall notify the proper authorities and withdraw from further service on the project.

c. Engineers shall endeavor to extend public knowledge and appreciation of engineering and its achievements.

3. Engineers shall avoid all conduct or practice that deceives the public.

a. Engineers shall avoid the use of statement containing a material misrepresentation of fact or omitting a material fact.

b. Consistent with the foregoing Engineers may advertise for recruitment of personnel.

c. Consistent with the foregoing Engineers may prepare articles for the lay or technical press, but such articles shall not imply credit to the author for work performed by others.

4. Engineers shall not disclose, without consent, confidential information concerning the business affairs or technical process of any present or former client or employer, or public body on which they serve.

a. Engineers shall not, without the consent of all interested parties, promote or arrange for new employment or practice in connection with a specific project for which the Engineers has gained particular and specialized knowledge.

b. Engineers shall not, with the consent of all interested parties, participate in or represent an adversary interest in connection
with a specific project or proceedings in which the Engineer has gained particular specialized knowledge on behalf of a former client or employer.

5. Engineers shall not be influenced in their professional duties by conflicting interests.
   a. Engineers shall not accept financial or other consideration, including free engineering designs, from material or equipment suppliers for specifying their product.
   b. Engineers shall not accept commission or allowances, directly or indirectly, from contractors or other parties dealing with clients or employers of the Engineer in connection with work for which the Engineer is responsible.

6. Engineers shall not attempt to obtain employment or advancement or professional engagement by untruthfully criticizing other engineers, or by other improper or questionable methods.
   a. Engineers shall not request, propose, or accept a commission on a contingent basis under circumstance in which their judgment by be compromised.
   b. Engineers in salaried positions shall accept part-time engineering work only to the extent consistent with policies of the employer and in accordance with ethical considerations.
   c. Engineers shall not, without consent, use equipment, supplies, laboratory, or office facilities of an employer to carry on outside private practice.

7. Engineers shall not attempt to injure, maliciously or falsely, directly or indirectly, the professional reputation, prospects, practice, or employment of other engineers. Engineers who believe other are guilty or unethical or illegal practice shall present such information to the proper authority for action.
   a. Engineers in private practice shall not review the work of another engineers for the same client, except with the knowledge of such engineers, or unless the connection of such engineer with the work has been terminated.
   b. Engineers in governmental, industrial, or educational employ are entitled to review and evaluate the work of other engineers when so required by their employment duties.
   c. Engineers in sales or industrial employ are entitled to make engineering comparisons of represented products with products of
other suppliers.

8. Engineers shall accept personal responsibility for their professional activities, provided, however, that Engineers may seek indemnification for services arising out of their practice for other than gross negligence, where the Engineers interests cannot be otherwise be protected.
   a. Engineers shall confirm with state registration laws in the practice of engineering.
   b. Engineers shall not use association with a non-engineer, a corporation, or partnership as a "cloak" of unethical acts.

9. Engineers shall give credit for engineering work to those to whom credit is due, and will recognize the proprietary interest of others.
   a. Engineers shall, whenever possible, name the person or persons who may be individually responsible for designs, inventions, writings, or their accomplishments.
   b. Engineers using designs supplied by a client recognize that the designs remain the property of the client and may not be duplicated by the Engineer for others without express permission.
   c. Engineers, before undertaking work for others in connection with which the Engineer may make improvements, plans, design, inventions, or other records that may justify copyrights or patents, should enter into a positive agreement regarding ownership.
   d. Engineers’ designs, data, record, and notes referring exclusively to an employer’s work are the employer’s property. Employer should indemnify the Engineer for the use of the information for any purpose other than the original purpose.

As Revised July 1996.

"By order of the United States District Court for the district of Columbia, former Section 11(c) of the NSPE Code of Ethics prohibiting competitive bidding, and all policy statements, opinions, rulings or other guidelines interpreting its scope, have been rescinded as unlawfully interfering with the legal right of engineers, protected under the antitrust laws, to provide price information to prospective clients; accordingly, nothing contained in the NSPE Code of Ethics, policy statements, opinions, rulings or other guidelines prohibits the submission of price quotations or competitive bids for engineering services at any time or in any amount."
Note: In regard to the question of application of the Code to corporations vis-a-vis real persons, business form or type should not negate not influence conformance of individuals to the Code. The Code deals with professional services, which services must be performed by real persons. Real person in turn establish and implement policies within business structures. The Code is clearly written to apply to the Engineers, and it is incumbent of members of NSPE to endeavor to live up to its provisions. This applies to all pertinent sections of the Code.