

What Shall We Build?

An Examination of the Engineering Profession
and its Role in Establishing a Just World Order

Kroc Institute Occasional Paper # 23:OP:2

February 2003

Daniel R. Lynch
MacLean Professor of Engineering
Dartmouth College, Hanover, New Hampshire

This work was completed while the writer was Visiting Melchor Professor in the
Department of Civil Engineering and Geological Sciences, University of Notre Dame.

Preface

This report is intended to stimulate discussion on the title theme, preparatory to an ongoing series of conferences and activities. The theme is intentionally normative. The central ideas can be summarized in the following set of propositions:

- the Industrial Revolution will run to completion, irreversibly and worldwide, in the coming 50 years;
- there is a vacuum in global governance which will persist through this period
- professions can have major impact on social organization and human progress
- the engineering profession, itself defined by the Industrial Revolution, “owns the moment” and must take responsibility for the outcomes of globalization (a fundamentally technological process); and
- human rights and worldwide justice are the authentic metrics of success.

New developments are needed within the profession if it is to serve the moment. A cooperative dialogue involving all parts of the profession – education, research, practice, professional societies, corporations, and agencies – is called for, beginning in 2003. An action agenda, comprising commitments to specific cooperative institutional developments, needs to be implemented in short order.

Many assertions are made herein which are not presented in a scholarly way, but in the sense of “we hold these truths to be self-evident.” This approach is intended to stimulate discussion on the web of underlying issues. The value of that discussion will turn on the effectiveness of the resulting actions.

We are at a critical point in history. What shall we build?

Contents

Preface.....	2
Contents.....	3
History.....	4
Professions	6
Human Rights – Authentic Professional Goals.....	8
Universal Declaration of Human Rights	8
Catholic Social Thought.....	10
New Rights in an Industrial World	12
Human Rights in Technology Services.....	12
Human Rights in Sustainability and Natural Resources	13
Engineering – An Emergent Global Profession.....	14
Professionals or Employees?.....	15
Can Corporations Have Morals?.....	16
Ends or Means of Professional Action?	17
The Engineers' Error	18
Action Agenda.....	20
What is to be Done?	20
A First Step.....	21
Experiments in Professional Education.....	22
Institutes.....	22
Career Paths.....	23
Case Studies in Action.....	23
Postscript.....	25
Acknowledgement.....	25
Bibliography.....	26
Persons Interviewed	28
Annex I: United Nations Charter Excerpts	29
Annex II: Excerpts from Professional Codes.....	30
Annex III: Overview of Professional Engineering Societies	31
National Society of Professional Engineers.....	31
American Society of Civil Engineers.....	32
National Institute for Engineering Ethics.....	33
The Order of the Engineer.....	34

History

There is no shortage of pronouncements that we are now at a key point in history. This critical moment has four defining characteristics: industrialization, the explosion in scientific and technical knowledge, globalization, and a missing emphasis on the public good.

Industrialization

The Industrial Revolution will run to completion during the next 50 years -- during the professional lifetimes of today's students. It is reasonable to project industrialization all over the planet -- resulting in a factor of 5 increase in per capita industrial metabolism.¹ The seeds of this industrial transformation have already germinated -- the knowledge, capital, manpower, and economic system are largely in place. Their natural outcome is inevitable, given a stable economic and political regime. Concurrently, reasonable projections have population stabilizing at roughly 12 billion, a factor of 2 above today. On balance, the completion of the Industrial Revolution implies a factor of 10 increase (5x2) in natural resource utilization and environmental loading.

These two common projections presume a peaceful planet -- i.e. a just, stable world order with the present material inequities largely abolished, and some kind of sustainable relationship between industrial practice and nature. Implied in turn are permanent human dependencies on technological services and on planetary organization to supply them. Few are projecting the alternatives, which are certainly unstable (and therefore unpredictable) from many perspectives.

If we accept this interpretation, we are living in a dream. There is no technology to support 12 billion people at 10 times the current aggregate consumption rate; and there is no vision of a planetary ecosystem in equilibrium with this level of industrial metabolism. **What we are building will not work.** But what is certain is that the process of Industrialization will continue unabated, worldwide. There is no other historical lesson.

Science and Technology

There is no questioning the fact that enormous technical change has occurred over our own professional lifetimes. In, say, 1950, biotechnology, biomedical engineering, environmental science, operations research, and computer science were still in their infancy. And civilian applications of global navigation, satellite imaging, digital communications, optics, and advanced materials were only just emerging. These technologies and their science bases are now essential ingredients in global industry. They were developed against the backdrop of the Cold War, which implicitly dominated the technology development agenda until very recently.

Today, the Cold War is officially over, and there is a great release of human potential energy formerly devoted to security technology. Projections that we will turn swords into plowshares are abundant. There is, however, no national or planetary agenda for research and development

¹ The factor of 5 is obtained by comparing present per capita consumption of natural resources (e.g. energy) in the USA with the world average.

which recognizes the "factor of 10" problem alluded to above. And there is no scientific principle that asserts that we will "think our way out of this" without concerted, disciplined effort, of equal intensity to that marshaled during the cold war. And finally, the "Century of Biology" presents as many risks as it does promises.

Globalization

At this point in time, we have developed a remarkable level of global organization. Commerce, capital flow, information flow, data bases -- these all amplify the reach of industrial activities to the planetary scale. Finished goods, work-in-progress, customer demand, and marketing information all transit the globe routinely. And technology, to the extent that it is published, is propagated worldwide within the natural mission of universities, aided by the globalization of English as the language both of technology and of commerce. Finally, the unparalleled failure of communism at the close of the 20th century leaves capitalism and free enterprise unchallenged on the world stage. And a new security paradigm is emerging in the wake of 9/11.

The dominant global organization is the corporation, organized to make profit within a capitalist system. These have surpassed national governments -- the focus of global thinking since the end of World War II -- in their scope and influence. They have become "super citizens" in that they influence government policy; but there is no real expectation of citizenship aside from obeying existing laws. As a result, the dominant organizing principles today are a) free trade and capitalism, organized in for-profit global corporations; and b) the requisite security based in national governments

Absent is any credible global government with real authority; any convergence of world religions; or any other normative influence which would constrain global corporate goals. It is not reasonable to expect these or any other global institutions to grow in authority during the coming 50 years, at a rate sufficient to represent the public interest.

Many questions arise. Is free trade the only global norm? Are corporations to be the only truly global institutions? If so, is return on capital the only feasible normative corporate expectation? Is there profit to be made by creating jobs in underemployed poor countries? Underpinning all of these, can the invisible hand of economic self-interest be a sufficient guide for the coming 50 years? And if not, **What Shall We Build?**

Public Interest

No principle of science or social science supports a pure laissez-faire attitude. It has been proven ineffective in all democracies; and there is nearly universal rejection of this hypothesis on theoretical, practical and moral grounds. Instead, institutions need to be created to constrain the invisible hand of self-interest. Until now, we have relied on governments for this. Significant and lasting advances have been achieved in national democracies which otherwise embrace free-market principles.

It is now 50 years since the Universal Declaration of Human Rights was ratified. It is a singular achievement of global government. Yet we still witness, in real-time, obvious and abundant

violations of these principles in many places. The task of securing and extending human rights is enormous. It falls outside the scope of today's accelerating globalism, which is fundamentally driven by free market forces. And scientific/ technical advances are posing new and complex ethical issues even as they promise basic human progress. We know that economic self-interest will not lead universally to acceptable outcomes; yet what units are responsible for the public good? This vacuum needs desperately to be filled.

One major feature of the 20th century has been the planetary struggle with totalitarianism. At the moment this appears to be over. And while vigilance is certainly required to avoid backsliding, this very feature makes progress toward the development of global norms difficult. People will not easily cede authority to new entities at the scale of the economy. This is evident in contemporary societies as diverse as the United States and Afghanistan. So the growth of authority in planetary institutions of government will be slow. While we need that, it will not likely emerge in the coming 50 years, during which the Industrial Revolution will complete its cycle. We are thus left with inadequate representation of the public interest in this process.

A central premise herein is that professions can and must address this void. Technology defines the moment. It is the baseline characteristic of the 20th century, and is here to stay. We need to look to the emergence of an associated profession -- engineering. The professional stewards of technology need to step up and take their share of the responsibility. Lead us along right paths!

Professions

There is ample historical precedence wherein professions emerged in response to a particular enduring crisis, with lasting implications. In most cases, they filled an important gap on an interim basis, defining professional services and responsibilities, gaining public acceptance of their role through competence and integrity, and eventually defining supplemental instruments of government or other social organization. In this spirit, one can define professionals as agents of progress. Professionals are first and foremost people. As people they share certain enduring humanistic concerns; as professionals they bring an added commitment to certain dimensions of skill, competence and service. Professions by definition transcend national governments, religions, and other social constructions. They transcend time, too, although they need to emerge in historical time and perfect their mission and identity over time.

Is engineering a profession? Will it rise to the current challenge as agent of technological progress? Will it truly serve authentic human needs? The profession needs to develop and accept responsibility for prioritizing, under public scrutiny, its members' technical and industrial activities and investments according to the public interest. Communications should deliver education and health care, not simply report death by preventable diseases. Security apparatuses should stabilize fair relationships, not become offensive weaponry or means of repression. Biotechnology should relieve pressure on natural resources, not simply speed their extinction. Engineers need to become accountable for overall outcomes or lose the professional claim.

With most engineers employed by for-profit organizations in an imperfect economy, this is a tall challenge. But normative expectations distinguish professionalism from raw economic action. And failure to respond to the present vacuum has profound consequences.

Catholic universities have a special opportunity. The history of Catholic social thought leading to professional formation is one of recurring high-impact ideas made real by practical people -- law, medicine, nursing, teaching, social work. The present global situation begs for an expression of that social thought within engineering, and for engineers who will be vehicles of practical progress in its implementation.

Let us respond.

Human Rights – Authentic Professional Goals

The Basis of a Just World Order

The proper focus for engineering, I assert, is the establishment of a just world order, rooted in human rights. Two planetary norms have been established during the 20th century: the United Nations Universal Declaration of Human Rights, and the collection of documents from the Roman Catholic Church (collectively, “Catholic Social Thought”[CST]). There is remarkable congruence. They are our best expressions of principle, to which all valid professions need to speak in the 21st century. Below we review these, and propose two extensions for the coming 50 years which specifically recognize the promise and peril of technology: rights in “technology services” and rights in the “sustainable access to natural resources.” These explicitly address the professional mission of engineering and could be introduced as additional UN Covenants which supplement the Declaration of Human Rights, or as new annexes to CST.

Universal Declaration of Human Rights

... A Common Standard of Achievement ...

The United Nations was founded in 1945. Its Charter clearly establishes Human Rights as a central concern. Its Preamble and Purposes (Article 1) are quoted in the annex. Article 68 charges the Economic and Social Council with pursuit of Human Rights. (See annex.)

In 1946, the UN Commission on Human Rights was established, with Eleanor Roosevelt as chair. The Universal Declaration of Human Rights was adopted in 1948 by the General Assembly. It is not legally binding. Some excerpts from the UDHR preamble follow:

Preamble

Whereas recognition of the inherent dignity and of the equal and inalienable rights of all members of the human family is the foundation of freedom, justice and peace in the world
.....

Now, therefore,

The General Assembly,

Proclaims this Universal Declaration of Human Rights as a common standard of achievement for all peoples and all nations, to the end that every individual and every organ of society, keeping this Declaration constantly in mind, shall strive by teaching and education to promote respect for these rights and freedoms and by progressive measures, national and international, to secure their universal and effective recognition and observance, both among the peoples of Member States themselves and among the peoples of territories under their jurisdiction.

There are 30 articles. Particularly relevant here are articles 23 through 26, and 28. Portions of these are excerpted below:

Article 23

1. Everyone has the right to work, to free choice of employment, to just and favourable conditions of work and to protection against unemployment.
2. Everyone, without any discrimination, has the right to equal pay for equal work.
3. Everyone who works has the right to just and favourable remuneration ensuring for himself and his family an existence worthy of human dignity, and supplemented, if necessary, by other means of social protection.

Article 24

Everyone has the right to rest and leisure, including reasonable limitation of working hours and periodic holidays with pay.

Article 25

1. Everyone has the right to a standard of living adequate for the health and well-being of himself and of his family, including food, clothing, housing and medical care and necessary social services, and the right to security in the event of unemployment, sickness, disability, widowhood, old age or other lack of livelihood in circumstances beyond his control.

Article 26

Everyone has the right to education. Education shall be free, at least in the elementary and fundamental stages. Elementary education shall be compulsory. Technical and professional education shall be made generally available and higher education shall be equally accessible to all on the basis of merit.

Article 28

Everyone is entitled to a social and international order in which the rights and freedoms set forth in this Declaration can be fully realized.

Articles 23 and 24 constitute a right to work and workers' rights; 25, a right to an adequate standard of living; 26, a right to information; and 28, a right to a just world order. All of these are, now and in the future, rooted in technology. They are not absolute, but are relative to current technology. Essentially, if we know how to do something, then people have a right to it. Article 25 is probably the most profound in the present technological context. In addition to the right to technological services, the right to a healthy environment is also imputed.

Subsequent Covenants are legally binding; the principal ones stemming from the Declaration are

- International Covenant on Economic, Social and Cultural Rights (145 ratifications)
- International Covenant on Civil and Political Rights (147 ratifications)

These were adopted in 1966 by the General Assembly. Both are legally binding treaties among signatory states. As of today, 145 states have ratified ICESCR; and 147, ICCPR². Together with the Universal Declaration, they constitute an International Bill of Rights.

In 1993, the World Conference on Human Rights produced the Vienna Declaration and Programme of Action whereby 171 countries affirmed a renewed commitment to the Declaration. This led to the creation of the UN High Commission for Human Rights, in 1993. The outgoing High Commissioner (since 1997) is Mary Robinson of Ireland.

Despite these remarkable developments, and the large number of signatory states to the Covenants, it is impossible to escape the fact that billions of people presently suffer elementary rights deprivation. Evidently governments are as yet unable to deliver on what is agreed upon. Shouldn't professions, as international organizations, become active? Surely they can have an impact!

Catholic Social Thought

... Opus Justiceae Pax ...

A remarkable development during the past century has been the evolution of (Roman) Catholic Social Thought (CST). Historically, Catholic teaching has emphasized the individual person, his relation to God, and individual salvation as liberation from earthly constraints. Beginning in 1891 with Leo XIII's encyclical *Rerum Novarum* (On Capital And Labor), we have a steady growth in emphasis on social (non-spiritual) matters, coincident with growth in large, planetary institutions and relationships. The Church's teaching could be interpreted as a natural evolution of thought as history proceeded through the Industrial Revolution. The constant emphasis on individual rights and dignity is a hallmark of Catholic Thought; that emphasis survives clearly as a centerpiece in CST. But what is remarkable is the emergence of a normative commitment to earthly progress toward justice and the conditions of material well-being in addition to spiritual well-being.

The earliest conflicts perceived involved the abuses of the Industrial Revolution and the equally abusive response -- totalitarian, atheist Marxism. There is a consistent concern for norms of human relations in the midst of huge emergent organizations and the possibility of totalitarianism. There is also consistent criticism of unchecked free-market capitalism, and the military demands of large nation states. Fundamentally, CST asserts the primacy of the individual over these emergent institutions; the dignity of the individual; the right to work, to just compensation and labor conditions; and the unambiguous assertion of the rights to life, freedom, and an adequate material standard for all people. It is easy to see the parallel of this thought with that expressed in the UN Charter and the Declaration, both of which have been supported by the Church.

A milestone was reached in the 1960's with the convening of the Second Vatican Council. In addition to expressing major liberalizing changes in organization, liturgy and approach to theology, the Vatican II documents express the imperative of international development, not

² There are 189 Member States of the UN.

coincidentally in parallel with the UN Covenants on Human Rights. Since Vatican II there is an growing sense of "Integral Development" of peoples which emphasizes a kind of sufficiency relative to the material standard of living, as a prerequisite to spiritual growth.

Perhaps most remarkable about the CST is its clear commitment to material progress. For an institution with 2000 years of thought emphasizing transcendent values, it is a major innovation to legitimize aspirations for the fruits of technology -- not in themselves, but as prerequisites to a just and lasting world order in which all humans can make progress in their relations with God.

It is asserted that this development is among the most profound of the transformations of the Industrial Revolution. There is the idea that men can indeed do much better than ever thought possible in escaping the tyranny of poverty and alienation. For educated and professional people, implementing this becomes a moral imperative -- participating in the ongoing work of the Creator. Equally important is the individual imperative to avoid the errors of selfishness, self-gratification and violence which attend modern technology.

Through the 1990's we have reached the 100-year mark since Leo XIII. The major experiments in industrial communism have failed, removing one of the largest and most pressing sets of issues before the Church. Global capitalism remains unchallenged in practice as an economic principle, along with its devotion to democratic free markets. Not insignificant is the consistent CST criticism of the unchecked excesses of capitalism, and the need for institutions which constrain it by asserting the rights and dignity of individuals, and thereby the public good. There have been significant attempts to depict a "New World Order" within CST and more generally.

An additional feature of CST is the increasing concern for protection of natural resources ("the environment"). Some traditional analyses have suggested that Catholic thought put humans above nature, legitimizing its unsustainable use (abuse) toward transcendent goals. But the opposite is clearly true: the tradition is one of stewardship of the earth, in partnership with the Creator, stemming from Genesis. The latter view is evident in modern CST. It is a necessary complement to secular views of "Spaceship Earth."

Relative to technology, CST has generally been quiet. Technology is largely viewed as an exogenous trend. All knowledge is intrinsically good. As facilitator of human agency it is neutral: it can liberate as well as enslave; it can build and destroy. Because of the historical Catholic emphasis on individuals as agents within economic, corporate and government organizations, little attention has been paid to professionals per se.³ In particular, there is little attention to professional engineers as stewards of technology, i.e. as responsible points of action in steering technology toward human development. It would seem to be natural at this point in time to add this emphasis. This is especially evident given that

- much of the 20th century ideological conflict, which gave rise to both CST and the Declaration, turns on organizing human relations around emergent industrial abilities and dependencies; and

³ Pius XI introduced a notion of guild responsibility in 1931 that has been left relatively unexplored.

- technology is the enduring, definitive feature of the modern world. It sustains large corporations and large populations. Without technology, there is no corporate power, no state power, and no sustainable economy at the scale now necessary.

If anyone is to be held responsible for technology outcomes, engineers are.

New Rights in an Industrial World

CST and the UDHR are commonly invoked as a normative guide for individuals, and for professionals in government, business, defense, and economics. Why not for engineers? After all, many of today's basic challenges are fundamentally shaped by technology. One conventionally identifies the major themes of political, social, and economic rights in the above-reviewed documents. We assert the emergence of new human rights, each of which is fundamentally defined by technology:

1. The right to economic participation
2. The right to technology services
3. The right to sustainable access to natural resources

Item 1 is essentially the right to work and to just compensation, and to other elementary workers' rights. It is among the earliest concerns in CST and is well-established. It is restated here in a context which emphasizes the importance of peoples' activities becoming "internal" to national economies. It is no small responsibility to devise productive jobs for 12 billion people! But it is easy to find things that need to be done. This is a challenge to the organizational skills of all contemporary professions.

Items 2 and 3 are new and are discussed below.

Human Rights in Technology Services

At this point in history, it is possible to assert fundamental human rights in the service of technology. With science exploding, it is not possible to anticipate its fruits or future material progress; but after 200 years of industrialism, we can affirmatively assert the existence of these rights in the abstract, and begin to sketch their outline.

There is abundant evidence that rights to the following technology services are declarable:

- Habitat – food, clothing, shelter; adequate, safe housing
- Water supply and sanitation
- Primary health care services and access to medicine
- Security – absence of threat of aggression; an information/monitoring technology and a contract among people to avoid destabilizing and/or offensive arms development.
- Freedom from tyranny of weapons
- Education, access to knowledge
- Access to information

- Dignified employment – participation! just wage

Many of these can be discerned in the Declaration and/or CST. It is interesting to note that all of these are achievable now. People everywhere have participated in the creation of scientific and technical knowledge; they deserve ownership of the fruits. The knowledge, capital and manpower are all available.

Human Rights in Sustainability and Natural Resources

No just world order is possible which is not fundamentally founded in natural resources and a stable pattern of their utilization. Article 28 of the Universal Declaration entitles people to “a social and international order in which ... rights and freedoms ... can be fully realized.” And the responsibility of stewardship of the natural world is expressed clearly in CST. And from a practical point of view, “sustainability” is presumed in all of these documents. At the very least, theorizing usually invokes the rights of unborn generations.

Since Rachel Carson, we have seen steady progress in the western democracies toward governmental guarantees to clean air and water, public rights in the harvest of living resources, and conservation of the biosphere. There is however little apparent opportunity on the world stage for comparable progress. Without this, these public rights will never be secured. And so we assert an emergent human right in the use and conservation of natural resources. Three aspects may be distinguished

- the right to a healthy environment, free of industrial effluent
- the right to equitable access to natural resource services
- the right to conservation of natural resources for later use; and related, the right to sustainable use of same

As stated, these natural resource rights transcend questions of ownership and sovereignty.

It is not hard to read the history of conflict in terms of access to natural resources. “If you want peace, work for justice.” Justice in this case involves securing these new natural resource rights. The manpower is available; the knowledge is only partly available concerning environmental and ecological interactions. There is a burden of research implied in securing these rights – we lack comprehensive understanding of ecology. And there is a burden of practical action now, while that ecological knowledge is still deficient.

Engineering – An Emergent Global Profession

Engineering is a profession. The collection of professional characteristics includes:

- *Demonstrated Distinctive Competence* in the applied sciences leading to practical machines, systems and products which perform as specified
- *Educational Standards and Specialized Schools* for the preservation and transmission of professional knowledge
- *Continuing Education* for members expected and rewarded
- *Licensing and Certification*
- *Codes of Conduct* which emphasize public service and the public good and a limited sphere of competence

These are generally accepted criterion for classification of an activity as a profession. Thus, the assertion that engineering is a profession is reasonable and often affirmed.

It is also asserted that this profession has an ambiguous social contract⁴, ambiguous as viewed by both the professional person and the served public. Some facts testify to this:

- There is an Order of the Engineer with a pledge, but no monitoring or enforcement. The same applies to the ethics statements and codes of all the professional societies. One cannot cease to be an engineer, as it is generally understood, by losing competence or integrity or by failure to act responsibly.
- Very few engineers actually pursue or maintain legal registration. In most cases, it is not a criterion of professional employment. But registration is the only certification of current professional authority beyond educational credentials.
- Codes of conduct, while generally emphasizing service to the public, are generally restrictive, not prescriptive. Thus the genuine search for public service is not fully realized.
- Most engineers are employed in the service of capital -- the client is the board of directors, the criterion is return on capital. This is different than delivering services to people.
- Most engineers show a lingering, nagging anxiety about what is *not* being done, and (less universally) about the offensive weapons focus in engineering practice. There is a sense of misplaced professional priorities, and a sense that glamour and greed are dominating priorities. Public service by working professionals is generally done on a personal, leisure-time basis – on humanistic, not professional, grounds.
- There is no expectation of “pro bono” professional work being done by engineers, beyond service projects within universities and otherwise pre-career activities. Certainly, these activities are good; but they do not match the power, scope and global reach of daily professional life. There is a void between professional ideals of service and that actually achieved.

⁴ Professions and their public are held together by a social contract – in which the public cedes authority (first authentic or moral authority, then later, civil and legal authority) to the profession. Implied is a circumscribed arena of competence and integrity, wherein the contract is mutually accepted.

The social contract between engineers and the public is thus imperfect. This is a natural consequence of the newness of the profession: it had no real role or calling prior to the Industrial Revolution. Its social contract is therefore not fundamentally defective; it is simply incomplete, a work in progress. It needs time and attention in order to mature. For this reason we may think of engineering as an emergent profession.

Three additional features seem particularly relevant. First, the confusion surrounding the question of professional versus employee. Related is the confusion about "corporate morality." And finally, the confusion between ends and means of professional activity. These are all interrelated, and lead to the persistence of the "engineers' error."

Professionals or Employees?

The lion's share of engineers work full-time for for-profit corporations⁵. Few are professionally licensed, although most hold accredited university degrees in engineering. Many corporations are large enough to provide full career paths for engineers. Are engineers employees, serving the financial success of their employers and without allegiance to contrary interests? Or, are they professionals, with independent norms of conduct and evaluation concerning purpose and outcome?

First we need to assume that in all cases, human conscience is accepted and expected from all persons, employer or employee. But what about professional codes of conduct and norms? This is a middle ground – a kind of additional conscience formed among an educated community with special knowledge and skills. Is there room for this in today's corporation, and are engineers expressing it?

It is useful to distinguish mutual obligations among

- Employees with conscience
- Professionals as employees with conscience and with additional professional goals and norms
- Corporate owners (principal stockholders and officers) with conscience as servants of the corporate mission

A critical distinction of the professional is the allegiance to 3 standards: personal conscience, obligation by contract to the corporate employer, and social contract stemming from his/her professional status. This latter standard injects a third-party obligation into the professional/corporate relationship, with potentially profound consequences.⁶ And a critical distinction of the owner is allegiance to the corporate mission per se. Allegiance to that mission by the professional is limited by the nature of the (expressed or implied) employment contracts.

⁵ According to Reynolds (1991) there are about 2 million engineers in the USA; and among males it is the single most common occupation.

⁶ The codes of ethics for engineers address some dimensions of this conflict. (See annex.)

It is easy to see how conflicts between the professional and corporate missions can produce serious dislocations. The submergence of professional concerns into individual employees' obligations of conscience is a convenient way out in contemporary corporate life. That is a failure of the social contract for the professional.

Another denial of the professional role is the common conception of engineers as upwardly-mobile white-collar workers. Individuals' professional goals and norms fade into Corporate ones with upward corporate mobility. The special professional obligation is short-lived and may never really mature.

There is ample evidence of both of these forms of non-professional corporate life. Witness the career paths of successful engineers in US corporations. Following a 4-year university degree, overstuffed with technical requirements at the expense of liberal learning, and 5 years of white-collar employment in a technical role, what is the next step "upward"? Answer: obtain an MBA and return to corporate life in a "management" role. This implies the abdication of the professional engineering role. The road not chosen – continued technical employment – is commonly associated with limited career development and corporate authority in the long run. Surely in these stereotypes there are nuggets of truth.

So we have both forms of abdication: the submergence of professional responsibility to the level of individual conscience, and the abandonment of it to corporate responsibility.

This phenomenon is intimately related to the problem, "Why can't Jack read, write and speak?" It is because we have not demanded that from Jack, neither in education nor in corporate life, associating those skills not with engineering but with "management." Of course this is a self-sustaining phenomena, the stereotype reinforced by self-selection in recruitment and an imperfect professional norm. Jack is perfectly capable of these; no mature profession would accept such a criticism.

The widespread association of engineers with corporate wealth, rather than authentic human progress, is one result of this confusion.

Can Corporations Have Morals?

This is a tall question, and highly relevant. The question does not concern individuals as employees, officers, or stockholders of corporations – they of course have conscience and live by it. Rather it is directed at the for-profit corporate entity itself, with unique purpose, authority, and governance, and licensed by a legitimate government.

Now it is not true that corporate goals are opposed to human progress either necessarily or in fact. Such an assertion would be foolish. But vast areas of human need are outside of the interests of for-profit corporations. On the one hand, large segments of the population are simply outside of the price system. And on the other hand, public goods by definition require markets which cannot or do not exist; they cannot be produced by real markets. Economists have labored long to expose the types and sources of market imperfection. And they have

routinely called for redress -- typically through government intervention. "Good corporations" advocate the creation of such interventions and participate in their construction.

It is a feature of the present situation that there is no global government which can so correct imperfect global markets, alone or in partnership with good corporations. And, governments are themselves imperfect representatives of public interest, when corporations have political voice alongside citizens. This is increasingly true as corporations become more global, extending operations beyond national borders. Essentially corporations have unlimited global growth potential, while national sovereignties are strictly limited. Their competitiveness is a fact of life, and reliance on mutual coercion to internalize public goods would seem foolish in the absence of good government at a comparable scale.

When all human needs are fairly represented on the bottom line of corporate entities, or in global laws and regulations -- then engineering as we know it will internalize all human service needs. In the meantime, while we are waiting for Hades to Glaciate, who will represent the public interest?

Profit and Corporate Nature

It is tempting to hope for ethical corporations, and a new social contract among people and corporations with corporate rights and responsibilities linked. However it is also reasonable to assert that by default, corporations are created fundamentally to create return on capital invested. To ask them to not do this is to ask them to act contrary to their nature, indeed unethically relative to their investors, with potentially brutal consequences. Essentially we are only reciting corporate facts of life, which need to be respected.

A corporation requires profit to fulfill its mission. The profit motive is a life-sustaining natural trait. But if profit were to be demoted from corporate *objective* (maximize profit), to a *constraint* on its operation (guarantee that profit exceeds a minimum acceptable level), that would be a remarkable step in the right direction. Progress can be had by limiting corporate profit to some reasonable standard or fair expectation, perhaps in the way that monopoly profits are limited. We would have a "just rate of return" concept to complement the "Just Wage."

But even a collection of fully "ethical" corporations will leave much human need unserved -- by a collective error of omission. Lacking good global government, who will direct us toward technological justice?

Ends or Means of Professional Action?

Look at the standard divisions of any engineering activity: aerospace engineering, mechanical engineering, computer science and engineering, civil engineering, chemical engineering, etc. These are widely prevalent in universities, corporations, and accreditation agencies. But these are all procedural, activity-based skills, in search of problems. One may presume there are problems to be solved. What are the problems?

Problems, not solutions or methodology, define a profession. It is reasonable to seek the underlying concerns which call for a permanent profession. True problems are inherent in the human situation; they endure over time as classes of difficulties to be overcome. Solution strategies evolve with history and technology.

The Industrial Revolution, its irreversibility, and human dependence on technology -- these pose significant, enduring problems for humans which are not addressed by other professions or human agencies. In this context we identify the fundamental concerns of engineering.

Hypothesis: there are 5 fundamental, enduring concerns of engineering. These concerns define the profession:

- Productivity, organization and management
- Infrastructure (including communications and information, e.g. education)
- Natural resources and environment
- Health
- Security

Implied in this hypothesis is that these concerns are permanent and will survive all technical evolution as underlying concerns for human welfare. They are not solutions, approaches, or scientific phenomena which are the customary basis for engineering organization. No mental gymnastics are required to relate these to human rights as described above; while the reverse is true of the conventional engineering descriptors (mechanical, electrical, etc.). Hence we have a natural overlap of professional definition with the more fundamental mission to secure human rights.

The widespread association of engineers with means rather than ends helps explain the confusion between tradesmen and professionals. Is the engineer like a plumber, or a priest?

The Industrial Revolution defines our profession. However we have not articulated these fundamental concerns which arise from it, to ourselves, the served public, or to students. Nor are we cultivating a sense of responsibility for these concerns within the sphere of professional activity. One way or the other, we will be held accountable for industrial outcomes.

The Engineers' Error

There is a widespread error in engineering thinking. It is stated that engineers serve the public, serve people, put people first, fulfill basic human needs, etc. (see Annex for excerpts from professional codes). But what we serve in immediate practice is for-profit corporate employers. The deduction that this serves human needs rests on the truth of the premise that corporations serve those needs.

Lets examine this premise. First we have to be careful about "needs." While all economic activities serve satisfied customers, that satisfaction does not distinguish between "wants" and

“needs,” and of course assumes an ability to pay. Not all economic activities are therefore serve human needs; those needs that are served, are not necessarily in the right priority and many needs go unmet. So in this sense, the premise is false. This is not to say that the corporation or its employees are in error. Indeed, it is important to assume the opposite, that individual actions are ordered by intellect and conscience. The error here is a collective one – the profession in the main has an error of omission. The engineers’ error separates goals from outcomes.

Several dimensions of this error are worth elaborating:

1. Basic human needs in the abstract, e.g. better cars. Safety is of course an abstract human need. But safety is not an objective of a car company; it is a constraint, posed in terms of today’s laws and technology. The objective is to make and sell a profitable product. And better cars means many things besides safety: more acceleration, different body design, embedded stereo, and a long list of market-important qualities which have little to do with human need. Hence the necessity of advertising. There is no need for advertising basic human needs to cause people to need them. That is a contradiction. If need is basic, then all people already know about it. Wants do not equal needs.
2. Basic human needs in fact. Improvements in cars are not basic relative to hunger, disease, and inadequate shelter. When those needs are satisfied, then we can talk about the next level of priority. There is a relativism here, moderated by what is technically possible and/or easy.
3. Priorities ordered by capitalism, unchecked by good government, must by their nature be distorted. The popes and the economists agree on this point, both theoretically and practically.
4. Science and technology are neutral knowledge, and knowledge is intrinsically good. But all knowledge is not equal in serving people. If engineering research stated that it simply developed neutral knowledge, that would be valid. If it stated that it develops knowledge prioritized by state and corporate interests, that would be valid. But serving people is another matter. That has to spring from the human priorities of researchers as people and as professionals, informed by conscience and the facts of the world.

Invoking “good government” as a public-interest constraint on corporate activity does not solve the problem; there is no global government with the requisite authority to effectively constrain us. And we would still be left with the juxtaposition of objective (profit) and constraint (needs) which certainly distorts outcomes. Inversion of this relationship would seem noble.

The Engineers’ Error is a collective one, an error of omission reflecting imperfect priorities set in an imperfect marketplace. If we are truly a profession, then we must fix this as best we can. This means creating the means for individual professionals to act in support of our professed goals; a supplement to the clear prioritization set by market forces. Failure to do so is tantamount to giving up the “professional” claim.

Action Agenda

What is to be Done?

As a profession, we need to act on several fronts:

- A. Redefine the legitimate spheres of our professional activity in terms of ends, not means:
 - Productivity, organization and management
 - Infrastructure (including communications and information e.g. education)
 - Natural resources and environment
 - Health
 - Security
- B. Prioritize our activities in terms of human rights, and especially those newly-emergent rights from the Industrial Revolution:
 - The right to economic participation (right to work)
 - The right to technology services
 - The right to sustainable access to natural resources
- C. Concentrate on extending service to unserved people, more so than perfecting service to those already served. Avoid the "Engineers' Error," where distorted priorities are bred.
- D. Work to define the practical baseline for technological rights, to propagate it across all peoples, and to advance this baseline through research.
- E. Monitor our progress toward basic human rights and initiate necessary changes or adjustments to our institutions and practices.

In doing these things we will begin to perfect the social contract of the profession, in a way consistent with the notion of stewards of technology, in a fundamentally, and permanently, technological world. We do not assert that professional engineering can or should be the whole answer. Rather, we assert that this profession must accept its responsibility for outcomes, and act accordingly.

Seeds of transformation need to be planted immediately. The horizon is the next 50 years, one professional generation. All parts of the profession need to be engaged: education, research, and practice. A clear sense of urgency is justified.

Fundamental to progress is the creation of a new "pro bono" opportunity and expectation among working professionals.⁷ In this new arrangement, individuals would work as licensed professionals, on real engineering jobs, on leave from (but supported by) their regular employment. The nature of the work would be "industrial strength." Within corporations and government agencies, engineering career paths need to be developed which expect and reward pro bono activity. Within universities, those career paths need to be seeded and incubated. And the profession needs to develop neutral, independent institutions to house that activity.

⁷ Pro Bono in this context transcends national economies and jurisdictions.

In the same spirit, fundamental progress is needed in defining practical work in the university. To teaching, we need to add a focus on graduate professional programs directed at the overarching goal (human rights). To research, we need to add interdisciplinary project work with the same goal and a focus on true human needs to prioritize advanced research. To practice, we need to add institutes to organize and channel the pro bono activities -- essentially shelter the latter on neutral territory and dignify it. In the same breath those institutes need to channel the participation of university energies toward collective goals -- in a blend of multi-disciplinary, problem-oriented actions.

It is important to note that none of our present institutions need to be asked to go outside of their understood roles: Universities should construct educational programs; corporations should support the professional activities of their engineers; research institutions should read, theorize and experiment. Relative to people, working professionals should ply their trade toward just ends: faculty should mentor the young in scientific skills and professional norms; students should develop their intellects and skills, and vote with their feet. There is nothing new here.

But most importantly, those who would claim the mantle of leadership need to LEAD! True leadership requires nerve, vision of outcome, the acceptance of risk, and the desire to learn from failure and success. Leadership is required across the board -- in education, research, and practice. To the stereotypical engineer who "follows the money," we need to say: "guide the money to right ends." To the university people who want primarily to "beat Stanford", we say, "make a difference."

Will the true leaders in engineering please step forward?

A First Step

As a first step, a series of working conferences needs to be launched. The goal is to develop practical implementations of the vision set out here, in university, corporate, NGO, and professional society settings. Specifically, we wish to mobilize all parts of the profession toward the human rights agenda, including

- The prioritization of research, and the creation of some specialized research institutes
- The creation of some novel engineering education programs
- The institution of pro bono exchanges between for-profit organizations and nonprofit units which provide engineering services to unserved people

The securing of practical commitments to action is essential in the near term. A small handful of initiatives need to be launched, jointly committed to mutual support, evolution and success. A criterion of participation will be the willingness to commit to near-term action on an institutional basis.

Independent US universities may be the best hope for a neutral zone in which to host these early efforts. They represent the highest achievements in science and technology education and research. And they aspire to the greatest ideals of scholarship and service in the university tradition. By their setting in an historic continental democracy, they are not beholden to the

wishes of government, military, corporate, or wealthy elites. It is natural to begin there. The mission is to seed a broad professional transformation, but not to own it.

Key themes for extended discussion and experiment include:

- Professional engineering education -- beyond ABET
- Integration of pro bono work in longer-term service centers -- themes, clients.
- Research priorities and novel research centers
- Human Resources (education, pro bono, career paths for professionals)
- Relations among NGO's, governments, corporations, universities, and the profession

A bottom - line challenge for any proposed activity: how does it give professional voice to the service of human rights? And how does it do what is not being done otherwise?

Preparatory discussions are sketched below.

Experiments in Professional Education

Novel professional programs should presume prior education at the BS level in an ABET-accredited program. Ideally students would also be EIT-certified. This allows the larger issues of engineering, technology and human rights to proceed on a foundation of basic competence.

Several concurrent programs would be desirable, focusing on different types of prior and posterior skills. Any such program must have a clearly identifiable, distinctive competence.

Funding for professional programs would need to be secured from Corporations (either fellowships or via leave arrangements of employees --essentially the same model now in place in MBA programs.) Additional fellowships should be sought from NGO's and government agencies, on the same basis and/or in exchange for engineering services in support of mission (relief, development, security, etc.) NSF education and ethics programs are obvious sources of support at the margins.

Faculty need to be fully-vetted in a hosting university. Supplemental faculty would be drawn from international exchange programs, which need to be a priority, and from corporate exchange programs. Both exchanges need to be 2-way streets.

Institutes

Institutes can be founded on any of the neglected problems alluded to herein. Examples generally fall into two categories: research centers and service centers.

In the Research category we put many recognizable themes: sustainable technology, (the "Factor of 10 Gang"), sustainable agriculture, and nonoffensive/nonviolent security technology.

A distinguishing feature of these is devotion to an externally-juried human rights agenda, prioritized on a timescale of 50 years, and an emphasis on affecting the global industrial agenda on that time scale. Many specific examples are being tried already. A critical question for the present discussion surrounds their prioritization relative to human rights -- are we researching the right things?

Service centers would be different -- characterized by extending technological services to the unserved. Examples might include:

- A center for engineering services in support of disaster relief and prevention
- A center for development engineering
- A center for networked education production and delivery
- A center for networked health care delivery to poor people
- A center for natural resource analysis

The idea of engineering service centers is perhaps the most innovative, although examples exist in other professions. They embody the idea of fully qualified professionals working toward publically-juried goals of establishing justice through human rights. They need to provide institutional support for professionals, and institutional continuity in longer-term projects. They could be attached to university degree programs or be independent of them. Staffing in the service centers would comprise a permanent staff, a transient corps of pro bono engineers (plus faculty and graduate students as appropriate). Projects could be commissioned from NGO's who have no in-house engineering staff.

Naturally, the distinction between research and service here is artificial; hybrid centers are easy to conceive.

Career Paths

Form and structure need to be given to the university/government/corporate linkage in the form of specific models of successful career development. The mentoring of individual trajectories among BS, postgraduate programs, corporate and national R&D, production, and pro bono is needed and existence proofs need to be presented as models, with commitments for the future. The university/corporate exchange needs to be two-way, beginning with student interns and extending to senior engineers and faculty. International scope is presumed.

Surely, some new institutions are needed in our Career Paths. There are examples in other professions: Doctors Without Borders offers an immediate model and it is already being emulated in the newly-organized Engineers Without Borders. We need to think creatively on this front.

Case Studies in Action

Manhattan Project: When Richard Feynman was assigned to Los Alamos during WW2, he was given charge of a computational unit comprising “clever boys from high school.” It soon became apparent that they were going too slow and that they were ignorant of the larger context of their work. He got permission to reveal their mission to them. The result: “complete transformation.” They increased their productivity by a factor of 10, on their own! The result is history; it led to the end of the war, the formation of the UN, and the present moment. Youth will respond, if their leaders ask it of them. A comparable project is needed now. Lets announce the goals!

Apollo Program: Many senior engineers were brought up in this era. They sought to achieve an absurd goal, never imagined to be possible previously, and linked to life and death implications relative to the arms race. In the words of Gene Krantz, “Failure was not an option.” They succeeded.

Clean Water Act: Through the 1960’s, the nation’s water resources had come to represent a case study in externalities. Progress was essentially stymied as state and local governments realized the complexities of the physical/chemical/biological phenomena involved, and their non-local economic reach. Congress declared that the national interest was involved; that there would be Zero Discharge – an absurd technical proposition; that polluters would be licensed; and that all licensees would be required to use “best practical technology,” a movable target. While some concentrated on the contradictions inherent in such goals, others proceeded to define and achieve BPT, with enormous benefit to the nation at large. An impossible task was achieved; detailed solutions are now part of every engineering school’s repertoire.

Afghanistan: In Fall 2001, I taught a small class of 9 students – 5 seniors, 4 graduate students. All majored in engineering or environmental studies. Our topic was natural resource management. The course required mastery of analytical material and a term paper.

Early in the term the definitive event occurred – the destruction of the WTC towers and the attack on the Pentagon, and the ensuing war in Afghanistan. Surrounded by crisis, I challenged the students to coordinate their term papers on the following: “Develop a reconstruction plan for the natural resource infrastructure of Afghanistan, assuming a just and stable regime and massive international aid.” Initially, response was mixed and generally timid. “There is no information;” “How can WE do anything useful;” etc. They had the skill and abandon of youth, the competence of ABET, and the benefit of liberal education. But they lacked professional experience and self-confidence. And they had no professional support services.

So I challenged them – “If you cannot do this, who can? What skill and knowledge can those ‘in charge’ bring which you cannot?” Their response was profound. They dug into the library, the internet, and the daily journalism (which was in-depth and excellent). They attended extra classes to share information and ideas; they made oral presentations of their drafts. They dealt frankly with the 20-year hiatus of modern information about the country. And they produced 9 excellent papers which are exemplary and as good a guide to the problem as any unit could produce. As we parted, plans were discussed for a continuing seminar with guest speakers.

Now this was so gratifying. Independent professionals like them, when faced with an impossible challenge, will rise to it. Leaders have only to ask for their best, coordinated efforts. IF students can do this, in the context of a for-credit course, imagine the power of a permanent institute staffed by pro bono professionals!

One lesson common to each of these cases: we should not shrink from impossible tasks!

Postscript

We are on the brink of a profound transformation of the planet. Whatever will be built, will be built with the willing complicity of the engineering profession. It could represent a breakthrough for human welfare, supporting a just world order. Or, it could be an unsustainable, unjust disaster of global proportions.

Our response now is critical. This could be our finest hour or our darkest failure. We will be held accountable for the outcomes. It will not be true that “We didn’t know....”. There are daily signals of need. The clock is ticking.

What shall we build?

Acknowledgement

The author is greatly indebted to all of the persons interviewed, each of whom gave their time and insights generously. A common criticism was that these arguments “go to far”, that they seem to usurp all authority and “power” for engineers. But the contrary is the intention, to assign responsibility for industrial outcomes to those who participate in their creation as professionals; and to challenge at least one latent group of professionals to accept that responsibility.

Bibliography

- Adler, E. and P.M. Haas. Conclusion: epistemic communities, world order, and the creation of a reflective research program. Special Issue, International Organization, Haas, P.M. (ed.) 367-390 (1992).
- Barrerra, A. Social Principles as a Framework for Ethical Analysis (With Application to the Tobin Tax). *J. Business Ethics* 23: 377-388 (2000).
- Barrera, A, O.P. Modern Catholic Social Documents and Political Economy. Georgetown Univ. Press, 2001.
- Bowyer, K.W. (ed.) Ethics and Computing: Living Responsibly in a Computerized World. IEEE Press, 2001.
- Brown, Dorothy M. and Elizabeth McKeown. The Poor Belong to Us: Catholic Charities and American Welfare. Harvard Univ. Press, 1997.
- Carter, Jimmy. An Hour Before Daylight: Memories of a Rural Boyhood. Simon & Schuster, 2001.
- Chesterton, G.K. Aquinas: the Dumb Ox. Image Books, 1974.
- Davis, M. and A. Stark. Conflict of Interest in the Professions. Oxford U. Press, 2001.
- Davis, Michael. Thinking Like an Engineer – Studies in The Ethics of a Profession. New York: Oxford University Press, 1998.
- Day, Dorothy. The Long Loneliness. Harper & Row, 1952.
- Elshtain, Jean Bethke. Who Are We? W.B. Eerdmans, Grand Rapids, 2000.
- Enderle, G. (ed.). International Business Ethics. Challenges and Approaches. U. Notre Dame Press, 1999.
- Feynman. R. Surely you're joking, Mr. Feynman? Bantam, 1986.
- Fort, T.L. Ethics and Governance. Business as Mediating Institution. Oxford U. Press, 2001.
- Gorlin, R.A. (ed.). Codes of Professional Responsibility. Ethics Standards in Business, Health and Law. Bureau of National Affairs, Inc. BNA Books, Washington DC, 1986.
- Grant, G.P. Technology and Justice. U. Notre Dame Press, 1986.
- Gremillion, J. The Gospel of Peace and Justice. Catholic Social Teaching since Pope John. Orbis Books, 1976.
- Haas, P.M. (ed.). Knowledge, Power and International Policy Coordination. Special Issue, International Organization 46:1, Winter 1992.
- Haas, P.M. Introduction: epistemic communities and international policy coordination. Special Issue, International Organization, Haas, P.M. (ed.) 1-35 (1992).
- Harris, Charles E. Jr. and Pritchard, Michael S. and Rabins, Michael J. Engineering Ethics, Second Edition. Wadsworth, 2000.
- Hatch, Nathan O. (ed.). The Professions in American History. U. Notre Dame Press, 1988.
- Henriot, P.J., E.P. DeBerri, M.J. Schultheis. Catholic Social Teaching: Our Best Kept Secret. Orbis Books, 1985.
- Herman, S.W. and A.G. Schaefer (eds). Spiritual Goods. Faith Traditions and the Practice of Business. Philosophy Documentation Center, 2001. (In part a reprint of articles from Business Ethics Quarterly).
- Hesburgh, T.M. The Ultimate Imperative – A Challenge for the Year 2000. Yale Univ. Press, 1974.

- Hollenbach, D. The Common Good Revisited. *Theological Studies* 50: 70-94 (1989).
- Houck, J.W. and O.F. Williams (eds.). *Is the Good Corporation Dead? Social Responsibility in a Global Economy*. Rowman and Littlefield, 1996.
- Johnson, Terence J. *Professions and Power*. Macmillan, London, 1972
- Johnson, D.M. (ed.). *Justice and Peace Education*. Orbis, 1986.
- Kimball, Bruce A. *The "True Professional Ideal" in America*. Blackwell, 1992.
- Krantz G. *Failure is Not an Option*. Simon and Schuster, 2000.
- Landy, T.M. (ed.). *As Leaven in the World*. Catholic perspectives on faith, vocation, and the intellectual life. Sheed and Ward, 2001.
- Layton, E.T. Jr. *The Revolt of the Engineers – Social Responsibility and the American Engineering Profession*. Case Western Univ. Press, 1971.
- Ludwig, D., R. Hilborn, C. Walters. *Uncertainty, Resource Exploitation, and Conservation: Lessons from History*. *Science* 260:17-18 (2 April 1993).
- Lynch, D.R. and C.E. Hutchinson. *Environmental Education*. *Proc. National Academy of Sciences* 89, 864-867 (1992).
- Lynch, D.R. *Environmental Education in the 21st Century*. *Directions*, Thayer School of Engineering, Dartmouth College. 10:1:46-52, Fall 95.
- Martin, Mike W. and Schinzinger, Roland. *Ethics in Engineering*. McGraw Hill Book Company, 1989.
- Menzel, P. *Material World. A Global Family Portrait*. Sierra Club Books, 1994
- Moorthy, R.S., R.T. DeGeorge, T. Donaldson, W.J.Ellos, R.C. Solomon, R.B.Textor. *Uncompromising Integrity: Motorola's Global Challenge*. Motorola University Press, 1998.
- Murphy, Patrick E. (ed.). *Eighty Exemplary Ethics Statements*. U. Notre Dame Press, 1998.
- Rachels, James. *The Elements of Moral Philosophy*. Temple University Press, 1986.
- Rawls, J. *A Theory of Justice*. Harvard U. Press, 1989.
- Reynolds, T.S. (ed.) *The Engineer in America. A Historical Anthology from Technology and Culture*. U. Chicago Press, 1991.
- Rice, C. *Fifty Questions on the Natural Law. What it is and why we need it*. San Francisco: Ignatius Press, 1999.
- Santmire, H. Paul. *The Travail of Nature: The Ambiguous Ecological Promise of Christian Theology*. Minneapolis: Fortress Press, 1985.
- Schlossberger, Eugene. *The Ethical Engineer*. Philadelphia: Temple University Press, 1993.
- Sen, Amartya. *On Ethics and Economics*. Blackwell, 1987.
- Sen, Amartya. *Development as Freedom*. Anchor Books, 1999.
- Sethi, S. P. and O.F. Williams. *Economic Imperatives and Ethical Values in Global Business; the South African Experience and International Codes Today*. U. Notre Dame Press, 2001.
- Vesilind, P.Aarne and Gunn, Alastair S. *Engineering, Ethics, and the Environment*. Cambridge University Press, 1998.
- Williams, O.F. and J.W. Hauck (eds.). *Catholic Social Thought and the New World Order. Building on One Hundred Years*. U. Notre Dame Press, 1993.
- Williams, O.F. (ed.). *Global Codes of Conduct – An idea whose time has come*. U. Notre Dame Press, 2000.
- Williams, O.F. and J.W. Hauck (eds.). *The Making of an Economic Vision. John Paul II's On Social Concern*. University Press of America, 1991.

Persons Interviewed

At the University of Notre Dame:

Scott Appleby, Director, Joan B. Kroc Institute for International Peace Studies; Professor of History
Patrick Gaffney, CSC, Associate Professor, Anthropology, Kroc Institute Fellow
Raimo Vayrynen, Professor, Political Science; Kroc Institute Fellow
Kristin Shrader-Freschette, O'Neill Professor of Philosophy; Concurrent Professor of Biological Sciences; Kroc Institute Fellow
Vaughan McKim,, Associate Professor, Philosophy; Acting Director, Reilly Center for Science, Technology and Values
Mark McCready, Professor and Chair, Chemical Engineering
Ahsan Kareem, Moran Professor of Civil Engineering and Geological Sciences
Oliver Williams, CSC, Associate Professor, Management; Academic Director, Center for Ethics and Religious Values in Business; Kroc Institute Fellow
James Rigert, CSC, Associate Professor Emeritus, Civil Engineering and Geological Sciences
Joannes Westerink, Associate Professor, Civil Engineering and Geological Sciences
William Gray, Massman Professor of Civil Engineering
Robert Nelson, Professor, Aerospace and Mechanical Engineering
Lionel Jenson, Associate Professor and Chair, East Asian Languages and Literature
J. Daniel Philpott, Assistant Professor, Political Science; Kroc Institute Fellow
Theodore Hesburgh, President Emeritus, University of Notre Dame
Frank Incropera, Dean, College of Engineering
Patricia Maurice, Associate Professor, Civil Engineering and Geological Sciences; Director, Center for Environmental Science and Technology
Jeff Talley, Assistant Professor, Civil Engineering and Geological Sciences
Nathan Hatch, Provost, University of Notre Dame
Ernest Bartell, CSC, Professor, Economics
Kevin Bowyer, Professor and Chair, Computer Science and Engineering

Elsewhere:

Albino Barrera, OP, Professor of Economics, Providence College
John Convey, Provost, Catholic University of America
Jack Johannes, Provost, Villanova University
Michael Mastanduno, Director, Dickey Center for International Understanding, Dartmouth College
Ronald Green, Director, Institute for Applied and Professional Ethics, Dartmouth College
Aine Donovan, Executive Director, Institute for Applied and Professional Ethics, Dartmouth College

Annex I: United Nations Charter Excerpts

Preamble

We The Peoples Of The United Nations Determined

to save succeeding generations from the scourge of war, which twice in our lifetime has brought untold sorrow to mankind, and

to reaffirm faith in fundamental human rights, in the dignity and worth of the human person, in the equal rights of men and women and of nations large and small, and

to establish conditions under which justice and respect for the obligations arising from treaties and other sources of international law can be maintained, and

to promote social progress and better standards of life in larger freedom,

Article 1

The Purposes of the United Nations are:

1.To maintain international peace and security, and to that end: to take effective collective measures for the prevention and removal of threats to the peace, and for the suppression of acts of aggression or other breaches of the peace, and to bring about by peaceful means, and in conformity with the principles of justice and international law, adjustment or settlement of international disputes or situations which might lead to a breach of the peace;

2.To develop friendly relations among nations based on respect for the principle of equal rights and self-determination of peoples, and to take other appropriate measures to strengthen universal peace;

3.To achieve international co-operation in solving international problems of an economic, social, cultural, or humanitarian character, and in promoting and encouraging respect for human rights and for fundamental freedoms for all without distinction as to race, sex, language, or religion; and

4.To be a centre for harmonizing the actions of nations in the attainment of these common ends.

Article 68

The Economic and Social Council shall set up commissions in economic and social fields and for the promotion of human rights, and such other commissions as may be required for the performance of its functions.

Annex II: Excerpts from Professional Codes

The following are excerpted from the normative statements of professional societies. They clearly state the idealized goals of public service for the profession. (See following Annex for more details.)

NSPE: Engineers' Creed

“As a Professional Engineer, I dedicate my professional knowledge and skill to the advancement and betterment of human welfare.”

ASCE:

“Engineers ... (use) their knowledge and skill for the enhancement of human welfare and the environment;...”

NIEE Statement of Ethics Principles

“The privilege of practicing engineering is entrusted to those qualified and who have the responsibility for applying engineering skills, scientific knowledge and ingenuity for the advancement of human welfare and quality of life. ... Engineers ... strive for the efficient use of the world's resources to meet long term human needs.”

“Engineers shall hold paramount the health, safety and welfare of the public in the practice of their profession.”

Order of the Engineer -- Obligation of the Engineer

“... my skill carries with it the obligation to serve humanity by making the best use of Earth's precious wealth.”

“... my skill and knowledge shall be given without reservation for the public good.”

Annex III: Overview of Professional Engineering Societies

A survey of web-served information by Engineering Societies led to this brief overview.

National Society of Professional Engineers

NSPE has an Engineers' Creed and a Code of Ethics comprising 6 Fundamental Canons, 5 Rules of Practice which elaborate on the Canons, and 9 Professional Obligations. Many of the Obligations deal with client and employer relations.

NSPE Engineers' Creed

As a Professional Engineer, I dedicate my professional knowledge and skill to the advancement and betterment of human welfare.

I pledge:

- To give the utmost of performance;
- To participate in none but honest enterprise;
- To live and work according to the laws of man and the highest standards of professional conduct;
- To place service before profit, the honor and standing of the profession before personal advantage, and the public welfare above all other considerations.

In humility and with need for Divine Guidance, I make this pledge.

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 standards of honesty and integrity. Engineering has 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 highest principles of ethical conduct.

The six NSPE Fundamental Canons are:

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 statements only in an objective and truthful manner.
4. Act for each employer or client as faithful agents 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.

American Society of Civil Engineers

The ASCE Code of Ethics comprises 4 Fundamental Principles, 7 Fundamental Canons, and Guidelines to Practice Under the Fundamental Canons of Ethics. The Fundamental Principles are taken from the of ABET Code of Ethics of Engineers. The Fundamental Canons resemble those of the NSPE; however Canon #7 is an addition.

Fundamental Principles

Engineers uphold and advance the integrity, honor and dignity of the engineering profession by:

1. using their knowledge and skill for the enhancement of human welfare and the environment;
2. being honest and impartial and serving with fidelity the public, their employers and clients;
3. striving to increase the competence and prestige of the engineering profession; and
4. supporting the professional and technical societies of their disciplines.

Fundamental Canons

1. Engineers shall hold paramount the safety, health and welfare of the public and shall strive to comply with the principles of sustainable development in the performance of their professional duties.
2. Engineers shall perform services only in areas of their competence.
3. Engineers shall issue public statements only in an objective and truthful manner.
4. Engineers shall act in professional matters for each employer or client as faithful agents or trustees, and shall avoid conflicts of interest.
5. Engineers shall build their professional reputation on the merit of their services and shall not compete unfairly with others.
6. Engineers shall act in such a manner as to uphold and enhance the honor, integrity, and dignity of the engineering profession.
7. Engineers shall continue their professional development throughout their careers, and shall provide opportunities for the professional development of those engineers under their supervision.

The ASCE definition of **Sustainable Development** is:

"Sustainable Development is the challenge of meeting human needs for natural resources, industrial products, energy, food, transportation, shelter, and effective waste management

while conserving and protecting environmental quality and the natural resource base essential for future development."

National Institute for Engineering Ethics

Originally established in 1988 the NIEE is a not-for-profit [IRS 501(c)(3)] educational corporation whose mission is to promote the study and application of ethics in our nation's engineering schools and throughout the engineering profession.

The principal thrusts of NIEE are communication, program development, education, and practice applications in the area of engineering ethics. A primary role of the Institute is to encourage cooperation among individuals, universities, professional and technical societies and business organizations with regard to engineering ethics and professionalism issues.

NIEE was initially created by the National Society of Professional Engineers (NSPE) but became independent of NSPE in 1995. Thus, is structured to serve as an independent liaison organization to promote engineering ethics among all engineering disciplines. Viewed as a cooperative effort among many engineering organizations with potential for far-reaching influence and impact, NIEE can and should bridge the various disciplines within the engineering profession.

The 10 guidelines below generally encompass the Canons of NSPE and ASCE, and extend them.

NIEE Statement of Ethics Principles

The privilege of practicing engineering is entrusted to those qualified and who have the responsibility for applying engineering skills, scientific knowledge and ingenuity for the advancement of human welfare and quality of life. Fundamental principles of conduct of engineers include truth, honesty and trustworthiness in their service to society, and honorable and ethical practice showing fairness, courtesy and good faith toward clients, colleagues and others. Engineers take societal, cultural, economic, environmental and safety aspects into consideration, and strive for the efficient use of the world's resources to meet long term human needs.

In the practice of engineering:

Engineers shall hold paramount the health, safety and welfare of the public in the practice of their profession.

Engineers shall practice only in their areas of competence, in a careful and diligent manner and in conformance with standards, laws, codes, and rules and regulations applicable to engineering practice.

Engineers shall examine the societal and environmental impact of their actions and projects, including the wise use and conservation of resources and energy, in order to make informed recommendations and decisions.

Engineers shall issue public statements only in an objective and truthful manner. If representing a particular interest, the engineer shall clearly identify that interest.

Engineers shall sign and take responsibility for all engineering work which they prepare or directly supervise.

Engineers shall act as faithful agents for their employers or clients and maintain confidentiality; they shall avoid conflicts of interest whenever possible, disclosing unavoidable conflicts.

Engineers shall ensure that a client is aware of the engineer's professional concerns regarding particular actions or projects, and of the consequences of engineering decisions or judgments that are overruled or disregarded. An employee engineer shall initially express those concerns to the employer.

Engineers shall appropriately report any public works, engineering decisions, or practice that endanger the health, safety and welfare of public. When, in an engineer's judgment, a significant risk to the public remains unresolved, that engineer may ethically make the concerns known publicly.

Engineers shall commit to life-long learning, strive to advance the body of engineering knowledge and should encourage other engineers to do likewise.

Engineers shall promote responsibility, commitment, and ethics both in the education and practice phases of engineering; they should enhance society's awareness of engineers' responsibilities to the public and encourage the communication of these principles of ethical conduct among engineers.

The Order of the Engineer

The Order is the roster of engineers in the United States who have participated in an Engineer's Ring Ceremony and who have publicly accepted the "Obligation of an Engineer."

The purpose of the Order is to stimulate formal public recognition by engineers in the United States of two basic principles. These principles are that (1) the primary purpose of engineering is service to the public, and (2) all members of the engineering profession share a common bond.

Any engineer is eligible for induction if he or she has graduated from an ABET-accredited engineering program or holds a license as a Professional Engineer

The Obligation is the formal statement of an engineer's responsibilities to the public and to the profession; the Obligation is publicly accepted by an engineer during induction at a Ring Ceremony. The Obligation is similar to the National Society of Professional Engineers'

Engineer's Creed, the Engineers' Council for Professional Development's Canon, and the Canadian Ritual of the Calling of an Engineer.

Obligation of the Engineer

I am an Engineer, in my profession I take deep pride. To it I owe solemn obligations.

Since the Stone Age, human progress has been spurred by the engineering genius. Engineers have made usable Nature's vast resources of material and energy for Humanity's [Mankind's] benefit. Engineers have vitalized and turned to practical use the principles of science and the means of technology. Were it not for this heritage of accumulated experience, my efforts would be feeble.

As an Engineer, I pledge to practice integrity and fair dealing, tolerance and respect, and to uphold devotion to the standards and the dignity of my profession, conscious always that my skill carries with it the obligation to serve humanity by making the best use of Earth's precious wealth.

As an Engineer[, in humility and with the need for Divine guidance,] I shall participate in none but honest enterprises. When needed, my skill and knowledge shall be given without reservation for the public good. In the performance of duty and in fidelity to my profession, I shall give the utmost.

Note: Brackets indicate the original wording of the Obligation. Either wording is acceptable, but new certificates have the newer wording.