Report of the Workshops on Ethical Issues in Engineering

Center for the Study of
Ethics in the Professions
Illinois Institute of Technology

Vivian Weil

Sponsored by a grant from the
National Science Foundation
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Preface

This report is a product of the Workshops on Ethical Issues in Engineering, presented by the Center for the Study of Ethics in the Professions at Illinois Institute of Technology in July, 1979. It contains summaries by the editor of all the presentations and some of the discussion. Neither speakers nor discussants may entirely agree with the editor's interpretation of their remarks. The appendices contain the work of participants. The reports on the Goodrich Airbrakes case in Appendix A do not appear in their entirety, but the course plans and the preambles to them in Appendix B are complete.

The Center is most grateful to the National Science Foundation which supported the Workshops under the terms of Grant No. NSF OSS78-0726, and to the National Endowment for the Humanities which also provided support. The editor is grateful to the Project Manager of the Center, Mark Frankel, and the former Project Manager, Ernest d'Anjou, for their assistance in carrying out this Workshops project and in producing this report.

V. W.
Chicago, Illinois
May, 1980

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Preliminary Background

Workshops on Ethical Issues in Engineering, funded by a grant from the National Science Foundation (NSF) with support from the National Endowment for the Humanities (NEH), were conducted from July 16 to July 27, 1979 at Illinois Institute of Technology (IIT). The idea for the Workshops grew out of the experience of IIT philosophers and engineering educators who worked together from September, 1976 through May, 1977. Their project was to develop and offer an innovative experimental course on Moral Issues in Engineering. The interchange between philosophers and engineers at IIT during the development phase enabled the philosophers to familiarize themselves with concrete moral problems faced by engineers. The exchange persuaded the engineering educators that philosophical moral concepts, theory, and reasoning could provide useful approaches to their problems.

The newly established Center for the Study of Ethics in the Professions at IIT made it possible for the philosophers and engineers to collaborate in the preparation and to team-teach in the new course. They were thus able to compensate for gaps in training and experience which meant that neither the philosophers nor the engineers could handle the demands of the new course alone. The Center's support also enabled the staff preparing the course to consult specialists from fields such as history, sociology, and management and to invite some selected specialists to the classroom to share their insights with the students.

The assumption was that the team teaching experience and the research it would require and stimulate would eventually equip the philosophers and the engineers to teach such courses independently. The team teaching effort revealed challenging moral and conceptual issues concerning responsibilities and rights of professionals in organizations. The collaborative effort also brought out fundamental questions about the structure and functioning of certain institutions: business organizations, government agencies, and professional associations. The focus of the course was on the idea of the professional as possessing difficult technical knowledge and skills (for meeting significant social needs) and exercising independent judgment in accord with acknowledged principles of moral and social responsibility. The aim of increasing the sensitivity of students to moral issues of practice and their readiness to deal responsibly with these aspects of practice distinguished the new applied ethics from more standard cognitive ethics courses.

The expressed need and desire by many institutions and practitioners for courses in ethical issues of engineering suggested the value of making IIT's resources, experience, and resulting insight available to seed courses in institutions throughout the country. Accordingly, with the support of a grant under the EVIST program of NSF, the 1979 summer Workshops on Ethical Issues in engineering were held at IIT for twenty four philosophy and engineering educators from across the country, but especially the midwest and south. They were selected from a highly qualified applicant pool of about 100 to participate in an interchange which was to prepare them to teach engineering ethics, either individually or as members of teaching teams. The group was divided half and half between philosophers and engineers; two of the philosophers had degrees in engineering. There was one philosopher/engineer pair from the same institution.

Specialists were brought in from the fields of history, management, law, political science, and sociology. They were joined by representatives from government, business, and professional associations. The lectures, seminars and discussions were designed to provide a kind of crash course for the participants and to stimulate further research and writing and new projects in engineering ethics. The need for literature connecting moral philosophy and moral problems of engineering, for annotated cases, and other teaching materials was recognized as no less urgent than the need for qualified teachers.

The formal sessions of the Workshops concentrated not on ethics courses but on moral issues in engineering. They addressed the sources of moral problems in the roles engineers occupy in business organizations, the use of moral reasoning, and identification of options for coping with problems. Responsibilities and options for individual engineers and for the profession collectively, were examined.

Constituting a kind of short course, the program presented a sequence of topics designed to yield new insight into the genesis of the moral problems of engineers, philosophical approaches to defining and defending an autonomous professional role, and the foundation of engineers' responsibilities and rights. Study of institutional and psychological obstacles to independent professional conduct accompanied analysis of responses such as dissent,unionization, enlightened management of engineering professionals, and educational and engineering society reforms. Investigation of the role of government regulation, its connection with independent professional conduct, and of the responsibilities of engineers in the formation of public policy completed the comprehensive introduction to engineering ethics.

At the opening of the Workshops, participants were divided into six, small mixed groups of philosophers and engineers which were to work on particular responsibility issues and to devise course plans. During the second week, participants made presentations of case analyses and course plans derived from the small group efforts, and they engaged in mutual critiquing of the course designs. Plans were devised for modules to be used as units in courses, as well as for entire courses, both seminar and lecture courses, quarter and semester length. One plan was devised for continuing education of practicing engineers. The annotated plans are presented separately in Appendix B.

The structure of the Workshops was constituted by lectures, seminars, and discussions in the morning and afternoon. On four occasions, evening sessions replaced the afternoon sessions in order to allow members of engineering societies and other practicing engineers to attend. The formal sessions typically featured lectures followed by discussion. In addition, time was allowed each day for informal discussion, which often went on well into the night. The sequence of topics was divided into six sections: I History and Socio-Economic Context; II Moral Concepts, Theory, Reasoning, and Codes; III Options for Individuals and for Institutions; IV The Role of Engineering Societies; V The Role of Government Regulation; and VI Engineers and Public Policy. The account of the sessions which follows is divided into these six sections, which are in turn divided by topics and speakers.

The summaries of the sessions cannot capture the complexity, richness, and quality of the lectures and discussions. The reader should bear in mind that the summaries, based on notes, tapes, and in some cases, the speaker's outline, represent the editor's interpretation of often controversial and original positions taken by speakers and discussants. The summaries condense and remove from context complex and subtle points which were made. Nevertheless it is hoped that the summaries will provide a useful account of the material covered and will stimulate the reader to pursue the issues.

There were readings assigned in advance of the workshops to provide a common background. They are listed in the bibliography, which is supplemented with a list of additional readings recommended as background for the participants, or recommended by speakers.

I History and Socio-Economic Context

The first and longest unit, consisting of four sections, was planned by Professor Fay Sawyier. The underlying assumption was that in order to behave responsibly you have to know something about the forces tending to push you one way or another. You also have to know who you are and where you are. It was part of the intention in this section to offer a kind of composite sketch of what living, working engineers are like. Historical and economic "facts", for example, were to be presented as they affect the perception, judgment, and action of engineers. Outsiders' observations of engineers in politics and bureaucracy were to be studied. Practicing engineers were to tell their own stories. Finally there was to be a close look at organizational pressures and how to resist them. Sawyier explained this approach in the opening session of the Workshops.

History

Professor Howard Rosen, IIT historian of technology, spoke on the history of engineering. His purpose was to convey an understanding of the sources of existing institutional patterns and of the perceptions and misperceptions of engineers by engineers and non-engineers. The aim was to see how these structures and images shape the engineer's role and conduct. Rosen pointed out that technology is not a specifically modern development but goes back to the beginnings of civilization. He noted that the association of technology with government aims and projects is also ancient. Technological developments sprang initially from a craft tradition which was restrictive in that knowledge was kept secret and maintained rather than enlarged, and practitioners were born into the tradition. Rosen traced the persistent myth of the heroic inventor-engineer to the Renaissance period.

With the rise of the modern state in Europe in the period from 1650 to 1750 and changing conditions of transportation, communication, production, and war, came standardized production, mining and refining advances, and growth of knowledge in such areas as ballistics and projectile motion. States set up schools for professional training, such as the Royal Academy in England, and organizations for research, experimentation, and publication. The United States was a most fertile ground for the development of a significant and respected role for engineering because, being resource rich and labor poor, it stood to benefit from substituting mechanized power for labor. Further, to achieve the goal of national unification technology was essential, for it provided a way to tame the wilderness, span rivers, and move people and goods. Engineers thus played a crucial role, and West Point, following the European model, became the training school for engineers.

This chronological sketch indicated that technology has only recently become systematically closely linked to science, around 1850 to 1870, and suggested that technological change is a social process rather than the work of individual hero-inventors. Rosen pointed out that traditionally those who worked on technology were of humble social origins and that engineers had always been looked down upon for doing physical work. By contrast, science was an extension of the high culture of the elite. The twentieth century brought the development of science-based industry and the structure of the modern corporation, the requirement of formal education for engineers in schools of higher learning, the support of engineering research by foundations, and the contractor role for government which made possible the growth and dissemination of new knowledge.

The research emphasis has become a salient and prestigious feature of engineering. Indeed, according to Rosen, it provides a kind of "cloak of identity" for engineers. Their self-perception, in his view, is taken from the research aspect and its association with the ethos and value system of science. The heroic, distinctively individual creative scientist became the role model even though relatively few engineers engage in research and most engineers continue to do the kind of work engineers have traditionally done. Although engineers are crucial to the operations of twentieth century American technological industry, they have failed to acquire individual authority in their positions in large business organizations. They may have continued to nourish aspirations for themselves deriving from the heroic-creative image of the engineer, but they have nevertheless generally accepted employee status. On Rosen's analysis, there is a conflict between the model of the heroic, individual creator and the service role engineers have actually tended to assume. His analysis suggested that engineers' lack of status and esteem relative to lawyers and physicians derives in part from their traditional association with physical work.

In the question and discussion session which followed, the engineers and philosophers encountered and struggled to understand the other discipline's different modes of expression and its distinctive outlook, the first effort in a process which continued throughout the Workshops. One of the philosophers who had earlier been a practicing engineer illustrated some of Rosen's points from his own experience. He observed that engineering had been the profession which oriental immigrants recommended to their able children because engineers were perceived as dealing with things rather than people. Working inside business organizations, first generation Americans could make their drawings and calculations away from public view. It would not matter how they looked or spoke, and they could thus avoid problems of public acceptance which interfered with careers in law or medicine.

One of the engineers noted a kind of history very significant for engineers which had not yet been emphasized, the history of recent engineering projects. He mentioned the Tacoma Narrows Bridge failure as an example of work by engineers who did not know their own history. Philosophers were intrigued by the notion of technical engineering knowledge as including historical knowledge. This point raised for the first time questions about the nature of engineering knowledge and the responsibility for acquiring certain knowledge. A significant area for further research was thus revealed, an area which has to date received very little attention. In addition, engineers insisted that they are not scientists, producing some puzzlement among the philosophers. It was only much later that philosophers realized that this meant that engineers are more concerned with practical reasoning about what to do than with scientific truth.

Profiles of Engineers

Engineers in Politics

The next session was designed to convey the complexities of the engineer's situation within business and governmental organizations and to consider profiles of engineers as they are perceived in these settings. The purpose was to gain an understanding of the context of moral choice for engineers. Two speakers were scheduled at that session, Joanne Alter, a Commissioner of the Metropolitan Sanitary District of Chicago, and Professor Richard Schott, of the University of Texas at Austin. Commissioner Alter's agency employs over four hundred engineers, and Professor Schott is the author of an incisive article on the engineering profession, "The Professions and Government: Engineering as a Case in Point."*

In her paper Commissioner Alter raised questions about the role of engineers, politicians, and bureaucrats in decision making about technological issues of concern to society. She drew a bold contrast between politicians and engineers, describing the former as too issue-oriented, too responsive to prevailing winds and the latter as insufficiently flexible, not adaptive to changing circumstances, and not easily enough diverted from assigned tasks to ask, "Should it be done?" In her view, "the clash comes when politics and politicians challenge the continuation of engineering decisions that follow original political decisions."

According to Ms. Alter, politicians are used to retrenching whereas engineers have not been "conditioned to retrench, much less admit they made a mistake." She has found it difficult to convince engineers to consider social and political ramifications of their projects, since they see it as their responsibility to do the job which has been assigned, without raising questions. This conformity creates serious problems for politicians who require more independent engineering judgments and data in order to make sound political judgments. In addition, Ms. Alter finds engineers ill equipped to engage in the interchange which must go on among citizens, politicians, and engineers if there is to be public understanding of major projects.

For an example, Ms. Alter discussed TARP, a current Metropolitan Sanitary District project, the Tunnel and Reservoir Plan to control flooding and pollution caused by sewer over-flow. In the approximately ten years since the techni-

* see Bibliography

cal choices and cost/benefit analysis were made, the cost has risen from 1.2 to 4.5 billion dollars. The adoption of national pollution goals made the project eligible for huge government grants. In Ms. Alter's estimation, the engineers on the project are insufficiently impressed by questions about whether this project now warrants those billions, and whether this is a justifiable allocation of resources. According to Ms. Alter, they tend instead to follow through on their assignment unreflectively. With changes in conditions, costs, and perceptions over a decade, some politicians are prepared to consider alternatives rejected earlier, but, Ms. Alter claimed, the engineers insist inflexibly that this is out of order after a project has begun. Participants reacted strongly to Commissioner Alter's remarks, especially engineers. It was one of the philosophers, however, who suggested that the reluctance to acknowledge error, to retrench, and to consider alternatives was a general human failing rather than a particular deficiency of engineers.

Another example Ms. Alter cited was her request that all deliveries of sludge to home gardeners be discontinued because of the controversy over risks produced by cadmium in the sludge. This example raised questions about paternalistic intervention and about degrees of risk, issues which were to come to the fore repeatedly during the Workshops. Ms. Alter was often interrupted by questions, and her responses produced vigorous debate centering on the question of the representation of engineers in positions of authority and power and their access to decision making processes. The heated interchange perhaps reflected certain natural tensions in the participant group as philosophers and engineers first joined in examining myths and perceptions about engineers. The intensity may also have come from touching a nerve of concern, the question of engineers' orientation toward affecting decision making. At any rate the explosive quality of the exchange was noteworthy and surprising and signalled the fact that people were beginning to get involved.

Engineers in Bureaucracy

Illness prevented the second speaker, Professor Schott, from being present. His paper, however, had been included in the readings assigned prior to the Workshops and his former colleague, Albert Blum, now Dean of IIT's Stuart School of Management, substituted for him in this session. Schott dealt with a problem revealed by a number of studies. Engineers have a tendency to move into management and administration in private industry and government, but, with their workmanlike, technical training and limited backgrounds, they are not prepared to take a broad perspective on administrative responsibilities, and they lack a "social ethic".

Schott noted that engineering has increasingly tended to recruit from lower socio-economic strata. Their social origins appear to influence strongly the values of many engineering students who seem to be anti-intellectual, contemptuous of middle-class values, and suspicious of liberal education. In addition, the density of the engineering curriculum, which allows few electives and only scant attention to courses in humanities and social sciences, leaves little time for reflection and denies exposure to areas of human knowledge which might broaden or inform the social outlook of students. In Schott's view, a key factor limiting engineering education in this way may be the attitudes of many engineering faculty to such studies.

For the many recruits and practitioners who seek advancement, financial reward, and a sense of authority and control, engineering is not a terminal career but a stepping stone to executive careers. According to Schott, observers note a certain congruence between engineers' occupational values and the norms of large organizations. As a consequence, engineers fail to present the classic problem of the professional-in-the-organization, an individual frustrated by the restrictions on professional conduct imposed by the organizational environment. Placing less emphasis on traditional professional values of individual independence and collegial orientation, engineers tend to adopt without question the prevailing norms of corporations and to bring a limited outlook to administrative tasks in government. Thus, lacking background and training which would foster concern about human welfare and broad social goals, engineers come to occupy positions with significant social impact.

Schott pointed out that engineers command assets which are very valuable for these positions, notably, skills for rational, orderly management and capabilities for designing information and other control systems. He noted that a number of commentators agree that if there is to be a shift of emphasis to broad social concerns, reform of professional education must be undertaken. Although Schott was primarily discussing engineers in administrative roles, his insights about narrow outlook and lack of an informed sense of social responsibility clearly apply to engineers in their roles as technologists. Dean Blum underlined the importance of liberal education for engineers.

Perspectives of Non-Academic Engineers

The aim in the next session was to present the viewpoint of practicing engineers. Professional engineers from the greater Chicago area had been invited to join the audience. The guest speakers discussed their experiences, their self-perceptions, and their views about professionalism in engineering. E. Montford Fucik, a civil engineer ending a long, successful career which included membership on the blue-ribbon Independent Panel to Review the Teton Dam Failure, made a spirited presentation exhibiting a traditional stance toward professionalism. After years as an active member and office-holder in the American Society of Civil Engineers and service on other professional bodies, Fucik endorsed the profession's recent increasing attention to social and ethical obligations of practitioners. However, he candidly expressed serious reservations about independent autonomous conduct on the part of engineer-employees. He evoked a storm of questions and challenges from participants when he stated that younger engineers should bow to the wisdom of their superiors. Thus, while welcoming and encouraging the profession's recent commitment in its codes to holding paramount the health, welfare, and safety of the public, he supported the prerogatives of management to curb more assertive conduct by engineers.

Participants were impressed by Fucik's candor and willingness to share his perspective, in order to help advance understanding of ethical issues in engineering. His intimate connection with past and evolving norms in the profession and his responsible role in major engineering projects, such as the Panama Canal, dams, and other large-scale constructions, made Fucik a very valuable informant.

The other speaker was Jay Dockendorff, a younger engineer who took on leadership of his company, H.P.D. Inc., several years ago when it separated from Chicago Bridge and Iron and commenced to operate profitably as an independent organization. Dockendorff seemed to identify responsible conduct on the part of engineers with sincere efforts to deliver good quality products, services, or systems as efficiently and economically as possible. If the discussion about social responsibility and moral obligations which has been provoked within the profession has affected this engineer,it has not produced quandary, uncertainty, or reflectiveness but a tightened,staunch clinging to apparently unchallengeable virtues.

Dockendorff portrayed himself and came across as very hard working, highly disciplined, reliable in business dealings, and completely occupied by the demands of his engineering business. Intense involvement in his tasks seems to have excluded concerns about the social role of his business or about himself as a professional. The image which Dockendorff conveyed mirrored the set of traits which are commonly associated with engineering students and fostered in engineering schools. He was unemotional and dry in his delivery and focused on a narrow, technical area. He ignored moral complexities and broad questions of social impact.

Dockendorff came close to acknowledging ethical issues when he described his separation from Chicago Bridge and Iron as owing to his preference for a smaller company. He explained the advantages of business on a smaller scale. Obligations and trust can be built up and tested in face-to-face situations over a period of time. From his account, it seemed that he had not encountered or thought about unethical dealings. Dockendorff's implied view was that it is sufficient for ethical conduct in engineering to hold tenaciously to traditional virtues. He supplied participants first hand acquaintance with a prevalent attitude which, though well-intentioned,is far too simple and partial for the complex situations and vexing problems engineers confront.

Organizational Pressures for Conformity

The next task was to study how engineers' situations in business organizations influence their perceptions and their actions. The session, conducted by Professor Jeffrey Gandz of the Business School of Western Ontario, had two aims. One was to provide an example of accomplished teaching by the case method This is a kind of pedagogical proficiency which business school faculty have often achieved. The need for an example of case presentation arises from the emphasis on cases in teaching engineering ethics, an emphasis new to philosophy and engineering educators. The other purpose was to apply this specialist's insights on organizational pressures for conformity to the problem of independent conduct on the part of engineers. Gandz's academic area is management and human behavior, and he has worked on the moral aspects of management problems. He had selected a case, the Ferdanna Case, which details circumstances surrounding corporate decisions concerning the marketing of a product, a drain cleaner. Although the details made dry reading, the case showed how, from inadequacies in communication, a situation could grow and lead eventually to serious human injury.

The opportunity for creating a dramatic, gripping scene in setting forth a case was well demonstrated by Gandz in his presentation. The simulated tension and uncertainty, the evoked sensitivity to what others were doing and feeling seemed useful for orienting engineering students to the interpersonal and emotional factors in situations of engineering practice. For, in spite of engineers' apparent preference for dealing with things rather than people and their disinterest in the social and emotional aspects of their circumstances, engineers almost always work in groups or teams. To be fully effective in these situations, they need some understanding of the interpersonal dimension. Two assumptions underlie this point; one is that general moral sensitivity is rooted in sensitivity to the people one deals with in daily face-to-face situations. The other is that responsiveness to such local human factors is essential to successful independent action in a group setting.

In introducing his case, Gandz observed that, given the direction of product liablity litigation, the onus is on the manufacturer to show that the benefit of a product outweighs inherent risks. The Ferdanna case, a Harvard Intercollegiate Business School product, dealt, among other matters, with responsibilities of engineers for quality control and review in ensuring product safety. It suggested that there is an obligation upon engineers to fully imagine and design for alternative scenarios in the life-history of a product once it leaves the manufacturer.

The case, which concerned the explosion of an unopened can of drain cleaner and resultant injuries to the household consumer, exhibited the need to foresee likely consequences to handlers and users in different scenarios of storage and handling of the product. The importance of anticipating likely in terpretations and misinterpretations of instructions and warnings also emerged. Discussion centered on the atmosphere of decision making associated with manufacture, control, review, and distribution of the product and its container. This focus was based on the assumption that defects in those processes of decision making made possible the highly injurious explosions of unopened cans.

To facilitate discussion, Professor Gandz showed a film available through McGraw Hill called Group Think. 'Group think' refers to a coercive atmosphere in collective decision making which tends to produce convergent responses. The film pictured decision making by a group within a company in which this atmosphere prevailed. Discussion centered on the problem posed by a need for group cohesion and at the same time an accompanying risk in group solidarity. For the greater the solidarity, the bigger the problem with a more or less subtle coercive atmosphere.

A list of symptoms of 'group think' emerged from the discussion. Members have an illusion of invulnerability, a phenomenon akin to "psyching up" before a game or contest. They share stereotypes, especially of the opposition. The illusion of morality—'We do it well, and that makes it right'—supports the decision or action in question. By such rationalization, members help each other deal with deviant attitudes. Self-censorship occurs: since belonging to the group is important, members stop themselves from saying things that might evoke negative responses. An illusion of unanimity is fostered as a sign of a cohesive group. More direct, less subtle pressures may be applied. Gate-keeping may be resorted to; that is, potential critics are excluded from the meeting.

In response to the question of how to resist 'group think' and obtain critical thinking in such settings, participants produced a list of useful suggestions, some of which follow. Express approval and other rewards should be given to encourage independent thinking. The leader should be willing to accept criticism and support a devil's advocate, bringing in an outsider for that role, if necessary. Alert to stereotyping, members should draw attention to it when it occurs. The "pro's and con's" of a proposed decision should be displayed, with a "Cassandra's advocate" to comment. The leader should ask herself or himself, 'Can I stand a decision that goes against me?'

The leader should avoid stacking the meeting to ensure a certain outcome. Instead of emphasizing premature concensus, the leader should pay attention to individuals. It might be necessary to test out whether people are communicating and to protect the weak, for example, an engineer being intimidated by a marketing person. The device of sending people back to talk with outside groups can be used. The more radical step of bringing another group into the decision making and sacrificing cohesion may be needed. To broaden the outlook, the leader should try to focus on another perspective, for example, that of the government regulator. Professor Gandz introduced the idea of a "second chance decision" and suggested the value of making every decision three times--sober, drunk, and sober again.

Changes in the internal structure of the company, such as a change in who reports to whom might be necessary for making decisions sufficiently responsive to consumers and the courts. To enable company units to reach decisions responsibly, organizational design must be addressed. Gandz emphasized certain tools of organizational design: the reward system, performance appraisal, training, and selection of people. For example, performance appraisal can de-emphasize short term profitability. Gandz thus made clear the need for critical independent thinking in corporate decision making and described organizational mechanisms for maximizing the role of independent engineering judgment.

II Moral Concepts, Theory, Reasoning, and Codes

The next session was the first of several sessions attempting to bring moral philosophy to bear on the moral problems of engineers. These sessions included a case study and a critical survey of the codes as well as formal philosophical analysis. The plan was to consider first a foundation for moral responsibility from the perspective of the individual moral agent in a large organization. The next concern was to support the idea that moral judgments can be objective and rational. Following a case analysis, a social perspective on moral rights and responsibility within business organizations was to be offered. Finally engineering codes of ethics were to be examined for ethical guidance.

Individual Responsibility

Dr. Vivian Weil introduced this portion of the Workshops with a short paper addressed to the view that individual responsibility is diminished when individuals' actions are components of social or collective actions. Collective actions usually require many individuals to act in a certain order, according to an organized scheme, often over an extended period of time. The morally significant consequences, those which affect the interests of others, may occur after a time and at a geographical distance. Since engineers' acts are very often components of collective actions which are seen as the deeds of business organizations, engineers are prone to a diminished sense of responsibility.

The philosopher, John Ladd, traces this attentuation of responsibility to two common assumptions. One is a notion of responsibility which assimilates moral responsibility to causal responsibility. The other is a conception of human action which identifies acting with causing some state of affairs to come into existence. According to this idea of moral responsibility, as one's causal contribution to some outcome decreases, so does the moral responsibility. Given the underlying concept of an act as making something happen, the individual whose causal contribution to some significant outcome is minimal, has done little or nothing.

Weil observed that consequences play an important role in our moral thinking, but she pursued Ladd's point that there is a defect in the conception of action which puts such stress on the outcome. Such a conception draws attention away from the moral agent, what she or he knew, believed, foresaw, intended, what she saw herself as initiating or was conscious of doing, and what bodily movements she executed or perhaps inhibited. The spotlight is thus removed from features of our acts which are essential for assessing them by standards of rationality and morality. This view of action is very hospitable to the attitude of one who justifies herself in some choice saying, 'It doesn't matter what I do--it won't change the outcome.'

According to Weil's analysis, what is essential for moral responsibility is that the agent appreciates what he is doing, including harmful aspects of the action, perceives alternatives, and selects from among them. His movements are guided by his desires and intentions: they do not result from a seizure, spasm, or some overpowering external force. The conduct of such a being may be shaped by moral standards and assessed by those standards. To relinquish such standards for guiding and evaluating behavior is to destroy oneself as a moral being. Weil concluded that a notion of action which focuses on states and processes of the agent helps one see why, even when the outcome is not changed, what one does matters.

The brief discussion which followed pursued the causal connection between an engineer's action and an untoward outcome. Weil urged that if the engineer's action is neither a necessary nor a sufficient condition nor a proximate cause but makes some causal contribution to the sequence of events leading to the outcome, the causal condition for responsibility is satisfied. This claim points to the need to find ways to permit engineers to acknowledge responsibility without self-sacrifice.

Objectivity in Science and Ethics

The guest speaker, Professor Gerald Dworkin, of the University of Illinois, chose to speak on objectivity in science and ethics. His aim was to undermine a subjectivist, non-cognitivist position in ethics. The view under attack, that moral beliefs are subjective and therefore not rationally held, is popular among scientists and engineers. A version of this position--ethical skepticism--has its source in the indisputable fact that there is widespread moral disagreement and it may be very difficult to resolve. However, Dworkin pointed out that it does not logically follow from the fact that two people disagree that one of them does not have good or even conclusive reasons for his judgment.

The subjectivist might add to the fact of disagreement the fact that there are complex causes for our having the moral beliefs we hold. Again, Dworkin argued that that does not show that no one has or could have good reasons for a moral belief. Dworkin considered the claim that X believes p because X lives in a particular society,occupies a certain economic and social position, and so on. This might mean that if certain events had not occurred, X would not have believed what X does believe. In other words, these events are necessary conditions for X's believing p. Again, Dworkin urged that this does not show that X does not have adequate reasons for his belief. Even if we interpret the causal relations in question as sufficient conditions of belief, that does not show that X's belief is unfounded and irrational.

However, if we say that X believes p only because he was brainwashed or refuses to look at the evidence, then X's beliefs are unfounded. For this is to say that there are no other reasons why X believes p, and these are not good reasons. The skeptic, however, would have a formidable task gathering empirical evidence to show that all our moral beliefs have such causes. More importantly, to show that these are not good reasons requires that one has a standard of good reasons. But this would be to concede that moral beliefs could have good reasons.

The subjectivist might press the case against an objective theory (a theory which holds there are or can be rational grounds for moral belief) by arguing that such a theory leaves it a mystery why there is not a concensus in ethics as there is, for example, in science. One reply is that close scrutiny shows that the disagreement in ethics is really over factual beliefs, not moral beliefs. However, Dworkin noted that there may remain cases of disagreement which strain credulity when explained in this way.

Since objectivity is somehow tied up with inter-subjective agreement, Dworkin considered it important to meet the attack based on lack of agreement in ethics. His strategy was to show that the contrast between science and ethics in this regard has been exaggerated. He contended that the comparison between science and ethics is unfair because levels of comparison are not held constant. For example, a very general moral principle such as 'It is always wrong to kill another person' is compared with a specific, particular judgment of science such as 'Pressure is inversely related to volume.' When a specific moral judgment such as 'It is unfair to refuse to hire someone because she was born on Monday' is compared with the proposition 'Indeterminacy is a fundamental feature of quantum phenomena,' there is wide agreement about the ethical matter and disagreement about the scientific matter.

Dworkin argued further that when theories are selected for comparison, a much wider range of ethical theories is considered. Anyone making judgments about right and wrong counts as having a moral theory: cannibals, nazis, and criminals are thrown in with Kantians and utilitarians. By contrast, scientific theories are selected normatively: chemistry, physics, biology, and astronomy qualify, but not astrology or phrenology. If one uses normative criteria in defining an ethical theory, then the range of disagreement is diminished.

To continue his critique of the strong contrast drawn between science and ethics, Dworkin considered theory choice in science. His point was that this is an area where one must make choices and act on them and therefore values influence choice. However, as in moral choice, standards and values do not dictate unique choices. In particular cases, two scientists committed to the same values may, on rational grounds, reach different decisions. Dworkin cautioned that this should not be taken to show that science is subjective, if by that is meant that theory choice is a matter of taste or arbitrary personal bias. But if 'objectivity' means standards that determine unique choices irrespective of human interests and purposes, then neither science nor ethics nor engineering nor any other area where we employ practical reasoning is objective.

The reaction to Dworkin's analysis was mixed. Engineers had to deal with an unfamiliar mode of abstract thinking and philosophers were not yet prepared to show how Dworkin's comments connected with actual engineering problems. The discussion thus exhibited skepticism of the sort which had prompted Dworkin's comments. Dworkin emphasized acquainting students with the dialectic of moral reasoning and pointed out the value of using thought experiments and literature to stimulate the moral imagination. Drawing out consequences with such aids might lead students to deal with the question, "Would I want to be that kind of person?" A philosopher asked, "To what extent do I regard my own interests?" and thus raised one of the most vexing moral questions for engineers.

A Case Study: Goodrich Airbrakes

The next session provided the first opportunity for participants as a group to engage in case analysis. During the scheduled hour and a half, Professor Jack Leonard, former chairman of civil engineering at IIT, led discussion of a very substantial case. It concerned the discovery by a junior engineer at B.F.Goodrich Company of a serious error in his supervisor's brake design. Unable to persuade his supervisor, or anyone else with responsibility for producing the brake, to correct the mistake, the young engineer was himself drawn into the effort to certify the brake in spite of its deficiency. He did not exit from the situation until after an actual brake failure in a test landing.

Professor Leonard had provided a chart which exhibited the organizational positions of the various individuals in the case. Engineers spelled out for philosophers implications of the contract which Goodrich had been awarded to develop and produce the new brake. Engineers also described what should be standard procedures for checking a new design and for preliminary testing and qualification tests of the prototype. The mistake of allowing the manufacturer to be his own inspector was emphasized. This sort of background seemed essential for appreciating the moral problems faced by several of the protagonists and for deciphering the postures of the others who either acquiesced or exerted pressure to stay on schedule.

From lack of time, experience, and skill, the group made only a tentative start on moral reasoning about the choices and actions of the characters The time allotted was clearly insufficient for this first exercise in applying moral concepts and reasoning to a complex, problematic episode. It was enough to suggest the enormous potential in case study. The effort stimulated a very strong interest in pursuing the general project of case analysis and in continuing work on this case. Accordingly, participants decided to concentrate on the case in their small groups and to present their results at a general group discussion planned for the following week.

A Philosophical Approach To Employee Rights

The speaker for the next session was Professor Robert Ladenson of IIT, whose paper was entitled, "Freedom of Expression in the Corporate Workplace; A Philosophical Inquiry." He argued in defense of the view that employees of large business organizations should be free to speak out on any subject without fear of dismissal or any other sanctions. Ladenson endorsed the implication that employees should not be penalized even for allegations which prove false and damaging to the corporation.

As things stand, employees lack the legal right to free expression. The common law doctrine of "employment at will" governs employer-employee relations in the private sector. This means that, generally speaking, employers may dismiss employees at will for good cause, for no cause, or "even for cause morally wrong." In addition, evidence indicates that companies generally lack an open atmosphere conducive to free expression. Ladenson noted that the traditional philosophical defense of freedom of expression applies to relations between citizens and the state. He proposed to address the question of whether any entrenched defense could be carried over to relations between employees in private corporations and their employers.

One mode of argument stresses the potential benefits to society from increased exposure of corporate wrongdoing, abuse, and waste. The second mode focuses on freedom of expression as an inherent right rooted in our basic social morality. The first mode, according to Ladenson, ties the degree of freedom to the weighing of costs and benefits, which, in turn, depends essentially on empirical beliefs about the extent of corporate wrongdoing. The fundamental liberty approach avoids this link with cost/benefit calculations. With this approach, the exercise of freedom of expression can be justified even when it leads to very undesirable consequences.

Ladenson urged that Mill's argument in chapter three of <u>On Liberty</u> provides a defense of the fundamental liberty conception which can be extended to the workplace. Mill contends that without freedom of expression, a person's specifically human capacities remain uncultivated. From both an individual and

a social perspective, developing these capacities of judgment, discrimination, and firmness of purpose are of primary importance.

Time permitted only a brief discussion of this examination of a philosophical foundation for a moral right in the workplace. A question remained about whether Ladenson had disposed of the cost/benefit approach. In addition, perhaps one could deploy Mill's argument in chapter two of <u>On Liberty</u>. There Mill contends that since it is not possible to select infallible and benevolent leaders, freedom of expression is required to ensure the opportunity for correcting erroneous beliefs and practices based on them.

Codes of Ethics

In the last of the sessions devoted to moral issues, Paul Torda, emeritus Professor of mechanical engineering and former director of IIT's innovative engineering program, E3, offered a critical survey of engineers'codes of ethics. Members of local engineering societies and other non-academic engineers were invited guests.

The message of the early codes, Torda noted, was 'Be a good boy.' Doing management's bidding was perceived as the route to becoming "professional". Torda observed that the early codes were not really concerned with ethical issues as much as with conflict-of-interest problems. The latter generally do not raise questions of ordinary morality. Another important feature of the early codes, in his view, was their paternalistic outlook which still persists. Torda stressed that engineers' identification with management had long hampered their development into genuine professionals.

Although he perceived a trend in the profession toward developing a concept of professional ethics, he observed that the codes require careful sifting for ethical guidance. They include issues which are not ethical, and fail to distinguish a duty to avoid harm from a duty to promote the general welfare. As a result of recent stirrings in the profession, the codes now state that the duty to the public is paramount. However, they fail to give clear indication of the meaning of that commitment. For example, they fail to spell out the priorities of the duty to serve "with fidelity the public, their employers and clients." Torda raised such questions as, 'To which public? How wide a range of activities by engineers is to be considered? Should writing and giving lectures, for example, be included? What about legal enforcement?'

An important fact to which Torda drew attention is that the codes,as distinguished from guidelines to employment, are silent about any duties of the employer. Rights of employees or benefits due them receive no mention. In his view, the codes still reflect the perspective of upper level management rather than that of independent professionals. The codes have yet to come to grips with the ethical problems of engineers employed in large organizations, over 75% of all engineers. In conclusion, Torda emphasized that engineers are not used to the problem of choice though that problem is at the center of ethical considerations. In his own evident commitment to the ideal of the ethically sensitive engineering professional, Torda provided a model of the autonomous, responsible stance he discussed.

III Options: for Individuals and for Institutions

The next concern was with expanding the range of choices and scope for action of engineers. If claims made in preceding sessions about responsibilities and rights of engineers were correct, it was necessary to consider how engineers might, without undue self-sacrifice, exercise rights and recognize responsibilities.

Options for Individuals

The first session focused on what might be called micro-level problems. The idea was to begin by exploring ways for individual engineers to become effective, responsible professionals in large organizations, using ordinary professional and persuasive skills, without resorting to dissent or whistleblowing. The assumption was that a basic understanding of the particular organizations which employ them is essential for engineers who seek greater autonomy.

A Self-Defense Repertoire

The first speaker, Professor Thomas Calero, of IIT, conveyed his perception of the need to orient engineers to the realities of corporate life. He began by discussing problems engineers are frequently said to have: underutilization, misutilization, lack of influence, and a sense of being over controlled. Engineers also seem to be offended by inefficiency and "irrationality", to suffer from inadequate recognition of their achievements, and from status inequalities, e.g. vis a vis architects in architectural construction firms. Their status relative to technicians is also problematic. Calero also commented on the engineer's problem of "creeping obsolescence", often a result of overspecialization.

Calero offered a "self-defense repertoire" of knowledge and skills which might help engineers. To begin, he noted that the authority hierarchy is the most compelling influence. He distinguished formal "line" authority, staff "functional" authority, personal authority, and collegial authority. The last-mentioned is particularly significant in that it extends outside the business organization to professional peers with similar credentials. Insofar as engineers become responsive to standards and evaluations of colleagues in the profession rather than of supervisors in the company, they assume a more independent posture.

In self-defense, engineers should acquire understanding of how top management has defined the products and services to be provided, the sequencing and timing of major steps, and targets to be met. Management's perspective on these matters heavily influences the nature of engineers' specialization, the engineer's individual tasks, and the extent to which underutilization becomes a problem. Within the framework of "systems thinking", engineers need to learn the strategic parts of the system, the nature of their mutual interdependence, and the main processes which link the parts. They should be interested in how system designs affect the planning and control of innovation. Particularly noteworthy is the frequent separation of knowledge from authority in modern work organizations.

The importance for engineers of sensing and assessing the organizational "climate" was emphasized as a self-defense strategy. Understanding of the staff-line distinction and of tensions which arise between staff and line are also important. The significance of sponsorship within the organization was also brought out. In this connection, Calero recommended identifying power centers and dominant coalitions. He emphasized the value of problem solving and communication skills for gaining and holding a position on a constroversy or solution.

Finally, Calero assessed the "dual ladder" device, which provides a second, separate promotional track for engineering professionals. He commented that it rests on a debatable assumption about the separability of technical and managerial duties. Where coordination is necessary, so is a single hierarchy, he urged. Calero concluded that the device did not seem promising for supporting engineers' professional authority but might simply formalize the powerlessness of the "professional" engineer.

Dissent and Whistle Blowing

The speaker for this session was Dr. Robert J. Baum of Rensselaer Institute, a national leader in the field of engineering ethics. His topic was dissent and whistle blowing, a central ethical issue for engineers. The main question, in Baum's view, is, "When does the individual have a responsibility either to the organization or some other group, which justifies overriding the judgment of the organization itself?"

As background to his analysis, Baum reviewed the doctrine of "employment at will", which makes employee dissent a problem. He noted that some recent pieces of legislation protect workers from being fired for whistle blowing to specific government agencies (e.g. OSHA, EPA). However, in cases when no cause or another cause has been given, the burden of proof is on workers to show they have been fired for whistle blowing. Baum suggested that a right to employment, which could be derived from a right to survival, might provide a basis for shifting the burden of proof to the employer.

Baum turned to fundamental questions about knowledge and belief which, he believes, are key questions in the whistle blowing issue. He drew attention to the new trend in codes of ethics to make the engineers' responsibility to protect the public the paramount responsibility. Baum maintained that this obligation rests on an implicit assumption that the engineer knows or can know what will promote the general welfare. He alluded to recent philosophical discussions on the theory of knowledge in order to cast doubt on engineers' claims to knowledge about the general welfare. He regarded as paternalistic the primacy of the responsibility to protect and promote the general welfare.

As an alternative, Baum discussed a "Draft Code of Ethics for Scientific Workers" prepared for the AAAS Committee on Scientific Freedom and Responsibility which had been distributed to participants.* He held that the approach in that document is superior by virtue of being non-paternalistic, even anti-paternalistic, and by circumventing the problem about knowledge. The strategy in the Draft Code is to employ the principle of informed consent. The engineer is thus, in Baum's view, freed from taking a "god-like" perspective and can act on individually held beliefs.

In contrast to Ladenson, Baum held that the reasonableness of whistle blowing turns on individuals' having adequate justification for their beliefs. Hence, he regarded the difficulty of determining when justification is adequate as a serious problem. The Draft Code avoids that question by enunciating a new, "operational" moral imperative: recognize your limitations and provide all the information you can to those who will be affected, leaving the decision to them. Baum held that this imperative does not require engineers to determine what is good or bad, only to transmit information. While current engineering codes require engineers to report what they know to authorities, the Draft Code requires them to give all the information they can to those who will be affected.

Using the Goodrich Airbrakes case, which he referred to as the A7D case, Baum showed how to apply the principles he advocated.* He focused skeptical doubts, which he had raised earlier, on the young engineer's discovery that the brake would not work. Baum charged that the engineer treated that judgment as fact. Baum contended that the young engineer's problem was a problem of inter-personal relations, of individuals with conflicting beliefs relating to one another, not a problem of knowledge and truth. The young engineer naively failed to realize there is no god at the top who will see the truth. There he will find only another engineer with another belief about what is the case.

Baum maintained that the key questions are about how a junior line engineer relates to a supervisor, what are the channels of communication, and what are significant factors of inter-personal dynamics. Noting that there are no grounds to justify whistle blowing in any of the current codes, including the relatively adventurous IEEE (Institute of Electrical and Electronics Engineers) code, Baum recommended devising procedures for adjudicating differences of belief. He referred to NRC's attempt to work out procedures for resolving technical dissent.*

Participants responded energetically to Baum's provocative approach. An engineer immediately drew attention to a provision in the Draft Code which makes it a responsibility of scientific workers to carry out assignments which conflict with their personal beliefs, as long as those affected have given fully informed consent. He argued that this provision seems to dismiss important ethical questions on which engineering ethics courses properly focus.

Others found difficulties with Baum's claims that scientific workers could transmit appropriate information to affected parties without making value judgments (about good or bad) and without relying on what they knew or believed. Further, the obstacles to obtaining informed consent seemed formidable. To some it seemed that invoking general skeptical doubts accomplished, if anything, too much. How could one know what approach to take with one's supervisor? However, Baum's caution about paternalism helped sharpen thinking about the engineer's role. While his use of the principle of informed consent provoked controversy, it suggested the fruitfulness of testing such principles from other areas of applied ethics.

* see Bibliography

Options for Institutions

Unionization

The next set of sessions featured three scheduled speakers, each considering an option for institutional change which might increase the independent authority of engineers. Collective bargaining, more enlightened management practices, and changes in education have all been recommended. The first speaker was Professor Martin Cohen of IIT whose area of expertise is collective bargaining. He concentrated on the prospects for unionization of engineers. He did not consider the question of whether unionization is compatible with greater professional independence.

Cohen's first major point was that although unionization of engineers was expected to show a dramatic increase after World War II, the upsurge did not materialize, and, in fact, stagnation set in. For a brief period in the early 50's, there seemed to be a potential for growth. However, after the Soviet success with Sputnik in 1957, scientists and engineers became a kind of new priesthood, according to Cohen. This meant that though engineers increased in numbers, they moved more rapidly into management positions. A University of California survey of engineering alumni in the early 60's indicated that 14 years after graduation, a majority were in management. After 15 years, fewer than 10% were in primarily technical work. Cohen asserted that these findings were duplicated at a number of schools.

Engineering students tend to have a strong management bias, in Cohen's view, for they tend to come from blue-collar backgrounds and to see themselves as moving upward. He suggested that the perspective of engineering students on unionization is that of prospective managers. The students should therefore be educated to deal fairly with unions. Two major principles are asserted in the law: workers have a right to unionize, and a majority vote rules. The law requires both management and labor to deal in good faith and spells out unfair labor practices. In conclusion, Cohen noted that engineers, excluding supervisors, have bargaining rights as do other professionals. They have the option of organizing as engineers or voting (majority rule) to be included in a larger bargaining unit.

Enlightened Management

The next speaker, Carl Ahlers, of Cummins Engine Company, addressed options for management dealing with engineering problems which raise issues of social responsibility. He emphasized that the sort of management practices he would describe differ only in subtle ways from more standard approaches and that they largely involve shadings of attitude. Ahlers focused on institutionalized methods in the company used to resolve problems. He presented two cases, the first already resolved, and the second at that time still unresolved. Both cases involved issues of health and safety. The first dealt with a fan hub safety problem and the second concerned engine emissions which were as of that date unregulated and had largely unknown health effects. Early findings, however, were disturbing.

The fan-hub problem arose in the manufacture of an engine. The design had a unique feature, a gear driven fan which had certain advantages over normal belt-driven fans. As it turned out, after they went into production, the process went out of control. Analysis suggested that fans could fly forward into the radiator, with injury resulting to someone nearby. Ahlers learned of the problem from an engineer on the spot who was not later identified. Ahlers was at the time director of environmental management which meant that he had to deal with environmental and safety issues in the context of government regulation. There was a relevant statute for guidance under the National Highway Traffic Safety Administration. According to the statute, if Cummins found a defect relating to safety, they had to report it to the government and perhaps get into a "safety recall".

Ahlers focused on the process used to determine first whether there was a safety problem and then to determine what to do about it. They had to discover whether there was a defect,what kind of failure could arise from the defect, and whether it could lead to injury. They also had to define a defect. According to the definition they adopted, a defect is a characteristic of either design or manufacture that creates a higher than average incidence rate of failure. This implies that there is an industry norm and that if the problem sticks out "like a sore thumb" from that norm, then it must be a defect. This definition assumes that some failures are built into any design and manufactured product and that there is some acceptable level of failure.

Ahlers orchestrated the finding process, of which the non-institutionalized part was as important as the institutionalized part. Reporting to a normal hierarchy, but outside the manufacturing organization and outside the research and engineering organization, Ahlers was not highly dependent on the management hierarchy for information about what was going on. This meant that if he wanted to know what was going on in manufacturing, he didn't go to the vice president in charge of manufacturing, but rather to a quality control specialist or a manufacturing engineer. He went to someone with immediate knowledge rather than the filtered perception of higher management. If he wanted to know about design, he went not to the chief engineer but to a senior engineer or front line engineer doing analysis or statistical work. Ahlers' mode of operating in this case conformed to a practice which he helped to develop in the company. Once it was determined that there was a dangerous defect, the process of "boiling" that finding up through the hierarchy for a company decision was easy and straightforward. Ahlers said that reflected the fact that Cummins wanted to do "the right thing."

Ahlers then turned to the unregulated emissions problem. Since 1970, the emissions from diesel engines have been controlled under the Clean Air Act and the EPA. With increasing technical knowledge, the industry has been required to become much more discerning in choosing pollutants. There are, however, many unspecified pollutants for which there are no standards. To deal with this problem EPA used the model of the Toxic Substances Control Act. In this act, Congress shifted the burden of proof from government to industry. It became industry's burden to find out about injurious substances, to indict and convict them, and to create standards.

In the case of the diesel business, EPA asked the industry to engage in testing, to identify substances, and to ascertain undesirable health effects before marketing. Lacking equipment and expertise, Cummins had to figure out a response for testing among 30,000 chemicals in engine exhaust. For the identification work, they went outside the company to those with more sophisticated chemical techniques. The substances which were isolated were then tested for health effects, primarily cancer. The tests, conducted outside the company under Cummins' supervision, had negative results which, in fact, replicated EPA's own results.

That was distressing news, for it said that there was a reasonable chance that diesel omissions could be causally related to some cancer rate. The problem then, according to Ahlers, is how to communicate this information to the public. He pointed out that sophisticated analysis makes it possible to discover causal connections enabling us to say of some human act that it will create a certain number of deaths eventually. For example, statistical techniques make it possible to accurately predict the failure rate of crank shafts. Ahlers asked, "Is the public ready to accept this knowledge? Is there a rising ethic of limited hazard acceptance?" His point was that as scientific knowledge is gathered, it ultimately has to be met by learning to weigh hazards and benefits and then asking whether we should go on or not. This response, which he referred to as the ethic of limited hazard acceptance, contrasts with the common tendency simply to ban the offender when the causal connection is established.

The emissions problem was not acute for Cummins because the EPA had made the findings public. However, it seemed certain that companies would acquire knowledge which no one else had. Thus, Ahlers had a second question. It concerned the institutional process used to arrive at a decision about what to say, how much to say, when to say it, and to whom. That is a management decision process which tends to "boil matters up" through the management hierarchy. The question is whether this properly should be a management decision process or whether a person acquiring knowledge should transmit it outside the organization. Ahlers' two questions stimulated a very sharp and full discussion.

A participant suggested consolidating the testing work in an industry institute or consortium. Another pointed out that there was still the general problem of communicating effectively to the public. Ahlers acknowledged the paternalism of asking whether the public is ready to know and wondered whether information should just be spilled out. Some feared that would produce a panic reaction. An engineer suggested that raw data should not be made public unless it was very startling and likely to have an immediate effect. A philosopher noted that the saturation effect expressed in either a generally cynical attitude or in the conviction that everything is safe should be carefully distinguished from a rising ethic of acceptable risk.

Another philosopher suggested that the public could accept information given in a proper context. That is the case with engineers, and it might be so for others with appropriate background. Our educational system, it was urged, could do more to teach us how to evaluate this information. However, Ahlers observed that information comes in increments and the question of conveying raw data remained.

A number of the group recommended a policy of releasing information to encourage the ethic of limited hazard acceptance. The paternalistic policy of withholding, they thought, leads to igorance, mistrust, and a potential for hysteria when information comes out. The suggestion was made that all the industries go to EPA with information as it is gathered. To have a meaningful standard of acceptable risk, the public has to have some understanding of what the risks are. Holding back information guarantees that the public will never be ready to determine acceptable risk.

Ahlers answered that this is functionally the case now, but it transfers the ethical dilemma to EPA, and when they acknowledge a death rate, they get attacked. A philosopher responded that it is nevertheless either paternalistic or very self-protective to take the stance that the public is not ready for the idea of acceptable risk when the industry is operating with that concept. If a person's acting individually would damage the company, the only solution may be for the industry to disclose to the EPA. Someone asked whether the communications problem arises for data about hazards to workers within the company. Ahlers answered that the same questions would be asked. He concluded by observing that the discussion had helped to clarify the issue of whether companies should assume the 'Should we tell?' role.

Educational Reform

The third speaker on institutional options was Professor Paul Torda of IIT, who discussed prospects and directions for educational reform. From a brief historical survey of engineering education in France, England, and the United States, Torda concluded that in all three countries industry had strongly influenced what was taught and how it was taught. He held that another obstacle to introducing philosophical ethics and professionalism in engineering education comes from traditionally assigning liberal studies a supportive, second-class role. He asserted that the problem was not simply a dense curriculum but the fact that engineering educators are not used to facing open-ended problems, that is, problems which admit of a variety of solutions.

Torda emphasized that real-life problems for engineers are open-ended: conflicts have to be considered and choices have to be made. Nevertheless, until quite recently, in his view, engineering educators have viewed liberal studies as a threat to quality engineering education. Noting that educators often recognize that a broad base of information is required by engineers, Torda added that they must recognize that a rational solution is not automatically dictated by the data. He commented that educators understand that personal world views must be examined in the light of new knowledge and experience and said they must also recognize that this may lead to redefining problems. Torda said that educators take seriously adherence to codes of ethics, but they need to take a broader approach to professional ethics.

In Torda's view, there is a role for philosophers in assisting students with a number of recognized problems. Students need to understand that they are legitmately apprehensive about reconciling professional knowledge with reality. Another problem is that students have to become aware of opportunities to integrate their concerns as citizens and parents with their professional concerns.

Torda held that systematic ethical discussion initiated early in training can prod students to more conscious scrutiny of their personal values and of the intersection of their values with the work sphere. He believes it important to look at the codes to see how real life situations and individual values can be reconciled. Students can be helped to recognize that one's status in the profession is not just a private matter. It is not enough to say, 'You are a moral person, and therefore as an engineer you are also moral.' Students should realize that employment naturally creates loyalties to the employer, and this loosens indentification with the profession.

Torda saw hope for the future in joint efforts by professionals and philosophers, such as those supported by NSF and NEH. He recommended the approach to teaching professional ethics presented in an article by Derek Bok.* He held, however, that class room teaching is almost inevitably ineffective and must be replaced by the problem approach. A participant suggested that the case approach might be an appropriate alternative.

Subsequent discussion centered on the question of who should teach engineering ethics. A participant commented that engineers are needed as role models. Torda observed that engineering educators are often too removed from practice. He added that it can be difficult to convince humanists, so long excluded, that they have an important role to play. A philosopher answered that it has been part of the process of professionalization to reject external moral authorities. Torda responded saying that only rarely does an engineer have the appropriate background which philosophers have for justifying moral positions and considering alternative perspectives.

One of the engineers added that it is somehow not respectable for an engineer to teach ethics alone. In a team taught course, the philosopher adds credibility, and the engineer also becomes more credible supplying factual data. A philosopher noted that the problem of the dignity or legitimacy of work in professional ethics also arises for philosophers. Torda concluded that, in any case, student participation is extremely important and held that there are successful efforts at integrating liberal studies in engineering education.

IV The Role of Professional Societies

The IEEE Model

Professional societies were considered separately because they are key institutions in the professions and because they can play a significant role in supporting and enforcing morally and socially responsible conduct. There were a number of issues to consider: support for individuals with moral conflicts; enforcement of codes; educating professionals about moral issues in engineering; educating the public about engineering projects; relation to industry; and advancement of employee benefits.

The first session, to which members of local engineering societies had been invited, featured as guest speaker Professor Stephen Unger of Columbia University. Using the IEEE as an example, he discussed what engineering societies can do to support ethics and social responsibility in engineering. He praised the IEEE code as a good first approximation at incorporating generally accepted moral precepts while accommodating differences in individual values.

Unger urged that the societies give priority and energy to supporting those who abide by the code, suggesting that it is inappropriate to punish violators when abiders are not protected. In any case, societies have tended to enforce codes almost always when violation of the law was involved. Unger doubted that it was an important function to duplicate law enforcement. He suggested instead an educational function such as giving awards for outstanding conduct in the ethical area. He urged that different societies might act to support legislation to benefit the ethical engineer and might join together in activities in the ethics area.

Unger took up two related topics: IEEE's assistance to the BART engineers and the development of machinery for support in IEEE and other societies.* A change in IEEE's constitution in June, 1972 led to the formation of the Committee on the Social Implications of Technology and made it legally possible for IEEE to move into areas of ethical concern. Unger pointed out that IEEE, like other societies, is a network of boards, committees, and sub-groups. This made the formation of CSIT a complicated process which Unger outlined.

Once formed, the CSIT published a newsletter and its efforts led to the new code of 1974. It also became involved in the energy area and other problems areas. Under prodding from Unger, CSIT looked into the BART case. It passed a resolution asking IEEE for machinery to help those penalized like the BART engineers and for intervention in the BART case even before such procedures were devised. A sub-committee of the Board of Directors recommended that the IEEE submit an amicus curiae brief in the BART engineers' suit to cover the principles involved, not the facts of the case.

This was done, and the brief put forth an important principle. It argued that if engineers are fired for acting in accordance with their code of ethics (ECPD version), than that is a breach of contract. That is, the brief held that it is an implied clause in the employment contract of every engineer that he or she abide by the code, in particular the part requiring that they hold paramount the health, safety, and welfare of the public. If an engineer is ever fired in contravention of this implied clause, that should be considered as grounds for suit. However, the case was settled out of court shortly after the brief was filed and so created no precedent in the common law. This was IEEE's first intervention.

Unger urged that in devising machinery for such interventión on a regular basis, engineering societies take as their model the procedures which the AAUP has devised for protecting academic freedom of university faculty. With devices such as censure of companies, societies could lend their prestige to strengthen the individual professional. Citing the costly bad designs of the DC-10's cargo door and floor, Unger maintained that it is in management's interest to have responsible engineers.

The BART Case

The aim of the next session was to study the role played by engineering societies in the unfolding of a very complex and long sequence of events in the development of BART. This study was to provide some understanding of how the societies do and might act. Professor Robert Anderson of Purdue University was the main speaker. His very detailed presentation was based on an NSF funded study in which he participated at Purdue. Stephen Unger, who had led the IEEE effort in support of the BART engineers, was present. Making use of diagrams, slides, and a videotape, Anderson attempted to lay out the story in its full richness.

He provided a historical survey of the origins of BART and included events which occurred between 1957 and 1969 which are not generally discussed. Following the survey, Anderson's approach was to try to convey the various perspectives of those involved in the affair. He eschewed passing moral judgment on any of the protagonists, preferring to describe their roles and to capture, if he could, their perception of the situation. The investigators had favored this approach because they were concerned about introducing their personal biases into the account. The variety of viewpoints was intended to produce a better understanding of the case. Unfortunately, there was no opportunity for participants to probe further into the justification for this approach nor to consider questions which it raised.

In the historical survey, Anderson stressed the role which engineering societies played in early stages. For example, in 1962, the Golden Gate chapter of the California Society of Professional Engineers came out in support of the bond issue authorization vote for several million to fund basic development. Later, as the terms of the contract between BART and PBTB, the engineering consortium, became a matter of discussion, engineers and others raised the question of whether it was a "sweetheart" deal, at the public's expense. Letters criticizing the deal were sent to the national presidents of NSPE and ASCE who, in response, cleared BART.

However, in December, 1962, the Ethical Practices Committee of the state society called a hearing over the exorbitant fees. A letter from the chairman to the BART Board described the BART personnel as naive and inexperienced and charged that they had negotiated a poor contract. The Golden Gate chapter became involved and recommended that BART hire competent engineering staff to be led by an experienced professional engineer. However, those raising questions were accused of "sour grapes" and threatened with the loss of sub-contracts.

The argument was made that to challénge the fee is to oppose the principle of adequate compensation contained in the code of ethics and thus, in theory, to subject the public to less than professional work. The Board of Ethical Review of NSPE used the affair as the basis of one of its generalized cases.* The Board raised the question of whether it is ethical for a group of consulting engineers to issue a public report criticizing fee arrangements contained in a contract with an engineering firm. It described circumstances recognizably like those in the BART situation. The answer was that it is not ethical.

Another society involvement came in 1969 when Roy Anderson, who three years later led the support efforts for the three engineers, competed for a vacancy on the BART Board of Directors. Nominated by CSPE's Diablo Chapter, he had excellent credentials and intimate knowledge of some aspects of BART and PBTB. However, he was very disenchanted with BART management. He was passed over in favor of a member of the political "in-group", and, thus, an attempt to put a technically competent person on the Board failed.

In presenting the various perspectives, Anderson pictured the dissenting engineers as very mobile in their previous employment. Having been repeatedly shafted in the past, they did not have much loyalty to the organization. They had almost always been in entry level positions,and there were no professionals under them at BART. They were on the "firing line", inasmuch as they would have to maintain the system when it went into operation. Whether for the sake of BART's interest,the public interest, or self-interest, they were concerned about the problems they would have. They did everything they could within the system to get management to respond, without success.

On the management side, the Board of Directors consisted largely of political appointees. The general manager was a strong driving force who excelled at public relations and politics but was technically incompetent. The chief engineer, who had had charge of all army construction in the US for the Army Corps of Engineers, knew no electronics. BART was intended to be a quantum jump in technology; it was to bring aerospace advances to mass transportation.

After the three engineers were fired, leaders of the Diablo Chapter attempted to get management to negotiate or talk with them or the three engineers, but management adamantly refused. In May of 1972, two months after the firing, the Diablo Chapter was cited at the annual convention for its engineering professionalism. By August, after they had succeeded in stimulating a public investigation of BART, there was an attempt at the state level of NSPE to censure the Diablo Chapter. The Golden Gate Chapter, then dominated by PBTB, led the censure effort. An ad hoc committee was appointed, and it unanimously cleared the Diablo Chapter. Later on, NSPE gave a journalism award to a Contra Costa county newspaper reporter for outstanding coverage of the problems with BART.

After CSPE faded from the case, the IEEE entered, spearheaded by Stephen Unger, with strong support from the president. According to Anderson, IEEE had at the time a very good president who led the society in its shift from purely technical to ethical concerns. Anderson viewed that leadership as crucial to the changing orientation of IEEE and similarly credited Roy Anderson's leadership with sustaining the efforts of the Diablo Chapter in behalf of the three engineers. In a final comment, Stephen Unger observed that industry is more dependent on the technical societies than is generally realized. "They do not support the societies out of altruism," he asserted. Unger held that industries are not very likely to withdraw if the societies take a more active role in the area of ethics and social responsibility.

The next session of the Workshops was the occasion for presentation of the group reports on the Goodrich Airbrake case. This had been planned for

during the original session on the case in the preceding week. The reports produced a very stimulating and useful discussion, which cannot be captured here. The sense of having begun to explore a very promising area for teaching and research was palpable. Unedited portions of the reports, with prefaces by the editor, appear in Appendix A.

IV. Government Regulation

General Issues

The relation of government regulation to the ethical and professional responsibilities of engineers has a number of facets. Government can control the licensing of professionals. Engineers in industry deal with government regulations and agencies. Engineers in regulatory agencies appear to have a mandated responsibility to the public. It seemed a useful approach to present a general over-view of the role of regulatory agencies and then to concentrate on a specific problem area, the setting of standards.

Professor Lois Graham led a brief discussion of the Stieglitz case which displayed problems of regulation*. Then Professor Paul Friesema of Northwestern University, a political scientist and a lawyer, spoke on the underlying issues of regulation. He began by emphasizing that the development of the regulatory agencies marked a shift in the center of policy making. It moved away from the legislators to bureaucrats and experts who are not accountable to the electorate. Technical issues led to this profound change in the political system, for Congress did not have the expertise to manage problems of technological development.

Friesema considered the peculiar problems of employee-professionals, that is of professionals who work for non-professionals. When the primary authority relations are hierarchical rather than collegial, it is a problem to find devices for setting and enforcing professional standards. The relevant question, in Friesema's view, is, 'What groups are available to be the conscience of non-independent professionals?' He suggested, as one response, that universities and professional schools might function as carriers of professional standards. He felt, however, that even in universities, there are few who are not compromised by association with industry.

Another answer is that government regulatory agencies can set norms for employee-professionals. There are two ways: by licensing professionals and by regulating the industries which employ professionals. Friesema regarded the licensing as really a subterfuge for self-regulation. By regulating the industries, however, the agencies provide a place to which the whistle blowers can turn. The agencies have the capacity to evaluate issues which are raised since the agencies employ professionals in the same profession. However, a new problem concerns the moral dilemmas of professionals in the agencies. The standard issues for non-employee professionals, Friesema noted, have to do with protecting the helpless client from the professional. In contrast, the issue for the employee-professional involves abandoning ties to the client and going public.

The substantial problems and limits of government regulation were Friesema's next concern. He referred to the Stieglitz case which featured the resignation of a top-flight engineer from a national safety standards board. The engineer felt that he was being asked to lend his authority to standards which were a fraud. Friesema said that most political scientists regard the whole system as a fraud; they generally agree that the capture of the agencies by industry is built into the system. The structure leads to bargaining between the regulator and the regulated to reach a stable equilibrium. Career lines of experts move back and forth across agency/industry lines. Inevitably, the agency is primarily responsive to the regulated even though that was not intended.

Another view, according to Friesema, is that the regulatory agencies in many instances are born captured. They are vehicles to assuage public fear, in fact, symbolic gestures. They seem to have a strong role, but they have the authority and resources to do very little. Theirs is a very limited mandate. Some have the impression that the agencies start out with great enthusiasm and then wear down, but the truth is, in Friesema's view, that regulatory fervor is not high in many instances.

However, Friesema saw some hope in the development of an adversarial public. New institutions, such as environmental groups and consumer groups, are assuming an adversarial role vis a vis the regulatory agencies. Now, he said, the public is not just creating an EPA but staying around and, by suing, forcing them to do their job. The agency is no longer out there alone to make compromises with the regulated, but has a more balanced set of constituents. The prospects that the regulatory agencies themselves can develop the structure for opposition to industry are very limited, Friesema held.

A participant asked about public members on regulatory bodies. Friesema viewed the presence of public members as an encouraging sign but regarded them as of little effect. The agencies need technical expertise and thus must rely on those who have gone to the same professional schools and accept the same standards as those in the industry. Nuclear engineers, for example, find nuclear things interesting and develop a stake in nuclear enterprises. Further, if they blow the whistle, they have almost no career options.

The next question concerned the way to design a more ethical workplace for engineers. Friesema's answer was that standards have to be set in an adversarial setting; he admitted that his was a lawyer's bias. He held that the solution for society's critical technical issues is to politicize them, to get away from experts. It would be desirable, he thought, to have a cadre of experts who are independent and adversarial, but they cannot be found. Groups such as the Sierra Club have to depend upon universities for technical expertise. In any case, critical public policy issues should not be removed from public influence, for technologists have no higher claim to make evaluative judgments than anyone else. This shift calls for the demythologizing of some parts of expertise. The experts' special role, Friesema urged, is to identify risks and to assign probabilities.

Subsequent discussion centered on two ideas Friesema had advanced: that academics might function to maintain professional values and that adversarial processes among competing interests offers the most promising approach. Participants debated the question of whether engineer-educators are or can be independent enough to be the carriers of ethical concerns. Friesema argued that this is a problem in every profession, except perhaps philosophy.

In his view, contesting the two-way bargain increases the chances for public policy responsive to public needs. Participants questioned whether groups claiming to represent the public interest had enough expertise. Friesema mentioned government initiatives to fund intervenors in the nuclear area. Apparently, it was judged to be in the public interest to pay for challenges to the integrity and judgment of experts.

A philosopher argued that it is a self-fulfilling prophecy to hold that professionals cannot take an independent stance, and it raised a problem for a code of ethics which encourages a more impartial standpoint. He urged that the adversarial arrangements Friesema advocated fostered a 'we-they' outlook, discouraging professionals from attempting to be impartial. In Friesema's view, the challenge is to find a way to ensure the standards professionals claim for themselves and to provide a soft landing for dissenters.

Setting Standards

The second session on government regulation included invited guests from engineering societies and the EPA, and featured a panel on the setting of standards. The panelists were William Thomas, a research attorney with an environmental science degree, Douglas Cassel, a public interest lawyer, Arthur Smith, a regulator from the enforcement division of EPA, and Robert Janowiak, president of a division of a company. They were to provide four distinct perspectives on the regulatory issue of setting standards.

Thomas introduced the topic with brief comments about lawyer-engineer interactions in situations of technological decision making. He noted significant contrasts in orientation and outlook of the two professions. For example, lawyers, not scientists or engineers, are usually limited to binary choices. Thomas illustrated the confusion which arises from not noticing how factual judgments shade almost imperceptibly into value judgments.

Cassel contributed what he termed a public interest perspective on the public interest perspective. He defined the function of public interest law firms: they represent points of view, economic interests, or social groups who would go unrepresented or underrepresented because of poverty or disaggregated economic interests. Within the last ten years, public interest law firms have enabled poor and middle class people to sue large and concentrated economic interests. The operative assumption is that the public is served if unrepresented views get into the fray.

However, Cassel saw a problem with a "naive" tendency to trust a pluralistic system. It offers an escape hatch for engineers in a government agency who, for example, knowingly make questionable compromises with safety. They can say, 'I don't have to worry because the Sierra Club will step in.' Cassel pointed out that there are very few public interest law firms and lawyers. They cannot get to 99 out of 100 hearings or proceedings having to do with setting standards, challenges to standards which have been passed, or legislative battles about criteria for standards. However, industry is always there, and government is there when regulations are involved.

Even when the public interest professionals are present, they are often "out-gunned". Cassel held that this was not just because the public interest firm has one lawyer and half an engineer against the engineering staff of US Steel and twenty five lawyers. In his view it is because of the stakes. If US Steel threatens large numbers of lay-offs as a result of imposed regulations, that may influence a judge. Cassel asserted that since the public interest movement is weak against the economic forces of large corporations, the public interest requires responsible professionals within government and industry. The problem he saw was that of encouraging engineers to accept this role.

Cassel observed that laws, codes of ethics, and a bill of rights for whistle blowers are not enough. He held that a more basic attitudinal change in engineers' education is required. Cassel maintained that it is the responsibility of engineering faculty, not just in ethics courses, but throughout the curriculum, to raise basic questions of social impact and professional responsibility. Cassel urged the educators to stimulate students to examine their career values. He concluded by saying that even in a social system in which trade-offs do not favor profit over public interest, we will still need responsible engineers. Though Cassel had not been present at the morning session, he had continued the theme with which that session ended.

Arthur Smith traced the history of a particular standard in order to convey how the process of standard-setting works at EPA. His example was the regulation of vinyl chloride, which is the basis of the second most widely used plastic in the US and a dangerous carcinogen. The statute which guided was Section 112, a 1970 amendment to the Clean Air Act. The procedure required a series of steps within prescribed intervals of time: the pollutant was designated, a standard was proposed, a hearing was held, and the regulation was promulgated.

In the case of vinyl chloride, the dangers were recognized in the early 70's. An EPA task force which was established in early 1974 considered where the problem was and surveyed regulatory alternatives. In 1974 and 1975, EPA made assessments of health effects of vinyl chloride. In December of 1975, the chemical was listed in the Federal Registry, designated as a hazardous pollutant, and there was a proposal to regulate. With the listing and proposal, came a request for public comment. Industry wrote more comment letters than anyone else. In early 1976, there was a public hearing, and in September EPA published the Standard Support document. It summarized the public comments and explained revisions of the proposal, if any, in the final promulgated standard. In October, the final regulation was published; this was the first time the agency chose to control an entire chemical process. The regulation contained emission limitations, equipment standards, and process standards.

Under Section 112, the standard was effective immediately for all new plants, and within 90 days for existing plants. To get a waiver to allow time for complying, an existing plant had to know about the standard and the need to come in within 90 days with a compliance schedule. The agency engineers had to become familiar with the industry so that they could assess the schedule, check

the milestones promised by the company engineers, and propose equivalent equipment. Finally, they had to deal with the problems of continuous monitoring and reporting and the "debugging" of the equipment involved. They found that companies differed in the degree to which they shared information about their problems.

Janowiak, conveying an industry perspective, asserted that standards are absolutely necessary. He focused on kinds of standards and problematic trends in setting standards. One relatively uncontroversial kind of standard is a compatibility standard; it is the sort needed to fit screws and holes. Such standards, of course, restrict design. The second type is a performance standard, such as mandated corrosion resistance. Such standards further restrict design of a product but are often necessary. However, Janowiak saw some problems since, for example, a product designed to withstand low temperatures in Alaska may be excessively restricted for Florida. The third type is the design standard, for example, a restriction on what type of glass may be used in a light bulb. This standard narrows the product further.

One problematic tendency Janowiak noted was the proliferation of people in the standards business. Originally, industry groups were standards setters. In addition, there were private standards organizations such as Underwriters Laboratories. The chief trend of recent years is the involvement of numerous federal agencies. The second problematic trend Janowiak cited is the increasing use of design standards, which he regards as stifling to innovation. He also stressed the importance of choosing a level of restriction which makes economic sense.

In the question period, debate focused on the design standard vs. performance standard choice. Cassel pointed out that though performance standards allow for more innovation, it is often easier for non-technical people to implement and enforce design standards. Design standards also have the advantage of producing standardization and its accompanying economies. Cassel stressed the importance of evaluating the situation and the trade-offs, to decide which standards are preferable. Janowiak conceded that this distinction between kinds of standards can break down. Thomas pointed out an interesting case in which standards impede innovation. In communities which have strict standards for housing construction, it can be a very challenging problem to design for solar energy.

The next session had been intended for working out course plans. However, participants had by then begun to reap the fruits of collaboration and devoted most of the session to examining philosophical moral concepts. In the discussion, led by Weil, distinct notions of responsibility were sorted out. Philosophers' use of the terms 'ethics,' 'morality,' 'moral theory,' and 'metaethics' were discussed. It appeared that sustained personal and intellectual contact had removed some barriers between the engineers and philosophers.

V Engineers and Public Policy

Preceding the session on engineers and public policy, there was a group meeting in which the participants voted unanimously for proposals prepared by the group. The proposals announced the group's intention to continue the project with another workshop in 1980. The new project would be enlarged to include practicing engineers from government and industry. Vivian Weil and Nelson Rogers were unanimously elected to head the new project.

The aim for the penultimate session was to consider the macro-issue of engineers' role in the formation of public policy concerning technological developments. A paper by Weil was distributed. It argued that engineers and scientists have a moral obligation to contribute knowledge and judgment to public debates about technological enterprises.

The invited speaker was Professor Allan Schnaiberg, a sociologist at Northwestern University. He considered the responsibilties of engineers in dealing with the technological problems of society and in laying out alternatives for the future. His first topic was the "insider-outsider" problem. He noted the uncanny accuracy of the movie China Syndrome with respect to the Three Mile Island accident. This was an extremely rare case in which insiders went public with precise predictions. He held that the insider-outsider problem varies with the industry. For the nuclear industry, an extreme case, the idea of a federal inspector in every plant means monitoring in a quasi-inside way. By contrast, in the oil industry, a broad range of technical information is available outside.

Schnaiberg contrasted two modes of regulation. In one mode, any time there is a problem, there is shut down. The other way is to find mechanisms for fine tuning, but that requires insider's information. He observed that in the first half of this century, technological development was managerially controlled. However, for a variety of reasons, technological issues are now more a matter of public participation. Schnaiberg did not expect public questioning of technology to slow down. He pointed to increased protections for whistle blowers. He advocated creation of covert channels for releasing insider's information. Otherwise, he argued, we have only heroes and the perils of living in a society where one's life conditions depend upon heroes. He also pointed out that there are few examples of successful whistle blowing.

Schnaiberg then turned to a second, also admittedly problematic, role for engineers which he advocated. He held that engineers have a responsibility to propose and evaluate imaginative, new technologies. In the question period, engineers, particularly, challenged Schnaiberg on his second proposal. Although that proposal demands a great deal of engineers, it does not involve deception, as does the covert action proposal. Unfortunately no time remained to challenge Schnaiberg on his idea of covert action.

Conclusion

The final address, by David Ewing of the Harvard Business Review, returned to the theme of the employed professional behaving in a morally and socially responsible way in the workplace. Ewing's interest in the rights of employees and his study of due precess for employees qualified him to present key observations on prospects for extending protection to employed professionals. He discussed due process for engineers,a procedure to assure equity and fairness to employees who feel they have been treated harshly or unfairly. He stressed that due process is almost but not quite a fiction in government and indusnry. It was the small area of gain in due process in recent years that Ewing wished to consider, for this area seemed to be growing in importance.

He began with the case of Louis V. McIntire, a chemical engineer at DuPont in its Orange, Texas plant. After 17 years at DuPont McIntire wrote a novel critical of the way large companies treat engineers and other professionals. Although the novel did not describe DuPont or any one at Dupont nor disclose that McIntire was a chemical engineer at DuPont, his superiors were angry. They called him in and fired him. McIntire sued DuPont, claiming that since he had been fired for writing a novel his constitutional right of free speech had been violated. In a 1974 decision, the court ruled against McIntire; he had no rights in this case, the District Court in Texas decided. The court said that it based its decision on the ancient common law rule that a company can fire an employee for cause, for no cause or for cause "morally wrong."

The next court case Ewing discussed, was the case of Geary vs. US Steel. This case, also decided in 1974, involved George Geary, an engineer who worked in sales for US Steel. Geary was a top-notch performer who had worked for the company for 14 years when he blew the whistle. US Steel had decided suddenly to develop and sell a new tubing for oil-well drilling. Geary believed this tubing to be unsafe and potentially dangerous to users. He had good reasons for his belief. He went to his boss, then the district manager, and finally to the Vice-President of Sales, urging them to hold the new tubing back from the market.

He did not go outside the company with his concerns; he "blew the whistle" only inside the organization. He did not block the project, sabotage it, or upset the morale of other employees. However, Geary's action displeased the vice president who fired him summarily. Geary sued US Steel, claiming that it had violated his constitutional liberties in firing him and that it had also violated the public interest. The case went to the Supreme Court of Pennsylvania. In a close decision, the court decided in favor of US Steel and against Geary. The view of the majority was that the old common law rule applied--that an employer can fire an employee without any kind of due process whatever.

However, the vote was 4 to 3. Ewing observed that 20 years ago a close vote like that would have been unthinkable. In addition, Justice Roberts, a judge held in high esteem, delivered a vigorous dissenting opinion. He wrote that it was outrageous to fire a veteran engineer who, with good reason for his beliefs was only trying to protect the public interest. Ewing regarded the Geary case as representing the uncertain state of the law at this point. However, in his view the tide is changing--many leading courts are almost on the verge of recognizing employee freedom.

Ewing cited another case which began in 1977 and ended late in 1978 in California. A young engineer named Marvin Murray was employed in Santa Clara by Microform Data Corporation. Murray's job was with a new computer terminal that his company was making for central telephone company operators. Murray realized that this new computer terminal, or console, violated the state's safety regulations. He went to his superiors and, in the words of whistleblower

Ernest Fitzgerald, "committed the truth". His superiors were displeased because they were in a great hurry to get the new terminal on the market. They fired Murray on the spot, believing that to be their right as managers. Murray took the company to court claiming that his discharge violated both the public interest and his constitutional rights.

In this case, the court decided that Murray was right. It said that the old common law rule was not sacred any more--that loyalty to the public interest and loyalty to high ethical standards can outweigh loyalty in the narrow sense to one's boss. So Murray won a judgment against the company. Unfortunately, this case was not appealed from the trial court, and so it lacks "precedential value".

Ewing pointed out that due process procedures are springing up in industry and government. In Ewing's view, these home-made due process systems promise to be very significant in the 1980's. For example, a company such as IBM has what they call an "open door"; that is, an investigator in the chief executive's office gets the facts, beginning with the presumption that the "whistle-blower" or complainer is right, and reaches a decision. Perhaps 50 companies have systems like this. Some work fairly, and some do not.

In a due process system of the type which Bank of America has, a group of investigators are constantly on call to hear complaints and work out solutions. They report to a strong vice-president for personnel. Bank of America also has a system for appealing decisions to executives in top management. Perhaps 20 companies, some of them prestigious companies, have such systems. In a hand-full of companies, including Polaroid, an employee elected committee of three employees are assigned to hear cases of alleged unfair treatment. The "judges" are elected by employees for three-year terms. Ewing predicted that the employee-assistance department, as developed by Bank of America, is the trend that will grow in the 1980's. His estimate was that Polaroid's employee-elected tribunal plan will not catch on until the 1990's.

In conclusion, Ewing observed that strong, authoritarian control in large, complex corporations is unattainable and unrealistic, even in a totalitarian atmosphere. Further, he held that such control is inconsistent with the Bill of Rights and the Founding Fathers' underlying conviction that human nature and organizations in particular are fallible. Ewing suggested finally that dissidents are a potential resource for decision-makers, and that a case can be made that such critics may act in the corporate interest. He cited the Goodrich Airbrakes case as an instance in which management could have remedied the problem in its early stages if there had been some way of airing dissent and protecting dissenters in the company. The company would have avoided exorbitant costs, the wrath of the Pentagon, and bad publicity. Thus, Ewing echoed a number of the main themes of the Workshops and closed the final session on a cautious note of optimism.

Participants were generally very enthusiastic about their experience in the Workshops. In their evaluations, they expressed the belief that the interchange had contributed substantially to their teaching and research and would have a lasting effect on their professional work. In the months following the

Workshops, participants reported progress on such topics as moral development and professional development, codes, case analysis, and risk assessment. A second conference, supported by a supplement to the NSF-EVIST grant and by funding from NEH, will be held at Rensselaer Polytechnic Institute in June, 1980. Most of the participants and IIT staff will attend, holding their sessions during the final meeting of the National Project on Philosophy and Engineering Ethics. Some combined meetings are planned.

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4. Kline
   Royce
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5. Kultgen
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6. Schaub
   Theis
   Uebelhoer
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These groups produced reports on the Goodrich Airbrakes case and course and curriculum plans.

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This bibliography was compiled from reading assigned or recommended in advance of the Workshops and from articles, documents, and books recommended or mentioned by speakers and participants. For a more comprehensive list, one should consult the bibliography in engineering ethics, prepared by the Center for the Study of Ethics in the Professions, with the support of an EVIST grant from NSF. Professor Robert Ladenson of IIT was Principal Investigator.

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Additional Readings

"A7D Case," ASEE Publication Series

A Survey of Policies and Procedures Applicable to the Expression of Differing Professional Opinions, Office of Management and Program Analysis, United States Nuclear Regulatory Commission

BART Fee Case, The Board of Ethical Review of NSPE, Opinions Board, 2, No 66-1

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Bazelon, David L., "Risk and Responsibility," Science, July, 1979

Bok, Derek C., "Can Ethics Be Taught?" Change, October, 1976, pp. 26-30

Draft Code of Ethics for Scientific Workers, AAAS committee on Scientific Freedom and Responsibility

Dworkin, Gerald, "Autonomy and Behavior Control" Hastings Center Report 6, February, 1976,pp.23-28

Ewing, David, Freedom Inside the Organization: Bringing Civil Liberties to the Workplace New York: Dutton, 1977

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Friedson, Eliot, Professional Dominance, Chicago: Aldine Press, 1970

Goldner, Fred H. and Ritti, R.R., "Professionalization as Career Immobility" The American Journal of Sociology 72,(5),1967, pp.489-502

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Weil, Vivian, "Engineers and Public Policy," Presented at a Conference on Philosophy and Public Policy, Stanford University, May, 1979

Weil, Vivian, "Moral Issues in Engineering: An Engineering School Instructional Approach," Professional Engineer, October, 1977, pp.35-37

Appendix A

Introduction

Portions of the group reports on the Goodrich case seemed valuable enough to include here despite their rough form. Some of the groups provided general commentary preceding their analysis. Group 4 observed that to live a moral life is to accept the results of one's action. Presumed in the moral life is the ability to see one's actions as causing harm or falling under rules which give direction to choices without determining them. This is a concept of moral duty with no particular duties specified. It implies a duty to discover those harms and those moral rules and, as meticulously as is appropriate, to apply them to answer the question, 'What ought I to do now?' A problem is seen as ethical when there seems to be a violation of a basic value such as honesty or fairness. The aim in case study in the class room is to help students see that they likewise have these basic values. We have succeeded if students are led to consider all the issues.

Group 1 added that this process should lead students to an improved self-image. At the same time it should lead students to the idea that their moral opinions matter. Unless they believe their moral opinions matter, they will not, except by accident, challenge the moral climate in which they find themselves. In their preamble, Group 1 noted that the Goodrich case typified the moral complexities of life. In most cases in which we end up doing wrong, there is no clear point before which we were right,and after which we are wrong. We are drawn into a compromised situation step by step, and not until we are quite far along do we realize that we are faced with a moral dilemma.

In their analyses,the groups offered contrasting approaches to the case. Selections from the group efforts follow. In each instance there is a short preface by the editor preceding the exerpt(s) from the group's report. The exerpts are unedited.

Group 1

The members of this group divided their analysis into two parts: factual commentary and moral commentary. In the moral commentary, they suggested employing the philosophical concept of alienation. Their paragraph on alienation follows.

Concept of Alienation

Exposure to the philosophical concept of alienation will guard against the feeling that one is isolated, and that no one will come to one's aid. Two arguments of these people reflect their deep alienation: the claim that "someone else will do it if I don't" and that "I have to think about my wife and children." Both "premises" are true but they are used to rationalize decisions already made. We dignify their consideration to treat them as premises of a genuine argument. They express hopelessness: the immoral act will occur no matter what they do. Of course the powerless person need not act. Again, unless you believe that someone will listen and that others will come to your aid, you will not, except by accident, challenge the moral climate in which you find yourself.

Group 2

This group also presented a two-part approach. The first part concentrated on the ways in which actors tried to find excuses for what they did (or did not do). Moral and non-moral motivation of the actors was explored in an interesting passage which appears in its entirety. This exploration pointed to the need for organizational reform. Thus, the second part, also included here, listed 33 points concerning organizational structure.

Gretzinger and Vandivier both showed a willingness to do what they acknowledged to be morally wrong. Yet both also felt it necessary to go on to rationalize what they acknowledged to be morally wrong (Gretzinger--must send his sons to college). Their concern to find an excuse seems to indicate they both take morality seriously. Yet, apparently both felt that there are limits to the demands that morality can make on us. This may mean that, contrary to what many philosophers have advocated, they hold morality is not always the highest court of appeal. They may think that other practical considerations may reasonably carry greater weight in some situations. If this is their view, they would seem to be urging that there are circumstances (of which this is one) in which one may have an excuse for not doing what would ordinarily be thought to be morally required. This need not imply that they thought they were morally justified in doing what they did. (E.g. temporary insanity may excuse irresponsible action, but it does not justify it.)

If this was their view, we might ask why they would think this. One possible reason would be the belief that organizational structures present barriers to individuals regarding themselves as morally responsible agents. Although no one in our group thought that this could plausibly be maintained in this case, we explored the question of whether this might in fact be the case in other situations. And, insofar as it is, and insofar as it is desirable that individuals retain their moral agency within the organizations in which they operate, there is reason to address ourselves to the question of the need for organizational reform (rather than blaming individuals).

Business or Organizational Concepts or Beliefs Conducive to Ethical Chaos

1. Concept of "buying back" the business by taking a dive on the contract.

2. No apparent LTV inspector at plant during design or test.

3. No apparent USAF inspector at plant during design or test.

4. Concept of LTV accepting absurdly low bid.

5. Concept of getting fat on spare parts rather than manufacturing profit.

6. Settling for seven years on a chief designer, Warren, with a volatile technical temper.

7. Allowing fear of Warren to permeate design department over time.

8. Putting a new man in charge of a production design.

9. ...particularly when he came from Norhtrop Tech.

10. Subordinate being put in charge of "fine tuning".

11. Manufacturing and test of prototype to a set date.

12. Subordinate to be main check on superior's original figures.

13. Marketing phony optimism, saying "everything is OK."

14. project manager a "line" man over highly technical people.

15. ...unqualified by education or experience, hence unrespected.

16. But VanHorn wants weak man as a fall guy, and not to be bothered by technicians.

17. Sink paid to take heat-- but ducks it.

18. Vandivier a floater-- hired and promoted through a series of downward promotions: engineer-- analyst--technical writer.

19. Research testing devices and techniques interchangeable with qualificatiion or Q. C. devices and techniques.

20. Not clear if Quality Control actually controlled test device in lab or if engineering and production had free access to same equipment.

21. Testing of any job should be Q.C. function-- Engineers observe.

22. Gretzinger basically an actor: sobs and tears over his dilemma; but he was a weak man, under Sink to be a fall guy.

23. Line admits to no control over Q.C. technical matters.

24. Nobody really wants to communicate upward at any time. They just do it for coverage.

25. Goodrich overpays for low level jobs--for a reason.

26. Guys don't like it when they find they have been bought.

27. It took them a month to write up a false report? Bull!

28. Transcription modification even in typing of written report.

29. Somebody had to sign the report. Who did?

30. Vandivier had a dumb lawyer.

31. Overspecification in DOD specs led to "engineering license" in interpreting tests.

32. Vandivier and Lawson have no idea of what fraud is legally, and the FBI did not help.

33. So overpowering that no one could take a critical attitude toward his beliefs.

Group 3

The members of this group employed the engineering codes of ethics (ASCE and ECPD versions). They set out the Codes' priorities of ethical responsibilities in descending order. The primary responsibility is to the public, followed by responsibility to the profession, to the employer, and to oneself. They evaluated the actions of the actors in terms of those priorities. Their conclusions are contained in the following paragraph from their report.

Engineering Codes of Ethics

The scale of values established by engineering codes of ethics would have required those involved in quality control to have protested to their superiors as soon as asked to falsify data and to have gone public if such company officials were not responsive. Given the organizational structure and the attitudes of such superiors, such action would have resulted, most probably, in the loss of employment.

Group 4

This group provided a two-part analysis. One part presented in a diagram an account of individual action particularly relevant for engineers. The diagram is reproduced here. It shows that since belief supports action, it is necessary to consider an ethic of belief. Whether a belief is right depends on the evidence available at the time and whether it is true. However, its truth may only be established later. Evidence gathering procedures may also be assessed. Recognizing one's limitations seems to enter into the ethic of belief. The second part of Group 4's report outlined macro-responsibilities, the responsibility of the profession and engineering societies to the newly graduated 'intern' engineer. The outline is also included.

Individual Action

1. <u>Action</u> depends upon <u>belief</u>
   ↑ morality ↖ ethic of belief

2. Was Lawson's belief <u>right?</u> — true--hindsight
   relative to evidence available at the time

3. Rational.
   a. evidence gathering procedures.

   b. recognize limitations of one's own competence.

Responsibilities of the Profession

1. Our thesis: we will argue that there is inadequate implementation of responsibility by the profession and the engineering societies for the education and protection of intern engineers. We will center our thesis around the Goodrich air brake case advocating that Lawson, the Junior engineer, was innocent of unethical or unprofessional behavior.

2. Education of engineers: Formal--8 years = 4 yrs. academics + 4 yrs. experience (intern Practice).
   Recognition as professional engineer (registration laws).
   Recognized by societies (more or less).

3. Lawson's actions, naive or greenhorn; self doubt part of gaining experience--part of his education (necessary for P.E.). Professional responsibility of his superiors, especially engineers.

4. Need for third party advocate for engineer.
5. Professional Engineering Societies can best provide:
   a. guidelines for internship program.

   b. third party advocacy

Group 5

1. Approach: What considerations did the actors neglect, what fallacies and rationalizations did they use, and what caused them to do so?

2. Deontological Considerations (in terms of duty and responsibility) They should have thought in terms of <u>prima facie</u> rather than <u>absolute</u> duties.

Relevant Prima Facie Duties
Provide material support for your family.
Be a moral example to your children.
Communicate information truthfully to your employer and customer.
Do not knowingly release dangerous products on an uninformed public.
Contribute to the financial success of your employer.
Promote the moral integrity of the organization in which you work.
Do not damage the reputation of your profession by unworthy acts.
Do not exert pressure on your subordinates to act immorally.

List of relevant duties for the case.

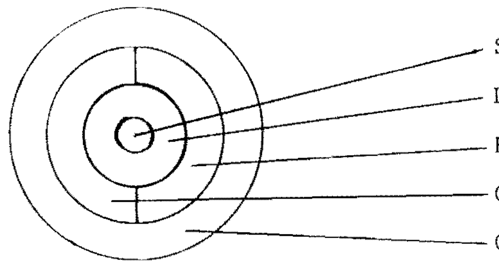
Fallacies which individuals may have committed in appealing to some duties for justification while ignoring overriding duties.

3. Teleological considerations (in terms of consequences at which one ought to aim or aim to prevent through acting).

They neglected to consider all the groups affected and the magnitude and likelihood of each effect.

They thought of immediate and visible effects on those near to them and ignored important harms to those more remote and to the institutions affected.

The Circle of Consequences



Tunnel Vision Fallacies

Spouse and Kids: Since your loved ones are most important to you and you have the most responsibility to them, no other duty can override a duty to them (also known as the Hostages to Fortune Fallacy or argumentum ad wife and kiddoes).

Someone Else Will Do It: It is all right for me to do what is wrong because if I don't, someone else will anyway.

Cog in the Machine: I am only a cog in a great self regulating machine, so that if I do anything wrong, the effects will be corrected by other parts.

Efficiency, or Time Is Money: Ethical problems are irresoluble, and so they must be ignored if there is to be closure according to schedule in the decision process. Morality is inefficient (and the obligation of the engineer is efficiency).

Beyond My Control, or the Accordian of Power: You claim you have power when you want responsibility and disclaim it when you want to avoid responsibility.

I Can't Be Wrong: (a) It is inconceivable that I am wrong, in view of my past accomplishments, and (b) I could not afford to be wrong in view of the awful consequences of mistakes; hence, I am not wrong (also known as the Supermind Fallacy).

Mind as Computer: All real problems have computable and speedy answers; since ethical problems do not, they are not real problems, only matters of bias.

Group 6

This group emphasized the actors and the problems of inter-personal reltions and communication. They focused on the corporate atmosphere and considered revisions of the onganizational structure. Their comments on Warren and Lawson, the supervisor and the young engineer, are included verbatim.

John Warren is painted in a very bad light. It seems to be implicit that we can not expect him to make an ethical decision of his own-or even ethically deliberate the issues. However, we are told that he will sign the final report only if ordered from above; it would be only the most pathological type who would be incapable of moral reflection. It would be extreme to relegate him to that status, but the question of how to develop a corporate atmosphere in which such people can develop psychologically is a valid one.

In the case of Warren and Lawson, to what extent would some previous knowledge, on Lawson's part, of various cancepts of personality have helped him in forcing Warren to listen? Could such practical techniques have been taught in school? Or even at Goodrich?

Appendix B

This appendix is made up of course plans and the rationales for course plans produced by the six small groups. We had intended to circulate, criticize and amend the course plans and their justifications over the course of the subsequent academic year. As things turned out,the efforts of teaching new courses, undertaking new research, and planning for a second conference in June at Rensselaer Polytechnic Institute made it impossible to carry out that intention. However, the plans and their rationales seem to be of value as first fruits of the two weeks of intense, inter-disciplinary discussion.

After short introductions by the editor, the plans and their rationales are presented verbatim, without individual attribution, in the hope that they will stimulate the participants and others already in the field or planning to enter the field to continue these efforts.

Introduction to Course Plans of Group 1

The members of group 1 felt that provinciality was evident in their producing separate individual plans. They worked to overcome their provinciality and thought they reached a rough accommodation in their group.

Group 1

Considerations Concerning a Course on Engineering Ethics

These thoughts proceed from considering the outline entitled "Professionalism" and comparing the author's tendency as an engineer, to stress codes, certification, societies, and history of engineering with my own product. I being a philosopher, use the particular problems of the engineer as a springboard to consider large issues confronting the citizen in modern technological society.

Since I am keeping to the assumption that the course design is for engineering students, I, upon reflection, find that the engineer's and my own designs must accomodate each other and edge each other into a middle ground to avoid a provincialism of intent that I now believe we have both been guilty of.

The problem arises in this way (as the evidence of our conference's discussions points) the engineer takes ethics to refer to (a) accepted practices of behavior and professional achievement in work place. His problem seems to be that what is said and what is done tend to diverge. The divergence is made especially painful for him in terms of various pressures--such as multiple loyties and expectations of conformity. Also, the engineer recognizes (b) an area of individual moral choice-- not only in trying to sort out loyalties or values in particular instances but an attitude to the workplace that, in some general way, suggests the range of action that seems appropriate--sadly, and often enough people find their bottom line is lower as their "freedom" to do as they think appropriate is less.

The philosopher, despite his collegial bickering, holds to the principle that truth should be sought through a rational consideration of argument and secondly, that moral action ought to be coordinated with the previous rational examination. Thus his mountain-view tends to overlook the details of the valley where work proceeds. This is not a necessity but a tendency of his interest. Thus, he contrasts to the engineer's tendency to accommodate the concrete and status quo matters of his work place.

Where then is an appropriate middle ground?

Each party must, no doubt, go more to the other side than his training and inclination habituates, as a tree grown crooked must be bent to its opposite extreme in order to straighten.

Group 1: Course Plan #1

I. First, I would start concretely with particular cases in order to (a) raise ethical issues, (b) show the complexity of actual situations, and (c) show the need for further analysis of social and institutional complexities.

II. Second, the first stage ought to lead to questions like: What is a moral action?; How do knowledge and beliefs function in moral theory?; What is the institutional component and conflicts of values, e.g., loyalties in ethical decision? This brings us forward to examining the response of major theorists. I would choose for exposition: (a) Aristotle; (b) Kant; (c) Utilitarianism; and perhaps, (d) Marx.

III. Last, assuming we have initially raised and focused ethical sensitivity and presented some common difficulties in the workplace, e.g., whistleblowing, etc. and, then, generated a sense of the complexity of moral life, introduced the major theoretical attempts to handle the matter, then, I would propose a private/co-operative attempt at social design. I propose two patterns for design: (1) ameliorative: that is, granted the dynamics of our institutions, work processes and relations, what safety measures and institutional changes would encourage and protect actual moral action. (2) Also, thinking about the relationship of ethical life to political life in the most general sense, how would one order human relationships--e.g. what sort of needs would be considered? what sort of economic and social systems would be optimum for ethical life? This utopian construction is for the sake of seeing ethics in the largest consideration of social reality and refining principles and a standard for the best life within society, as the designer-student understands it.

Group 1: Course Plan #2

Professionalism

Course Outline:

1. Communication: business letter writing; oral presentation; written reports; submission of technical material to professional journals; communicating with your audience.

2. History of Engineering: evolution of engineering institutions; the place of the engineer in societies; scientific vs. engineering developments; current status of engineering profession (present role).

3. Introduction to Business Law: civil and criminal law; contracts; patent law; real estate; engineering proposals and bids; moral rules vs. legality.

4. Ethics: historical aspects; philosophical theories; codes of ethics; epistemology.

5. Professional Registration: legal registration; examinations; regulations of the State Board.

6. Professional Societies: membership; functions; organization; relation to both the public and the State Board.

7. Continuing Education: advanced degrees; non-credit short courses and workshops; professional meetings; society technical publications; continuing education credit.

Course Objectives

1. To develop a sensitivity to moral issues and show the complexity of engineering institutions and decision-making.

2. Introduce theoretical aspects of philosophy and the mechanism for using these theoretical concepts in solving ethical problems in engineering.

3. Examine non-technical issues that affect a young engineer (registration, professional societies, and communication).

Texts:

Format: 3 credit hours; 2 classes per week

Group 1: Course Plan #3

Topics for a Course in Philosophy & Engineering

1. Differences among scientific law, legal law, and moral rule.

2. Epistemology: progressive (positivistic) models vs. revolutionary models; knowledge and alienation.

3. Choices; constraints on: truth, free will, what else? What can we expect of others after we make our choice?

4. Moral behavior; models of: epistemology and choices, value inventory.

5. Model Cases: but which? role play, student discussion and strategy for avoiding moral morass.

6. Professional Codes:

Are there special obligations which hold for the "expert" which do not hold for the "nonexpert"?

Which is more important: upholding and enhancing human dignity or improving the general welfare?

Need to discuss how much can the public know?

What are the limits of improving public awareness of engineering?

Group 1: Course Plan #4

Special Course on Ethics for Engineers

I. Primary teacher: philosopher
Teacher helper : engineer

II. Course Objectives

III. Discussion method as much as possible

IV. Background of Ethics & History

V. Major Ethical Theories

VI. Applied Ethical Theory

VII. Engineering Ethics
- A. Codes of Ethics
  1. Brief history of need
  2. Brief history of development
- B. Applying the codes to cases

VIII. Term Paper
- A. Case Studies
- B. Analysis & Conclusions

Introduction to Course Plan of Group 2

The members of group two reached a consensus on a single plan. Their aim was to provide a comprehensive list of topics in a flexible outline form from which choices could be made. They thought it important to begin with a case study which introduces students to the need to balance loyalty to the organization with social responsibilities to the wider society. Their idea was that students should identify issues and then see the usefulness of theory as they struggled with the tension between personal integrity and compromise. They wanted students to appreciate the difficulty and complexity of determining ethical obligations and options for action.

There was discussion of producing a separate report on the politics of adopting such courses. Some suggested that educators employ the argument, "If our school does not, some other less qualified school will do it." In a more serious vein, others recommended that the point be made that competent people are now teaching in this area.

Group 2: Course Plan

Engineering Ethics

Objective: To make students aware of and reflective on matters of importance in engineering ethics.

I. Social Role of Technology (briefly)--3 views
   A. Technology as the panacea for social problems.
   B. Technology as the cause of social problems.
   C. Technology as ethically neutral(its value depends on what we make of it)

II. Ethical Obligations of the Individual Engineer--Ethical Considerations:
   A. Case study--whistle-blowing (point of departure)
   B. Loyalty to the organization.
   C. Social responsibility of individual engineer.
   D. Personal integrity and compromise.
   E. Significance of work environment.
   F. Organizational barriers to individual responsibility.
   G. Ethical vs. legal considerations.
   H. Why be moral?
   I. Additional case studies (e.g. engineer-client relationship)

III. Engineering as a Profession
   A. History of engineering societies and professional codes.
   B. Various professional codes--comparisons and contrasts.
   C. Evaluation and criticism of codes--application to actual cases.
   D. Concept of profession--Is engineering a profession?
   E. Organization, operation of engineering societies; the individual in the society.

IV. The Practice of Engineering.
   A. Competitive bidding.
   B. Bribing foreign officials.
   C. Prejudice and discrimination (racial, sexual)
   D. Role of regulatory agencies.
   E. Career choice.

Introduction to Course Plan of Group 3

The members of group three agreed on a single plan describing a course primarily intended for practicing engineers with management responsibility in government. Formulated as a ten hour, two week seminar, the plan could be adapted for a one credit semester course for engineering students.

Group members recommended careful selection of cases useful for raising consciousness. They also urged including traditional philosophical theory. In their view, use should be made of a case which concerned neither a trivial nor catastrophic episode. They also suggested that specific topics such as pressure from contractors and techniques for monitoring research contracts be included. The course might be suitable for continuing education within a university extension program or it could be offered by professional societies.

Group 3: Course Plan

Technical Management and Ethical Responsibilities

A 10-session course designed for technical or project engineers with management responsibility in government.

I. Ethical Problems
   A. Typical Problem situations
      1. Pressure from contractors.
      2. Whistle-blowing.
      3. Research evaluation.
   B. A case study.

II. Representative Ethical Theories.
   A. The Ethics of Duty.
   B. Utilitarianism.
   C. Self-realization.
   D. Ethical Naturalism.

III. Application of Ethical Theories to Typical Problems (individual papers).

IV. Professional Codes of Ethics.
   A. The Meaning of "Professional".
   B. The Nature of Professional Codes.
   C. Application of Codes to Typical Problems (individual papers).

V. Ethical Evaluation of Professional Codes.
   A. The Use of Meta-ethical Criteria.
   B. Evaluation of Ethical Theories.
   C. Consistency of Codes with Ethical Theory (individual papers).

VI. Evaluation of Professional Codes and Societies.
   A. Possible Revisions of Ethical Codes.
   B. Possible Re-structuring of Professional Societies.

The above course outline could be adapted readily for a one-hour credit semester course for engineering students.

In a three-hour semester course, more specifically philosophical and literary sources should be used.

Introduction to Course and Curriculum Plans of Group 4

The members of group four addressed the problem of teaching engineering ethics in the context of curriculum planning. Their idea was to include more liberal arts in a kind of "Europeanizing" of the professional training of engineers. They suggested that philosophers participate as philosophers, considering philosophical concepts and theories, just as mathematicians enter in to teach mathematics. They submitted two different versions of their basic ideas.

Group 4: Curriculum Plan #1

A Professional Curriculum in Engineering

Paraphrasing Schott, it is obvious that more courses cannot be added to the four year curriculum common in engineering, without sacrifice of important material. In addition, a "course" is something any student can suffer and bear without learning anything, if the course is perceived as being imposed. Therefore, ethics similar to communications skills and other areas, may be introduced as a course, but more importantly must be a part of every course. We perceive more problems with the faculty than with the curriculum.

We propose a three part program to bring ethics, humanities, writing, speaking, and other disciplines into the engineering curriculum.

1. Engineering should admit students with three years of liberal studies with certain basic requirements which might be measured by entrance exam, course work, or a combination of the two, and two years of engineering, for a master's degree program in engineering. A pre-engineering faculty could design a curriculum to assure basic skills in science, a cohesive program in the humanities and social sciences, ethics, logic and philosophy, and speech.

2. The engineering faculty needs to be aware of and forced to use integrative, multidisciplinary, social, historical, legal and other perspectives in all courses taught. Since students would then have the background, it would not be necessary to teach spelling in order to require written answers or opinions.

3. A course in ethics with problems encountered in engineering proctice would be recommended in the pre-engineering segment.

Pre-engineering would include math, physics, chemistry, biological sciences, earth sciences, philosophy, ethics, and pre-engineering courses, which includes drawing and mechanics.

A possible additional part of the program would be a required senior seminar, possibly only one credit, which would integrate an engineering problem, speech, writing, ethics with social and environmental, political and economic considerations.

Group 4: Curriculum Plan and Course Plan #2

We can not accomplish professional aims of education in 4 years.
We presuppose an unified and enlightened faculty who will cooperate.

Therefore, we propose a 5 year master's degree program.

3 years of Pre-Engineering--

I. a)
1. Writing
2. Oral communication
3. Chemistry
4. History of engineering
5. Integration seminar

b)
1. Logic
2. Math
3. Physics
4. Biology
5. Integration seminar

II. a)
1. History
2. Literature
3. Mechanics
4. Math
5. Fine Arts

b)
1. History
2. Mechanics
3. Psychology
4. Economics
5. Mechanical drawing

III. a)
1. Earth science
2. Computer science
3. Management
4. Language

b)
1. Science option
2. Social science--government
3. Philosophy--Life--challenge to integration
4. Language

IV. & V: Specialized courses in engineering fields

N.B. All courses taught with the view of integrated engineering are planned in close conjunction with the school of engineering. The integration seminars are to teach how to inter-relate courses. Combining two courses each semester shows inter-relations.

Fifth year seminar--Technology and Ethical Problems--
Case studies bringing out
1) Personal value presuppositions
2) Organizational structures as affecting decisions
3) Reflecting on methodology of personal decisions

Introduction to Course Plan of Group 5

The members of group five explain the goals and methods of their course very clearly and effectively in their outline. In their oral presentation they stated that they assumed it is good for people to become self conscious and that it is good to enlarge the possibilities of action, not to constrain them. They thought it important to stimulate processes of reflection and self-scrutiny in students. Habits of mind in cognitive and affective areas should be affected. They stressed that these efforts should be backed by responsible scholarship although the interdisciplinary raft is not very substantial yet. In case study, they recommended successively revealing parts of cases and urging students to make judgments.

Group 5: Course Plan

Specifications for the Design of a Course, "Ethical Considerations in Engineering Practice"

Since each institution has its own peculiarities that will figure in a professor's final shaping of a course syllabus, we restricted ourselves to recommending desirable features and to forewarning of possible snags.

Desirable Features

A. Course Objectives/Areas of Learning

1. To introduce the student to the ethical dimensions of day-to-day engineering practice with emphasis on the actual (real) complexities of work situations.
2. To promote tolerance of others and the tendency to entertain others' ideas before judging them.
3. To learn and to exercise communication skills that attend moral reasoning and that facilitate moral persuasion.
   a. To understand channels of communication in complex situations.
   b. To reason responsibly.
   c. To recognize appropriate actions and alternatives within situations.
4. To help the student clarify his or her perception of personal and group values that affect ethical decision-making.
5. To acquaint the student with sources of help in resolving ethical dilemmas (societies, agencies, public media, educational institutions, legal remedies, clergy).

B. Methodology & Pedagogy

1. Level: we reasoned that the course might best serve sophomores and juniors, giving them some taste of complex engineering decision-making and initiating "moral reasoning" before senior-level design courses, thesis work, technology-assessment work, and other tasks that might benefit from an understanding of moral reasoning.
2. Insofar as possible, the class should include students from different major fields. There should be no prerequisites, other than standard freshman composition.
3. Responsibility: we believe that a team-teaching approach would be most effective, given the tendency of students to credit the professing of ethics by philosophers and the professing of actual engineering situations by engineering faculty. Since local policies may require single-professor responsibility for a course, use of guest lecturers could meet the goal of confronting students with differing professional points-of-view.
4. We believe the course should begin with study of a real case, both to capture students' interest and imagination and to confront them with the problems of values conflicts,thus establishing the need for moral theory. Seminar-style discussions, lectures on the history and processes of moral reasoning, role-playing, position papers, and debates could be used to keep each student fully engaged with the course. Students should be required to take a stand on a case and defend their view; they should also learn to critique their peers' positions responsibly. If possible, students might relate cooperative work experiences to their peers, or might seek out cases of Decision-making from recent graduates or other practicing engineers. Students should either produce their own "Codes of Ethics" or conduct a thorough analysis and critique of existing codes.

Possible Snags

A. We recognized that the course must be kept small if discussion is to involve each student personally (as it must to meet our objectives); head-counting administrators, F.T.E. problems, and the like must be considered.

B. Students should get appropriate credit for the course. We feel that something in the range of three hours of general education credit is reasonable, but local interpretation of ECPD guidelines appears to be highly variable and sometimes capricious. However, this accounting problem is resolved, the student should not have to make a sacrifice to take the course. We believe a strong case can be made both for the humanistic and the social sciences dimension of the course (personal growth and social interaction).

C. The instructor's first task in teaching tolerance will probably be in winning his or her colleagues' tolerance for the establishment of what some might consider a threatening course.

Introduction to Course Plans of Group 6

The members of this group produced a quantity of rich material. The informal seminar course they proposed is fully and intriguingly explained in their preamble and outlines (#1a and 1b). This group also submitted a plan for a more formal course (#2). The latter plan, in agreement with many of the other plans, emphasized starting with cases.

The working assumption behind plan #3 is that exercise in deliberative processes is a necessary condition of moral behavior. The plan allows for ground clearing in the beginning, for dealing with students' misconceptions. A controversial moral claim is introduced and students are asked whether they agree or disagree. Then the instructor provides considerations which undercut subjectivist or relativist positions. The instructor attempts to spell out the logic of moral discourse, showing that a singular moral judgment commits one to reasons which can be tested against Considered Moral Judgments.

Group 6: Course Plan #1a

Formal or Procedural Considerations; Engineering Ethics Undergraduate Seminar

Certain assumptions about ethics define the purpose of the course and dictate a range of procedures to be followed.

A. Teachers of engineering and philosophy have no special competence to determine what is, and is not, right and good.

B. There is good reason to believe that any number of mutually exclusive lifestyles might be equally moral. A particular set of value priorities, habits and dispositions are fundamental to a given lifestyle. It may be futile or even immoral to commend one lifestyle over another in a doctrinaire way.

Therefore-

A. The course will emphasize value exploration and skills, especially those skills necessary to identify, describe, analyze and argue about complex moral situations.

B. The students will be encouraged to direct the course, within limits, to those exercises and topics which they find helpful, important and interesting.

C. Since skills are developed by'doing',the course will be, to the highest degree possible, fully participatory.

How-

These are techniques which have been used in "business and occupational ethics" courses, including especially engineering ethics courses. We left out discussion of those techniques that flopped miserably.

1) Open the course with a questionaire; to preserve privacy,divide the questions into those for which you want student identification and those which are best answered anonomously.

- -if possible, collaborate with a sociologist, a psychologist, and a computer scientist in constructing the instrument.
- -the questionaire might include some or all of the following: value inventory; career expectations/fantasies; course topics and procedures; student interests; demographic, biographic and educational information.

2) Attend to the physical plant of the classroom. An ideal setup might be a room only slightly larger than necessary to hold the students, instructors, and walk-in clients-with movable tables and chairs to facilitate both small group and whole group discussions. For variety or special occasions we've held meetings at the student union, or had breakfast/lunch at a funky downtown cafe where one can get a week's allotment of starch and grease for under $1. These types of changes should be unanimously approved by class participants. Some have held one-meeting-a-week classes at their home with refreshments.

3) Discuss the appropriate role of student and teacher, onuses and bonuses of various grading policies. We believe it best to gear our contributions to the level of sophistication of the students and this level, with even minimal luck, will increase as the semester progresses. This might entail avoiding big words when possible, keeping razzle-dazzle arguments and monologues to a minimum, not always filling up silences, not alwasys speaking first and last. More positively we think the teacher might well keep discussions on the track (more or less), represent positions on a problem that are obviously missing, or strengthen a position that is weakly represented.

4) The students should decide, within limits, what types of projects they want to undertake. Possibilities--

a. several short discussion papers

b. essay exams--we ask the students to write 3 test questions and submit them. We select one from each student, put them into groups by type, and direct them to answer one question from 2 or more groups. This exercise is done on a take home basis.

c. interview with someone practicing in their field. A great in-class project is to work up a list of questions to choose from in the interviews. These are presented in class and followed by cross questioning. They can call someone on the watts line, combine with job interview etc.

d. in-class, small group discussions with a report to the whole class following. Type A: the groups are randomly selected; B: the groups are self-selected. In either case, the whole group gets the same grade.

e. the students do some low key research, finding the codes, writing to professional societies, corporations, regulatory agencies. One can ask for a book report, either from a bibliography or from a student hunt.

5) Miscellaneous considerations

a. if possible, cases, discussion of ethical theory and the particulars of argument skill will be integrated--much as they might be in actual deliberation.

b. if possible, cases should include normal engineering work along with cases involving extraordinary mistakes or heroism.

c. lobby for lots of money and unlimited faculty support. Money for tapes, videotapes, guest speakers, coffee money, co-teaching, released time. Faculty support is an essential element in giving the course credibility on campus, and it doesn't hurt on funding questions either.

d. preparation for this course involves more emphasis on a good night's sleep, eating your spinach and the like than on scholarly note taking etc.

Group 6: Course Plan #1b

Seminar Course Outline

Substance: The following four topical areas, in essentially the chronology given, are suggested for a seminar course (10-15 people) on technology and human values. Discussion leaders will consist of a member of the engineering faculty and a moral philosopher with interests in applied ethics. The purpose of the course is to provide a framework through which an engineering student may relate personal values to professional practice.

I. Personalities and Personal Value Systems:

The emphasis of this section is to raise issues to which a student can relate through his/her own situations or experiences. It often happens that engineering students have never been asked to organize and justify their own value systems. This portion of the course is viewed as a period of self-discovery and awareness of the other.

Specific suggestions might include administration of a personality test (there are several) or the writing of reflective papers which request a rigorous survey and justification for values which are held. Case studies can play a major role here but should be selected specifically to present individuals and situations with which the young engineer is likely to empathize. At this time one of the various engineering Codes of Ethics could also be included and subjected to a critical analysis. Comparison and contrast with individual personal values are invited.

II. Basic Concepts as an introduction to Moral Philosophy (led by a philosopher)

In this section, specific concepts or interests will be addressed and then illustrated with case studies. For example, the issue of justice could be examined in a case (or sincerity, truth, integrity, etc., or engineering professionalism). During these discussions it should be possible to demonstrate points of tangency with the greater body of knowledge of moral philosophy and philosophers.

III. Historical Aspects of Technology

An attempt to follow the threads of technology and science to their roots. There is an expanding reading list in the area of the history of technology which can be used--for example, the works of Edwin Layton, and Lynn White, Jr. Significant landmarks, particularly the marriage of science with technology, can be discussed. It is important to understand that whatever technology is viewed as today, it has undergone transitions.

In taking this historical approach, an interesting aspect to explore is the spiritual content of technology. The essays of Lynn White, Jr. are particularly well suited for this.

IV. Issues of Wider Interest for General Discussion

These issues could change with the times or circumstances. Suggestions are topics within the areas of energy and environment and the hope is for the group to use the skills and abilities developed during the previous portions of the course.

Group 6: Course Plan #2

Assumptions: Three quarter credit course--30 lectures available at 50 minutes each. Students--seniors only from engineering disciplines. Class size to be limited to 30 if at all possible.

Purpose: To present and discuss problems of professionalism including ethics that will be encountered in the professional practice of engineering.

Background: Questions of professionalism and ethics have been introduced at various points during the first three years of engineering education. This has been in a formal fashion in first year introduction to engineering courses and in more detail in the introductory courses to the various disciplines. It has been accomplished in an informal, random fashion by student professional organization speakers and in various technical classes. Few students have had a course in philosophy or ethics.

Methodology: Lecture, assigned readings, and discussion.

Course to be team taught with an engineer and a philosopher working together in all classes.
Films and visiting speakers from engineering practice will be used as appropriate.

Lectures 1 thru 6 Professionalism

a. concepts
b. development of engineering profession
c. education and continuing education
d. registration
e. professional societies

Lectures 7 thru 10 The Ethical Dilemma and Related Cases

a. values and their development
b. conflicting demands of society, profession, and personal desires.

Lectures 11 thru 15 Theories of Moral Philosophy

a. brief introduction to ethical concepts of Plato, the Stoics, Kant, Utilitarians, existentialists, theories of justice.

Lectures 16 thru 18 Engineers and Clients

a. Engineer in Private Practice
b. Engineer in Government
c. Engineer in Industry

Lectures 19 thru 21 Professionalism and Codes of Ethics

a. development
b. limitations
c. serving whose interests
d. possibilities for change

Lectures 22 thru 24 Public Safety and Whistle Blowing

a. case studies

Lectures 25 thru 27 Obligations to Employers, Clients, and Peers

a. case histories
b. guidelines to employment
c. conflicts of interests

Lecture 28 Enforcement and Alternatives

a. within professional society
b. ombudsman
c. other

Lectures 29 thru 30 Visiting speakers--at least 2, possibly 3 during term

Assignments to include as a minimum:

a. mid-term test
b. term paper final

c. essay for selected topic or topics
d. possibility of weekly or daily quiz on assigned reading

Group 6: Course Plan #3

Working Assumption: Awareness of and exercise in moral reflection is a necessary condition for moral behavior

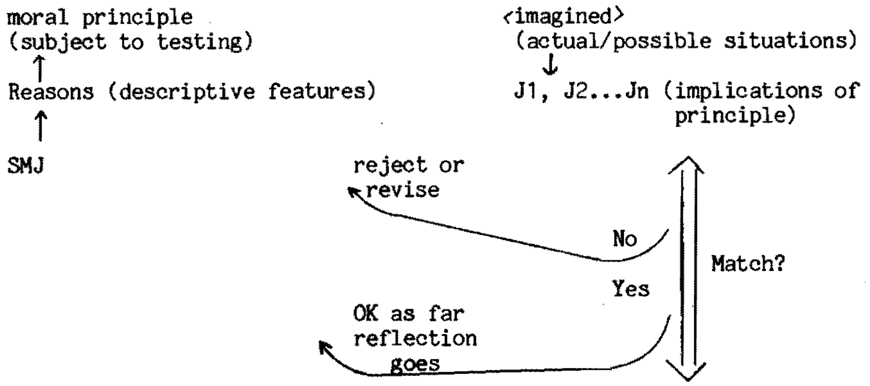
Curriculum (rough outline)

Semester: 2 1/2 hours, twice/week; 35-40 students, lecture/discussion; taught in evening so people in practice can attend under Department of Continuing Education

1. Ground clearing:
   --Introduce a moral claim; ask whether they agree or not, and reason(s) why.
   --Look for responses that suggest relativism or subjectivism.
   --Summation lecture: undercutting the grounds from relativism and subjectivism.

2. Logic of moral reasoning (lecture).
   "Supervenience": Conceptual relation between singular moral judgment, facts, moral principles (theories).
   E.g., A,B,C, in grading are assessment terms. Teacher is committed to cite facts about the case as reason for assessment.

3. Outline of decision prodedure:



Impartial judgment in imagined situation. → Considered Moral Judgments (e.g., one ought not inflict gratuitous pain)

4. Run a case through decision procedure:
   --Have students take a stand
   --Elicit reasons for their stand (e.g., it serves the best interest of self or family)
   --Formulate implicit principle (e.g., one morally ought to do A, doing A serves the best interest of self or family)
   --Construct a situation for testing (e.g., Jones' robbing you and getting away with it)
   --Implication of principle: (e.g., Jones morally ought to rob you)
   --How do we qualify? --ongoing process of qualifying

5. Case studies: (We don't introduce theories first; we identify moral theories as we go along)

   a. Run through cases as in (4); or
   b. Divide class into groups--and have them present "run-through" of cases
   d. Match developed principles with existing codes and laws

Requirements: 4-5 papers--(best three of five for grade). Assign cases not discussed: goal to apply decision procedure to cases and arrive at a tentative, but reflective principle.

Team taught: member of discipline in question provides consulting role, adds information regarding facts, working situation, etc.