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# *The (Re)Formation of a Profession: University Challenges to Engineering\**

Daniel R. Lynch

*Reformation of engineering as a profession is an urgent priority. Catholic Social Thought can serve as a guide to a rights-oriented profession; and Catholic institutions have a special leadership opportunity.*

I write to express the outlook from a professional school embedded in a conventional, secular, liberal arts college. Before me is the emergent generation of engineering professionals. What do we say to them? The opportunity is precious and the stakes are high.

## Introduction

In the American system we have insisted on a careful positioning of engineering education. The first professional degree occurs after four years of college (anomalously five at Dartmouth), and there is widespread commitment to university-style affiliation with non-professional students, curricula, and norms of scholarly development. We as custodians of the engineering disciplines must understand this important achievement and what it entails *vis-à-vis* what should and shouldn't be taught. We must perform against recognizable scholarly criteria -- we must create, conserve, and convey the central animating ideas, the important facts, the useful analyses, and initiate careers that are authentically productive. And we must look to the intellectual nourishment of a whole professional cadre, which populates numerous external institutions and creates very specific demands on the time of our students and faculty. To fail in either of these dimensions is to lose our preferred place in American higher education. So there is much at stake in contemplating our roles in a larger context.

A few facts about engineering are useful. There are about one and a half million American engineers; it is the most popular occupation among American males. About half of these are employed in the manufacturing industries; twelve percent are in government service, three percent are self-employed. About 65,000 students earn the B.S. yearly. Twenty percent of these are female, twenty-four percent American minorities, and seven percent foreign nationals. Most engineers are employed in corporate life; a very small percentage are officially licensed as professionals, and that percentage is concentrated away from the high-technology and high-profit areas today.

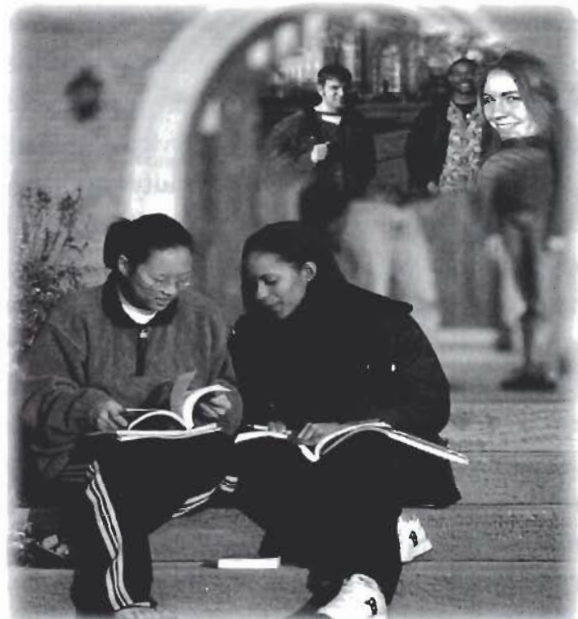


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Among the Association of Catholic Colleges and Universities, there are only thirteen schools of engineering, among roughly 340 nationwide. One important message from this is that the preparation of this profession is largely outside of mainline Catholic institutions. The fact that engineering is an "immigrant's profession," offering upward economic mobility, suggests heavy participation from traditional Catholic sources. But most aspiring engineers are not pursuing Catholic higher education. So the work of their formation as persons and professionals is on the outside, so to speak, as is the formation of the profession itself. And institutions like Dartmouth need to find ways and means of professional formation that are simultaneously right and secular.

### The Industrial Revolution

Now there is no shortage of pronouncements that the world at large is undergoing key transformations today. In technological terms, we are witnessing the maturation of the Industrial Revolution which will most likely be complete on the planet during the lifetimes of our students. It is reasonable to project a factor of five increase in per capita industrial metabolism, based on the existing evidence. Concurrently, reasonable projections have population stabilizing at roughly twice that of today. So on balance, the completion of the Industrial Revolution implies a factor of ten increase (5x2) in both natural resource utilization and environmental loading.

These two common projections presume 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. The alternatives are almost universally unacceptable. But there is no technology to support ten to twelve billion people at ten times the current aggregate consumption rate. Finally

there is no vision of a planetary ecosystem in equilibrium with this level of industry. Finally there is no planetary organization capable of constraining the global marketplace toward right outcomes. *What we are building will not work.*

Into this vacuum of global governance we inject the notion of *professions as global organizations*. Is engineering a profession? what is its natural scope? and what constitutes "right" engineering?

### Professions

It is asserted that engineering should be viewed as an *emergent profession*, imperfectly formed, but one that is here to stay. It is fundamentally defined by the industrial revolution and the need for development, stewardship and right deployment of industrial knowledge. As I argue above, global society is now irreversibly dependent on this -- so the *need* for a profession is there. We already find in engineering many of the conventional hallmarks of professions, including

- a clearly conceived distinctive competence,
- educational standards and accreditation,
- provision for licensing and continuing education,
- codes of conduct and judicial processes.

But we find also an *ambiguous social contract*. Are engineers professionals, or employees? Do their loyalties lie in making profit for their employers, or in serving the population at large? Who is the client? Is there in fact an independent institutional response to a basic human problem? Is there something in education or certification which requires adherence to the professional version of these ideas? Behind all these questions is the nagging fact that most engineers are not in fact licensed as such -- their "professional" status stems from their university preparation and their corporate employment. As a result, the "profession" is largely captive today to financial priorities, which are in fact *laissez-faire* globally and which are the primary and imperfect determinants of

global industrialization.

A negative conclusion to the professional question is of course possible and common. Where does that leave us? Without any hope of a profession devoted to technological stewardship, at a time when the technical genie appears to be out of the bottle, driving many imperfect globalization processes, and at a time when people everywhere are looking for ways to channel their individual energies toward right industrial ends. So we assert, yes, engineering is a profession, albeit imperfect and emergent, and we must perfect it as one of many instruments of right global governance. That affirmation has profound consequences.

### Engineering and Human Rights

It is commonly asserted in various ways that "engineers serve basic human needs." What are those needs? Certainly, engineering addresses material needs and above we assert that a material dependence on technology is essential to any realistic view of the planet. But a workable definition of those needs is sorely needed. It is easy to use up the whole industrial product and still have an unacceptable material condition -- unacceptable from almost any viewpoint. And materialism itself cannot be allowed free rein here.

So I suggest we return to an irrefutable secular reference point here: the Universal Declaration of Human Rights. Significantly the UDHR preamble cites a principle familiar to students of Catholic teaching:

"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...."

Article 25 is especially relevant:

"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. "

These and other contemporary statements elevate the material human condition to the position of authoritative right. And while scholars will debate the distinctions among positive (economic) and negative rights, entitlements, necessities, wants, needs, etc., there is broad consensus for a certain baseline. It is asserted that the object of professional engineering be the provision of this baseline of material well being, perhaps in a Rawlsian sense focusing on the least-well-provided for.

### Catholic Social Thought

Historically, Catholic teaching has emphasized the individual person, his or her relation to God, and individual salvation as liberation from earthly constraints. Beginning in 1891 with Leo XIII's *Rerum Novarum* we have a steady growth in emphasis on non-spiritual matters, coincident with growth in large, planetary institutions and relationships. There is now over 100 years' accumulated thinking on these matters, bundled in the rubric "Catholic Social Thought" (CST).

Perhaps most remarkable about CST is its clear commitment to material progress. For an institution with 2000 years of tradition 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 find God and make progress in their relations with Him.

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 imperative to avoid the errors of selfishness, self-gratification and violence that attend modern technology.)

It is easy to see the parallel of this thought with that expressed in the Universal Declaration, which itself has been supported by the Church.



Photo Courtesy of John Carroll University

CST adds an ontological element in declaring the origin and purpose of these "rights" to material progress; the UDHR takes them, effectively, as necessary preconditions to peace. This convergence is a testament to the "Natural Law" origin of these ideas, independent of an articulated theology. That is arguably a necessary foundation for normative statements that can work in a pluralistic profession. Ultimately it is not enough; but it is sufficient to get started in the absence of convergence on the ontological level.

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 when transcendent goals are served. 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 itself, CST has generally been quiet. Technology is largely viewed as an exogenous thing, a developing branch of knowledge. All knowledge is intrinsically good. But as facilitator of human agency, technology is only neutral: it can liberate as well as enslave; it can build and destroy. Catholic thought emphasizes individuals as agents within economic, corporate and government organizations, with technology being logically external. In particular, there is little attention to professional engineers as *stewards of technology*, i.e. as responsible points of action in steering technical development toward human development.

It would seem to be natural at this point in time to add an overt emphasis on technology to CST. Matthew's account of the words of Jesus describing the Last Judgement would seem particularly relevant: the only criteria employed deal with the material needs of fellow humans!

### **Professional Responsibilities**

So we arrive at the point of affirming engineering as a profession, and the task of fixing the imperfections. The first job is announcing the *central concern*: we advocate this be the *attainment of human rights in technology*, as expressed in either the UDHR or in CST.

There are three aspects. The first is the right to the *material baseline* of life. Included are housing, water supply and sanitation, freedom from threat of aggression, access to information,

and the like. These we name necessary "technological services." The second is the right to proper *stewardship of natural resources* (the ultimate industrial input). While newer in its conception, we assert that all people have the right to sustained and productive use of the natural resources of the planet. No individual property right or national sovereignty right can be allowed to supersede this elementary right of people -- a controversial position today, but necessary. The third right is to the proper use, *cultivation, and application of technological knowledge*. Knowledge is the ultimate substitute for depletable natural resources. Its proper development must accompany natural resource use.

These responsibilities devolve from engineering as we already know it. Dealing with the details is within the defined competence of today's engineers. And outcomes in terms of these rights are directly attributable to the actions of engineers. We need to see to it that engineers and their professional organizations take responsibility for those outcomes.

It is important to grasp what is at stake here. Today many organizations claim allegiance to some of these rights. But we are asserting that professional engineers adopt *responsibility* for their *achievement*. Not exclusive responsibility -- that would be foolish and autocratic. But responsibility nevertheless, in the sense that non-achievement represents a failure before the Creator, and that those so endowed are obliged to find leadership paths.

### The University Role

Why do we have professional schools in universities? On the one hand we legitimize professional education and the intellectual disciplines underpinning it. In this sense we entrust the formation of new professionals to the university, in exchange for professional constraints on the outcome (necessary skills, etc.) But perhaps most importantly, we implicitly entrust the formation and re-formation of the

*profession* to the university. Educators cannot shrink from these responsibilities: the formation of persons, the formation of professionals, and the (re)formation of the profession itself. The latter point is of ultimate importance for professional engineering today. Are we providing the right compass for individual professionals in terms of professional obligations? Are we providing the institutional means to facilitate professional achievement? And, relative to general education, are we developing the right expectations for professional responsibility for industrial outcomes?

The ideas above lead to many suggestions for reform. First and foremost, we need the profession's acceptance and articulation of the animating ideas grounded in human rights, and of professional responsibilities stemming from them. This is a critical step which needs to be taken by leadership organizations.

Along these lines, we note a pervasive error in the confusion of ends and means. The standard organizational lines of engineering education emphasize means, not ends: mechanical engineering, aerospace engineering, computer engineering, chemical engineering, etc. Where

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are the ends served? A proper organization of the profession would emphasize the human purposes served. An example organizational structure might be:

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

These represent fundamental human concerns and spheres in which we can address human rights. The standing group of categories are means-oriented, dealing with natural phenomena but not human problems. Trade groups deal with means; professions deal with ends. The end does not justify the means; but the means alone are not enough.

Recently I began "polling" department chairs and deans about what informs their priorities in hiring, research, etc. Almost universally I found the following responses:

- Follow the money
- Follow curiosity
- Follow the prestige (beat Harvard)

Each of these is a distortion. The price system is obviously imperfect; while we need money in academe, it is not a goal but a constraint. Human curiosity is a good guide, and uninquisitive professors are not good ones. But curiosity has no intrinsic value -- it is simply a trait. And who needs another Harvard? We have one and it cannot teach most students. Certainly we need competitive faculty but the standard is empty beyond that. What is obviously missing here is the overarching, principled objective of professional education! That vacuum is easy to explain in terms of the newness of the profession and its confusion on this point. But it cannot be allowed to persist. I have offered some suggestions for moving forward.

An overwhelming need is for the profession to get outside of the imperfect price system as its sole method of prioritization; and to construct an independent sense of the balance of market and

non-market priorities. Essentially, all economic activity is not equal and good. Singular in this category is the lack of any organized *pro bono* engineering activity wherein prioritized extra-market activities are pursued with full-strength engineering talent. This must be corrected. God's economy of human activity is not man's.

Regarding iconography, engineering is permeated with two distinct visions of the "good engineer." One concentrates on the innate satisfaction which attends making something work and understanding it -- perhaps the vision of Samuel Florman. That is good; we certainly need to encourage this kind of satisfaction with specialized work; it is primal and human. But it characterizes both good and bad sides of technology, its productive and destructive sides. I saw this as an undergraduate and as an early-career professional.

As a graduate student I began to love the deep foundational theory we preserve as engineering science -- it addresses natural phenomena as diverse as atmospheric motions, microelectronics, and navigation, with explanatory power. This is the world of Gauss, Helmholtz, Markov, Kalman. We certainly need to instill in our students a love of theory which works and a disciplined commitment to it. But this too is neutral, a construction of the mind which can work both ways for us.

These two images of engineering are displayed centrally in the symbol of one of our great institutes -- *mens et manus*, a blacksmith and a scholar. They are not a bad guide to the nature of our profession. But professors need more, the "third rail" of engineering, the central animating idea of the profession -- the responsibility before God for securing human rights in a technological world. And this view should always accompany the other two, prominently before students and onlookers alike. It is the only thing which can distinguish engineering-as-profession, and the only thing which can properly guide us in right paths. Catholic Social Thought, the Universal Declaration, the state of globalization today...



THE CENTRAL  
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FOR SECURING HUMAN RIGHTS  
IN A TECHNOLOGICAL WORLD.

these are the starting points. From here it is up to us.

\*Portions of this text rely on my longer arguments detailed in "What Shall We Build? An Examination of the Engineering Profession and its Role in Establishing a Just World Order," Daniel R. Lynch; Kroc Institute Occasional Paper # 23:OP:2 . University of Notre Dame, February 2003.

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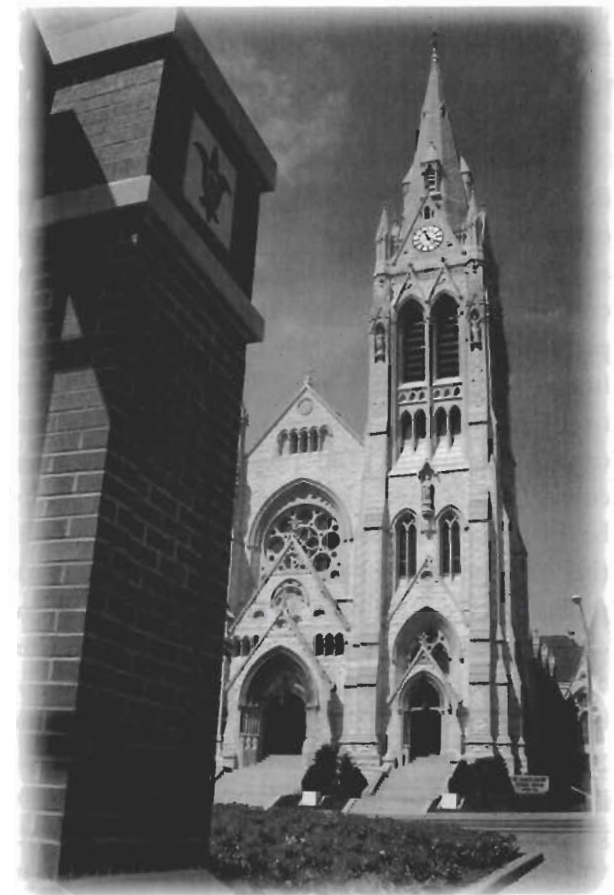


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