ChE curriculum

THE INFUSION OF SOCIO-HUMANISTIC CONCEPTS INTO ENGINEERING COURSES

*via Horizontal Integration of Subject Matter**

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During the past decade, many universities have been critically reappraising the effectiveness of some of their traditional elective courses in view of the rapidly changing needs of professional education in a wide variety of fields including science, engineering, business administration, journalism, law and medicine. No longer is it possible for professionals in any of these fields to function in a comfortable milieu designed and limited largely by its practitioners. A number of significant trends are discernible in the interaction among the professions, society, and higher education. Irrespective of the particular professional field, the same questions keep recurring. Prominent among these are the sensitivity of the professions to social needs, the concept of professionalism and professional competence, the problem of licensure of professionals and of the maintenance and upgrading of competence, the opening of licensing boards to lay people, the emphasis on ethics, values, motivations and the need for a broader, more humanistic and humane view on the part of decision makers and their advisors. As a result, an urgent call is being heard from many sectors for a "new breed" of professional whose training and values reach beyond the cost-efficiency considerations to include an assessment of the political, social, and human dimensions of the problem at hand.

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TREND TOWARD THE HUMANITIES

Over the past quarter century, engineering education has been evolving toward a more "liberal" format, with an increasing emphasis upon the humanities and social sciences to complement the technical content of the curriculum. In 1951, the Engineers Council for Professional Development mandated that to meet minimum accreditation requirements, all undergraduate engineering curricula must contain 20% non-technical (humanities, social sciences) courses. Even though this move constituted a significant break away from the almost total preoccupation with the development of technical expertise, the effect (although salutary) has been of limited impact. Examination of the transcripts of recent engineering graduates reveals little perceptible focus on, or coordination among, the non-technical courses elected; one strongly suspects that such criteria as convenience of scheduling, word-of-mouth reports on amount of work required, etc., were the primary factors influencing the choice of those courses. Whereas the resulting potpourri, no doubt, induced some alternate viewpoints for the students, the result in most cases falls far short of the intended impact.

Dr. Simon Ramo*, an engineer who was formerly an advisor to the White House, recently argued

> **Engineers must spend as much time learning about and dealing with society as they do in applying science and technology to society and its problems. The present veneer of humanities and social sciences in university engineering curricula is quite inadequate for this purpose.**

*Ramo, Simon. 75th Anniversary Convocation, National Bureau of Standards (1976).

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Certainly we can agree that the "humanizing" of professional education requires more than merely encouraging students to read a few more humanistic texts in the hope that a stronger awareness of the human implications of their activities will occur by magic contagion.

PROPOSED APPROACH

In an attempt to address this problem, in 1976 a group of educators from various disciplines at the Cooper Union (originally under the initiative of the Engineering School) launched a curricular reform study with the firm intent to compose a genuinely interdisciplinary (not just mutidisciplinary) approach to engineering education. One of the significant results of this study was a proposal

TABLE 1
Social Aspects of the Technical Decision Process

Technological advances are increasingly shaping contemporary society and culture. Professionals in many fields recognize that it is no longer possible to function in traditional contexts. This course will examine the social, ethical, and humanistic dimensions of currently critical problem areas, especially natural resource limitations, energy alternatives, and environmental issues, wherein social and human impact are equal in importance to technical/economic criteria. Course format will encourage effective horizontal integration of guiding concepts from the humanities and technical disciplines.

TOPICS

- **Science, engineering and technology.**
  - **Their place in the spectrum of human knowledge.**
  - **Interrelationships among them.**
- **Case studies in engineering ethics. (See Table 2)**
- **The current dialogue between technology and social philosophy.**
- **Independent projects involving social and technical aspects.** (See Table 3)
- **Setting standards: Values, valuation and applications.**
- **Summary and conclusions.**

TEXTS

- **Baum, Robert J. and Albert Flores,** Ethical Problems in Engineering. **The Center for Human Dimensions, Rensselaer Polytechnic Institute, Troy, NY (1978).**
- **Florman, Samuel C.,** The Existential Pleasures of Engineering, **St. Martins, NY (1976).**
- **Kuhn, Thomas S.,** The Structure of Scientific Revolutions, **2nd ed., University of Chicago Press, Chicago (1970).**

ADDITIONAL READING REFERENCES

Dubos, René, So Human an Animal, **Scribner, NY (1968). pp. 181-242.**

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Mumford, Lewis, Technics and Civilization, **Harcourt, Brace, NY (1934), pp 321-363.**

Mumford, Lewis, The Myth of the Machine, Vol. II—The Pentagon of Power, **Harcourt, Brace, Jovanovitch, NY (1970). pp 281-293.**

Reich, Charles A., The Greening of America, **Random House, NY (1970). pp 6-9; 87-128.**

Roszak, Theodore, Person/Planet—The Creative Disintegration of Industrial Society, **Anchor Press/Doubleday (1979). pp xix-xxx; 27-39; 132-137; 306-321.**

Simons, J. H., A Structure of Science, **Philosophical Library, New York (1966). pp 1-64.**

to effect a horizonal integration (topical and methodological) of humanities/social sciences subject matter with the engineering/design content of the curriculum. This would be accomplished in a team teaching format, involving both humanities and engineering faculty members concerned with the human and social implications of supposedly neutral technologies and methodologies.

THE EXPERIMENTAL COURSE

The initial attempt to implement this concept involved a course entitled "Social Aspects of the Technical Decision Process," which was team taught by the authors.

Course content was built around an integrated set of topics and related specific problem formulations cutting across disciplinary boundaries, such as alternative energy, ecology, urban planning, etc., which represent traditional engineering concerns but have built-in social and historical dimensions. A guiding question was whether the latter are mere additional concerns which one may or may not deal with depending upon one's sense of involvement, or whether such concerns might not affect the very problem formulations themselves.

Table 1 indicates the course content. The central concern of the "horizontally integrated" topical core, as exemplified in this initial course, was the relation between professional competence and (supposedly extraneous) ethics and social impact, including an examination of the basic concept of professionalism itself. To prevent these considerations from appearing to be nothing more than academic moralizing, this material was couched in the context of presently critical technological problem areas such as those listed in Tables 2 and 3.

For example, in the initial layout of a new processing plant or in the preliminary design of an electrical power distribution system, students can be led to recognize the necessity of considering, in the early stages of planning, the impact upon both the social and natural environments in addition to the usual technical and economic criteria. Failure to do so may lead not only to costly delays or expensive modifications of the operating system but above all, to unacceptable human consequences. In considering a series of examples of this type, the students begin to recognize that it is expeditious to consider the technical-social system as the unified entity which it really is, rather than artificially subdividing it into components which, in the final design, may not mesh in a compatible manner. In short, the students are led to realize that the understanding of social/political phenomena is as necessary as the acquiring of technical expertise.

TABLE 2
Ethics Cases Considered from Baum and Flores

A case was chosen by each student for oral presentation and critique to the class. The cases considered in this manner were:

- **Engineering Ethics: A Blend of the Ideal and the Practical (p 30)**
- **Ethics, Engineering, and Publicity (p 91)**
- **False Statements in Advertising (p 102)**
- **Conflict of Interest—Related Work for Two Parties (p 115)**
- **Liability and the Engineer—Responsibility to Former Employers (p 145)**
- **Misuse of Confidential Information (p 152)**
- **An Anatomy of Whistle Blowing (p 168)**
- **The Case of the Three Engineers vs. BART (p 227)**
- **Carl W. Houston and Stone and Webster (p 262)**
- **The Life and Times of Lawrence Tate (p 288)**
- **A Research Pirate in Action: The Case of Dr. Aries (p 290)**
- **Old Secrets in a New Job (p 292)**
- **Reactor Safety: Independence of Rasmussen Study Doubted (p 301)**

TABLE 3
Term Papers

Each student in consultation with the course instructors prepared a report on a contemporary topic involving both technical and social impact factors. Each topic was first presented orally to the class to elicit suggestions and criticisms and then a written report was prepared. Topics of the papers were:

- **Recombinant DNA—Technology and Social Aspects**
- **Dilemmas of the Technological Polity**
- **Being There (Jerzy Kosinsky)—The Plight of the Self-Made Man**
- **The Supersonic Transport—Should it Continue?**
- **Microwaves**
- **Space Colonization**
- **Fluoridation—Pros and Cons**
- **Television and Society**
- **Nuclear Wastes**
- **Technology vs. the Environment, A Case Study: Insecticides**
- **Sperm Bank/Artificial Insemination (AID) Technology: The Technique and its Social Implications**
- **Government Interventions in the Business of IT&T**

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