The Engineer's Role in Public Policy

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Abstract

Engineers in industry are increasingly involved in compliance with laws and regulations. As our society becomes more technologically sophisticated, a growing number of engineers are also becoming involved in the processes for developing new public policies. Consequently, university engineering education should address the intent and significance of public policy as it relates to the practice of engineering.

The engineering department at McNeese State University recently created a new course entitled The Engineer's Role in Public Policy. This was an interdisciplinary course (involving students in the chemical engineering, civil engineering, electrical engineering, and mechanical engineering disciplines) that provided an opportunity for an interdisciplinary examination of current and future public policies.

This paper primarily focuses on the material covered by the new course and briefly addresses the teaching methods that were used. Much more could be said about the teaching methods, and the authors are considering developing a separate paper on this topic. While the initial offering of the course was very successful, the authors are currently seeking ways to improve upon the course and collaborate with other engineering faculty who have similar interests or relevant experience.

The new course identified issues of primary concern to engineers and trends toward international standards making and international forums for debate on environmental and safety issues. Case studies focused on business ethics, the clean air act, the clean water act, super fund legislation, the activities of the Intergovernmental Panel on Climate Change, electric and magnetic field effects, nuclear power, and deregulation/restructuring in major U.S. industries.

The new course allowed students to be involved in participative activities such as role playing as well as lectures. The importance of credible engineering analyses in public policy development was emphasized. Students used the web to critically review the position statements developed by engineering societies and trade associations. Issue management techniques were discussed, including communication with policy makers and the development of one-pagers. The course involved student participation in focus groups and discussed technologies for sampling public opinion.

Introduction

We live in an age of increasing political and technological sophistication. In the United States the political system has been profoundly influenced by educational advances, changing attitudes, and the impact of television and other media. Walter Cronkite, Marshall McLuhan and Alvin Toffler have discussed and documented the sweeping changes that have occurred in the political environment.

Beginning in the 1960's, and continuing to the present, an increasing number of U.S. citizens have became political activists. It has became commonplace for individuals with political agendas to demonstrate, to form special interest groups, and to develop funding warchests to influence issues. Today about 700 million dollars is spent each year for lobbying at the federal level. Almost every major industry and professional group has a presence in Washington and develops materials describing policy positions and legislative proposals. The effective interest groups have become masters of the seven second soundbyte, and employ highly educated teams of policy analysts to do extensive research, use focus groups, and craft messages with the proper "spin." To function in our modern society it has become necessary to understand the meaning and connotation of the terms shown here in quotation marks.

We not only live in an age of increasing political sophistication, we also live in an age of increasing technological sophistication. About thirty years ago Gordon E. Moore made the, at that time, startling prediction that the number of transistors per integrated circuit would double every two years. This prediction proved to be accurate and to this date technology change in many areas continues to be exponential.

The rapid changes in technology have helped society in many ways, but technological sophistication has also created new challenges and difficulties. There are societal implications associated with the introduction of new technologies. Like most of the people in our society, public policy makers have a limited understanding of the new technologies and/or the societal implications. Public policy makers are struggling to become sufficiently knowledgeable to address issues like cloning, the handling of the waste products from nuclear power plants, and prospect of possible global climate change.

What Do Engineers Do? Perception versus Reality

There are many definitions of engineering. Most of them suggest that engineers use mathematics, science, and analytical methods to design things or build things to make people's lives more comfortable or more productive. Many articles have been written about the popular perception that engineers are geeks, technonerds, or loners who have highly developed technical skills, but lack social skills. The popular perception (as illustrated in the Dilbert cartoons) is that engineers work alone, doing boring work in small offices surrounded by computers, and take a hygiene break about once a week whether they need it or not!

Of course, the popular perception as described here is very far from reality. The truth is that engineers increasingly work in teams. Engineers can not function effectively in isolation. It is critically important that engineers understand the business environment they work in and it is

essential that engineers understand the laws and regulations affecting their work. Because of their technological expertise many engineers are called upon to comment on the economic, environmental, safety, and health implications of corporate policies, and in some cases, engineers are asked to support efforts to influence public policy development.

Future Engineering Shortages: Quantitative and Qualitative

The popular perceptions about engineers discussed in the preceding section provide a certain amount of humor, but this is a very serious matter. It will be critically important that engineers make efforts to correct these false perceptions about engineers because the perception of what engineers do influences interest and enrollment in engineering. During the last two decades interest and enrollment in engineering has been declining. The following data from the National Science Foundation (NSF) makes this point:

U.S. Graduates in Engineering (B.S) by Year

1986……76,000
1990……74,000
1994……66,000
1998……60,000

A great deal of additional data on this subject is available on the NSF website. The diminishing supply of engineers is particularly concerning when the increasing technological sophistication of our society is taken into account. In other words, while the supply of engineers is sharply declining the demand for engineers is greatly increasing.

And, of course, we should not only be concerned about the quantity of engineers being produced, but also, we should be concerned about the quality of engineers being produced. The Accreditation Board for Engineering and Technology (ABET) and others are endeavoring to modify the engineering educational system to more effectively address the current functions of engineers. Specifically the ABET criteria for program outcomes require that engineering programs must demonstrate that their graduates have not only the ability to apply knowledge of mathematics, science, and engineering, but also have the ability to function on multi-disciplinary teams, understand professional and ethical responsibilities, communicate effectively, understand the impact of engineering solutions in a global and societal context, and have a knowledge of contemporary issues. Additional information about the ABET criteria is available on the ABET website.

Why Engineers Need Information about Public Policy

Unfortunately many engineering students have a very limited understanding of how public policies will affect their future work activities. Most engineering students have even less understanding about how public policies are developed and/or how they can influence the development of public policies.

Engineering work is increasingly influenced by laws and regulations. The failure to comply with environmental laws and safety regulations can sometimes cost a company much more than mediocre or ineffective engineering design work. And yet, most engineering programs in universities provide little information about public policy processes and how to interact with these processes. Some individual instructors make it a point to provide include information about public policy developments in their courses, but this information is often perceived by students as less important than the more technical, problem solving discussions.

Engineering involvement in public policy development is sadly lacking. Reference 12 in the bibliography section of this paper points out that not one single engineer serves on the Federal Energy Regulatory Commission (FERC) but FERC has been dramatically restructuring and revising the regulations affecting electricity supply and delivery in the electric power industry. Lacking competent experts, FERC has opted for input from committees of stakeholders to provide guidance in these very serious undertakings. Reference 12 raises the question, "Would doctors allow a committee of stakeholders to decide policies for the treatment of cancer?" Of course the answer is "no!" And engineers should similarly protest sweeping public policy changes that are not subject to intensive engineering analysis.

Why McNeese State University was well suited for this kind of course

Four engineering disciplines (Chemical, Civil, Electrical, and Mechanical) are integrated into a single engineering program at McNeese State University. Most of the students in the engineering program obtain a Bachelor of Science as a terminal degree and find employment in the petro-chemical industry or related industries in the immediate area. The engineering faculty, therefore, tries to provide training and education of practical value that will prepare graduates to perform effectively in the industrial business environment.

Industry in the Lake Charles area is significantly influenced by environmental and safety laws and regulations. All of the engineers employed in industry need an understanding of these laws and regulations. Those engineers who become senior level managers or senior level staff will also need to understand how to influence the development of laws and regulations.

Creating This Course

When this course was proposed, concerns were raised about possible duplication with courses offered in management and political science. To allay these concerns, the authors pointed out that this course would focus on the technical analysis required to provide support for policy positions, which is not covered in any of the existing courses. It was also pointed out that courses of this type are critically needed for the next generation of engineers because our society is becoming more technologically sophisticated and because the engineering profession is changing dramatically.

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Strategy For Selling This Course To Students

It was not difficult to convince students to enroll in this course. Most engineering students seek out those courses which will provide a broadening experience and make them more marketable in the job market. In explaining the value of the course to prospective students the instructor distributed copies of the articles listed in the bibliography and provided anecdotes from his experience in the public policy arena.

Elements of the Course

The course began with a discussion of terminology including the definition of public policy. The terms used in the Introduction Section of this paper were defined and discussed. It was noted that according to Webster's dictionary a policy is "a definite course of action selected from among alternatives and in light of given conditions to guide and determine present and future decisions." Corporations make *corporate policies*, and governments make *public policies.* It was explained that the primary focus of the course would be on public policies, but the students were asked to keep in mind that some of the techniques used to influence public policy development can also be used to influence corporate policy development.

Several articles were given to the students to clarify the purpose of this course. The substance of these articles is discussed earlier in this paper under the heading "Why Engineers Need Information about Public Policy." Public policy information sources were identified including the web sites of professional societies. Specifically it was pointed out that the AICHE has issued several position papers in just last two years including papers on the National Energy Policy, the Role of Nuclear Energy to Address Global Climate Change Issues, An Engineering Approach to Superfund Cleanups, and Greenhouse Gas Emissions. It was noted that the ASME has issued position statements on such areas as Global Climate Changes, Pre-College Science, Math, Engineering and, Technology (SMET), Research and Development, Energy Policy, and Standards Policy. Additionally recently issued ASCE issued papers on topics such as Infrastructure Financing, Smart Growth/Sustainable Development, Math and Science Education, and Clean Water Drinking Water, and Wastewater Issues were discussed. Students were asked to review IEEE position statements and policy communications in such diverse topics as the National Aviation Safety Program, Tort Law and Product Liability Reform, Information Security in Electric Power, Tax Incentives for Continuing Education and Training, Energy Efficiency, and Measures of Engineering Supply and Demand. Professional societies provide a medium for engineers to interact in public policy arena by volunteering for the committees that produce such paper and communications. Additional sources of information are the web sites of trade associations, the web site of the Washington Internships for Students of Engineering (WISE), the Federal Register and the Congressional Quarterly. Professional engineering ethics were related to public policy in the sense that engineers have an obligation to safeguard the overall public welfare by becoming involved in the public policy arena.

Categories of public policies and the stages of public policy development were discussed. It was explained that the primary emphasis for the course would be on distributive, regulatory, self-regulatory , and redistributive policies rather than on procedural or symbolic policies. Experiences with concerns about air pollution leading to the first Clean Air Act were related to the five stages of public policy development defined in the textbook (Public Policymaking – An Introduction, James E. Anderson, ISBN0-395-96104-1). It was noted that the primary focus of

this course would be on stages 2 and 3 (policy formulation and policy adoption) when technical support information is most critical.

One hour was devoted to a discussion of the codes and standards process because codes and standards are, in fact, public policies that affect engineering practice. It was explained that in the United States, unlike in most other countries, codes and standards have historically been developed using a voluntary (non-governmental) process administered by the American National Standards Institute (ANSI). The role of industry representatives in standards development was explained using anecdotes and case examples. The trend toward the globalization of markets and the increasingly important role of the International Standards Organization (ISO) and the International Electrotechnical Commission (IEC) was discussed. A brief history of IEEE standards activities and means for accessing current IEEE standards was also included.

An overview of the U.S. government's history, current structure, and responsibilities was provided. Video tapes from several sources were used to convey the sense of purpose and the principles of the founding fathers. The debate over the location of the nation's capital (ultimately in Washington, D.C.) was discussed as an example of how facts, objective information, and a political compromise process interacted to lead to a decision. The similar (tripartite) structure of federal, state, and local governments was discussed as a prelude to a discussion of state's rights and to provide a perspective on how regional differences enter into policy debates. Other topics discussed included the use of checks and balances, the characteristics of a democracy and a republic, the Bill of Rights and the Constitution, the role of the Supreme Court and other courts, the make-up of the Senate and the House of Representatives, the responsibilities of the Executive Branch in federal and state government, the process leading to the development of the federal government's budget and how a bill becomes a law.

A number of energy and environmental policy issues were discussed in detail. The global climate change issue was one of the subjects covered in some depth. After a discussion of the state of the science and a review of papers describing the concerns about possible environmental catastrophes and draconian economic impacts, the students were asked to draft short position statements and issue management strategies as if they were employed by General Motors or the Sierra Club. After the students had attempted to prepare these documents, the actual position statements and issue management strategies developed by General Motors and the Sierra Club were distributed as a basis for comparing and contrasting approaches. The instructor commented on his participation in meetings of the Intergovernmental Panel on Climate Change and the possible implications of the U.S. not agreeing to the approach established in Kyoto. The students were asked to find newspaper articles and web articles about the approach taken by the Administration in preparing for the Environmental Summit in South Africa.

The evolution of nuclear power in the United States was another one of the subjects covered in some depth. A U.S. government video tape advocating peace time uses of safe nuclear technology from the early 1950's provided a starting point for the discussion. Changes in the government's role, public perceptions, and electric utility industry economics over the last 50 years were discussed to illustrate how the nuclear power issue evolved. The accidents at Three Mile Island in Pennsylvania and Chernobyl in the former Soviet Union were discussed. The instructor was well qualified to discuss these locations having visited both sites. Materials were provided concerning the recent congressional debate which was resolved in favor of using Yucca Mountain as a site for nuclear waste storage.

The class enjoyed an exercise intended to show how industry and special interest groups respond to media events. During the semester one of the television networks showed a made-for-TV movie entitled "Atomic Twister." After watching the movie the students were asked to prepare a nuclear industry response in the form of a press release. After the students had attempted to prepare this document, the actual press release prepare by the Nuclear Energy Institute was distributed as a basis for comparing and contrasting approaches. The press release identified technical inaccuracies in the Atomic Twister movie, but also commended the film crew for providing certain factual information about the nuclear power industry.

The instructor provided information about the evolution and technical basis for electric power industry deregulation/restructuring issues using excerpts from a recently published book (Power System Operations and Electricity Markets, CRC Press, ISBN 0849308135). It was pointed out that while the press identifies Louisiana as a state that has not yet provided customer choice, Louisiana has been profoundly affected by competition involving non-utility generators and utility generation providers. A senior manager from the local electric utility company spoke to the class about these issues and provided data on future projections for power generation installations and transmission system requirements.

The students were asked to identify other current public policy issues and prepare issue briefs concerning these issues. Some of the subjects covered included the debate about government funding for high speed rail transportation and government efforts to prevent future accounting scandal situations similar to those involving Enron, WorldCom and other companies. C-Span tapes were shown covering hearings in the telecommunications industry and the software industry.

Other issues were introduced by exposing the class to C-Span and other television programs covering debates between candidates for the mid-term elections in 2002. The debate between Colorado candidates for the U.S. Senate -- Tom Strickland (Democrat) and Wayne Allard (Republican) was particularly interesting in terms of showing contrasting views on energy development and environmental protection.
The class particularly enjoyed the classes focusing on politics and the political system. Both national political trends and events and Louisiana's unique political tradition were discussed in some detail.

Video tapes obtained from the Wisconsin Lobbying Association were used to introduce the subject of lobbying and how lobbyists function. The students were asked to locate a web site listing all Louisiana lobbyists and another web site showing funds provided for lobbying at the national level. The instructor explained how trade associations apply the "four C's" in retaining lobbyist services and managing issues:

- o Identifying Critical Issues
- o Building Consensus
- o Developing Communications Plans
- o Coordinating with Allied Groups and Supporters

Some class time was spent in discussing ways to build credibility, sell ideas, and influence decisions. These skills are useful in influencing public policy but they are also useful who work in

almost any phase of business or industry.

The students were asked to make presentations and play the role of spokesperson for an industry in addressing an issue. Methods used to address both friendly audiences and audiences who are likely to oppose positions on issues. Video tapes of Walter Cronkite and Marshall McLuhan were used to describe the "hot and cold" styles of Richard Nixon and John Kennedy. A video tape of Alvin Toffler was used to explain how television and the coming information age are affecting politics, policy making, and working environment of engineers.

Teaching Methods

This course was intended to acquaint students with contemporary issues and processes for obtaining technical information about these issues. Guest speakers, 35 mm slide presentations, video tapes, audio tapes, web based presentations were used in addition to conventional, power point enabled lectures from the instructor. Students were asked to work individually, in teams of three members, and as a class on various projects. The instructor reminded the students that their unsupported opinions were much less valuable and credible than positions that could be supported by technical analyses and/or by showing that other individuals or other groups had developed similar positions.

This course was also intended to help students become sensitive to differing viewpoints and develop better communications skills. The students were asked to develop issue management strategies and exercise judgment in areas where facts and hard data were unavailable. Much more could be said about the teaching methods, and the authors are considering developing a separate paper on this topic.

Similar Courses In Other Universities

In a non-exhaustive search of the internet, ten degree programs were found that deal with the interaction of technologists/engineers and public policy. These include George Washington, Princeton, George Mason, Georgia Tech, Rutgers, Carneige Mellon, and MIT. All except Carneige Mellon only offer degrees at the graduate level. Carneige's program offers a second degree for engineering students that provides them with the knowledge to integrate technology and policy.

From the brief survey performed it has been determined that most engineering programs do not include a public policy related course as part of their curriculum. The course discussed here is significantly different from the courses described by the other universities. The authors intend to interact with faculty in other institutions to examine the similarities and differences of public policy related courses currently offerred or contemplated.

Conclusions

This paper provides a status report on the development of a course entitled "The Engineer's Role in Public Policy." The initial offering of the course was very successful in accomplishing the goal

of broadening the perspectives of students. Several of the students are now taking an interest in watching public policy programs on CNN or C-SPAN and some have expressed an interest in serving on the IEEE-USA Energy Policy Committee. One student even aspires to purse public service, either as a staff member in a regulatory agency or as an elected official!

In a paper of this length it was impossible to completely cover the breadth of this subject. There are many aspects to the engineer's role in public policy. Many of the public policy issues currently being debated in national and international forums have engineering and technology implications. Interested readers can obtain additional information about these issues and the processes for influencing these issues by contacting the engineering professional societies, the U.S. office of technology policy, and others identified in the bibliographical section of this paper.

The authors hope that this paper will be useful to engineering educators in other universities who are considering offering a similar course. It is the thesis of this paper that more efforts are needed to encourage engineers to become involved in public policy activities. Courses of this type are one means of accomplishing this objective. The authors would welcome suggestions on changes that should be made in this course.

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