2006-763: A SOPHOMORE-LEVEL ENGINEERING AND PUBLIC POLICY COURSE REQUIRED FOR B.A. ENGINEERING MAJORS AT LAFAYETTE COLLEGE

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A Sophomore-level Engineering and Public Policy Course Required for B.A. Engineering Majors at Lafayette College

Abstract

Lafayette College offers a sophomore-level *Introduction to Engineering and Public Policy* course (EP 251). The course is required for sophomores in Lafayette's general B.A. Engineering program, however it is a popular elective for other engineering majors. Most of the students in the B.A. Engineering program are either interested in engineering management careers, or are using the degree as a foundation for careers other than engineering. Because of the diverse student interests, the course is designed to allow the students to understand the pervasive role of government in the technical arena, and the need to use/manage technology within that context. The emphasis of the course material is on the federal level, however international, state, and local differences are included. This paper presents the curriculum for EP251 and discusses instructor observations about how well the course works for sophomore engineering students. The instructor is interested in feedback about the need for such a curriculum.

Introduction

Lafayette College offers a sophomore-level *Introduction to Engineering and Public Policy* course (EP 251). The course is required for sophomores in Lafayette's general B.A. Engineering program and is a popular elective for other engineering majors. Most of the students in the B.A. Engineering program are either interested in engineering management careers, or are using the degree as a foundation for careers other than engineering. Other majors that frequently take the course as an elective include students in geology, civil engineering, chemical engineering, and international affairs. Because of the diverse student interests, the course is designed to allow the students to understand the pervasive role of government in the technical arena, and the need to use/manage technology within that context. The emphasis of the course material is on the federal level, however international, state, and local differences are included. The desired student outcomes are as follows:

1) Students will know **why public policy is needed** in modern society, and in particular, why it is needed for technological issues.
2) Students will know what the **main organizations** are in the technical public policy arena.
3) Students will understand at a basic level what the **public policy process involves**, and how that relates to technological issues.
4) Students will understand at a basic level what the **policy analysis process** involves, and how that relates to technological issues.
5) Students will understand what it means to be a **policy analyst**.
6) Students will have an introductory level of knowledge of two popular **policy analysis tools**: cost benefit analysis, risk analysis.
7) Students will gain an appreciation for the complexities, uncertainties, and the role of the public/values/engineering ethics as they apply to decision-making for a **variety of technological policy issues**.
8) Students will practice verbal, written, graphical, and teamwork skills with special emphasis on the **verbal communication of technical information**.

Unfortunately, a text on engineering and public policy is not available. Therefore, the main resources used in the course include assigned chapters from a generic public policy text, *Public Policy: Politics, Analysis, and Alternatives,*[1] and a reader of current events known as *Taking Sides: Clashing Views on Controversial Issues in Science, Technology, and Society*[2]. In addition, there are several additional readings which are either provided by the instructor, or students are directed to the online copy of a journal article. The students are also required to find some readings on their own for the assigned projects to improve their information literacy skills as they relate to engineering public policy issues.

As a sophomore-level course at a liberal arts college, the emphasis is to introduce students to the theoretical aspects of engineering public policy without making the course professionally-oriented. At the same time, it is important to have students realize the many applications of such theory to current events. And, the instructor hopes that the course serves to motivate students to focus on particular technological areas, to consider public policy careers, or to become active in the policy-making of their communities. EP 251 is also an introductory course , therefore the instructor needs to ensure that all students have a common basis in US civics, understand the role that public policy has in the technology arena, and appreciate the various tools used to solve engineering policy problems. Broad exposure is more appropriate at a sophomore introductory level, while detailed treatment of this subject may be better managed in upper-level elective courses. Therefore, the course objectives are accomplished via a combination of theory, integrated case studies and examples based on current events, group projects and debates based on current events, a newspaper journal, and field trips. Each of these is described below in terms of the stated student outcomes for the course with attachments of relevant student handouts.

The Theory

The first expected student outcome is that students will know why public policy is needed in modern society, and in particular, why it is needed for technological issues. For this course, public policy is defined as the funding, procurement, and/or regulation that the government provides. The funding, procurement, and regulation is used to allocate public goods, distribute or redistribute wealth, stabilize against extremes, and provide growth for the future. [1]

The second expected outcome is that upon completing the course, students are expected to know the main organizations in the technical public policy arena. The science advisor, the Office of Science and Technology Policy (OSTP), and the National Science and Technology Council (NSTC) play a role at the executive level. Also, under the executive branch of government are the civilian mission agencies including National Aeronautics and Space Administration (NASA), Department of Transportation (DOT), the Environmental Protection Agency (EPA), National Science Foundation (NSF), etc., and the military mission agencies include the Department of Defense (DOD) branches, the Pentagon, Defense Advanced Research Projects Agency (DARPA), etc. Many non-governmental groups have an influence in the technical public policy arena including the American Association for the Advancement of Science (AAAS), think tanks, lobbyists, the private sector, universities, standard setting organizations, the National Academies, private foundations, and professional societies.

The third outcome is that students know what the public policy process involves and how the process relates to technological issues. The process begins with agenda setting. Once an issue reaches the agenda, policy is formulated or analyzed, adopted, implemented, and finally evaluated, changed, or terminated. [1] There are a variety of public policy models used to describe the overall public policy process including the Policy-Administration Dichotomy Model, the Coequal model, the Mix in Administration Model, and the Mix in Policy Model. [1] There are also a variety of descriptive policy models which explain how policy happens including Elite theory, Group theory, Institutionalism, Rational Choice theory, Political Systems theory, and the Policy Process model which is a combination of all of the theories. [1]

The fourth outcome is that students are expected to gain an understanding of what the policy analysis process involves and how it relates to technological issues. As stated in the students' text, public policy analysis is a systematic, objective, and institutionalized approach to improving the art of government in terms of selecting alternative courses of action. [1] There are several types of analysis tools, each of which is based on obtaining measurable evaluation results. Categories of evaluation measures include policy output, performance evaluation, policy outcomes, and feedback from those affected by the policy. [1] Students are also introduced to the types of policy analysis conducted including the differences between scientific, professional, and political levels of analysis.

Related to the fourth outcome, the fifth outcome involves helping students gain an understanding of what it means to be a policy analyst. Policy analysts formulate, implement, and evaluate public policy. They use policy analysis tools such as cost-benefit analysis and risk analysis to analyze public policy alternatives. Students acquire an introductory level knowledge of these two popular analysis tools while realizing that there are many such tools, each with its own limitations.

There are two exams and a final take-home exam. The two exams are not cumulative and primarily test the theory taught through the last class before the exam. The final exam involves critical public-policy analysis of a case study.

Case Studies, Homework, Examples, Field Trips, and a Newspaper Journal

The sixth outcome is achieved throughout the entire semester as students gain an appreciation for the complexities, uncertainties, and the role of the public, societal values and engineering ethics as they apply to decision-making for a variety of technological policy issues. This is primarily done via the case studies used to explain the theory including those on stem cell research, digital music downloading, human cloning, cell phones and driving, defense systems, space exploration, science research and development, fuel cells, hybrid and electric automobiles, and the urban environment. Some of the assigned homework assignments for 2005 are included in Appendix A.

One of the homework assignments not described in the appendix is a semester-long task. Students are required to maintain a newspaper journal over the course of the semester. The journal is organized according to the first seven student outcomes described above, in which students are expected to find two articles that illustrate each outcome. In addition to the articles,

students are required to provide a one-page discussion of how the articles demonstrate that student outcome. For example, the first student outcome says that students will know why public policy is needed as a result of taking EP 251; the students must find two articles that illustrate why public policy is needed and describe how those articles illustrates that point.

In addition, students are required to attend at least two field trips/events outside of the classroom including a local planning commission meeting, and a field trip to Washington D.C. to meet with decision makers involved in technology policy. The agenda for the 2004 trip to D.C. included visits at the EPA, Congressional Research Service (CRS), and with congressional staff members. There are also often relevant guest lectures on campus.

Group Projects and Debates

The last outcome relates to the student practice of their verbal, written, graphical, and teamwork skills with special emphasis on verbally communicating technical information. This is achieved through group projects, presentations, class debates, and peer reviews including a peer-review of videotaped presentations. To enhance the quality of these presentations and alleviate some student frustration, there is focused class time and peer review to explain the rudiments of verbal technical communication.

Typically, four issues are debated throughout the semester. In 2005, the class debated the following issues:

1) The USA should immediately adopt federal regulations to reduce this country's production of greenhouse gases to 1990 levels within the next decade;
2) The State of Pennsylvania should allocate funds for human embryonic stem cell research;
3) The Easton Area School District should require that Creationism (or Intelligent Design) and Evolution are taught as alternative theories; and
4) The US government should stop funding the space exploration program and allow private companies to provide those services.

Students are graded on the quantity and quality of all debate points, questions, and answers. In addition, students are expected to integrate theory from the course into the debate, demonstrate knowledge of the topic, and effectively communicate. The assigned sections in *Taking Sides: Clashing Views on Controversial Issues in Science, Technology, and Society*[2] provide some background for the debate topics, but students are expected to find additional arguments.

Each semester, there are two group projects each. The first project is based on a federal public policy where each student group represents a different stakeholder group and produces a 5-page written position piece for their assigned stakeholder group. The group projects that have been assigned for the last four years are presented in Appendix B.

Concluding Thoughts

An engineering and public policy course has been taught in various formats at Lafayette College for over two decades. The course will continue to be taught to meet the needs of B.A.

Engineering students. In addition, the course is well received by engineering and non engineering students and provides an environment to discuss the intellectual intersection of social sciences and engineering. It has been the instructor's experience that regardless of interest in a policy career, students are eager to discuss the implications of technology on society. The primary difficulties are the lack of a textbook in this area, and the constant need to keep abreast of rapidly changing engineering policy topics. It is also becoming more difficult to cover engineering public policy at anything other than the federal level because of the vast amount of information. And, it is important for the instructor to maintain a classroom environment that respects differing political perspectives, and in fact, highlights the many aspects other than politics that affect technology policy.

References

1. Kraft, M. and Furlong, S. (2004). Public Policy: Politics, Analysis, and Alternatives, CQ Press, Washington D.C.
2. Easton, Thomas A. (2005). Taking Sides: Clashing Views on Controversial Issues in Science, Technology, and Society, McGraw Hill, Connecticut.

Appendix A
Example Homework Assignments

EP 251: Assignment #1 (to be done individually)

1. Now that President Bush has won the election, name his top three **engineering public policy issues** for his last term in office. Limit your complete answer to 1 typed page. Include citations for source of information that should justify why you picked these issues.

2. Your city wants to contract out the provision of drinking water to a private firm. Limit your complete answer to 1 typed page.
   - ***a.*** Present a public policy argument for doing this. Note if your argument is based on politics, ethics, economics, other factors, or a combination.
   - ***b.*** Present a public policy argument against doing this. Note if your argument is based on politics, ethics, economics, other factors, or a combination.
   - ***c.*** What types of information would you need to have to make a decision on if this is "good public policy?" *Hint: indicators of market failure/success.*

3. Find one recent (last 6 months) advertisement for an engineering public policy job. Copy the ad and attach – the ad should include the job title, qualifications, job description, and employer.

EP 251: Assignment #2 (to be done individually)

1. Determine the following for the Transportation Bill known as the Safe, Accountable, Flexible and Efficient Transportation Equity Act or SAFETEA currently in the news:
   a. Who sponsored the original House bill (H.R. 3550)?
   b. Who sponsored the current version of the bill?
   c. What is the current status?
   d. How long has the bill been under consideration?
   e. Is this a new policy or is it a continuation of previous policy?
   f. What is the time period and budget for the latest version of the bill?
   g. What projects are included for Easton, PA in the current version of the bill? How much is budgeted?

2. Who are your Congress members – Senator and Representative (based on where your parents' home is located), what is his/her educational background? What committees are they on? Can you guess at a reason why they picked those committees?

EP 251: Assignment #3 (to be done individually)

1. Describe an example of an engineering, science, or technology policy issue in terms of each of the following theories. Use a different example for each of the theories. You need to briefly describe the policy and then describe how the theory explains how the policy became reality. The first is done for you. Please follow this example for b) thru e). No more than 1 page per theory.

a) Elite theory
b) Group theory

c) Institutionalism
d) Rational choice theory
e) Political systems theory

EP 251: Assignment #4 (to be done individually)

1. Pick one issue that you heard at the Planning Commission meeting (Wednesday October 5th - City Council Chambers, Easton City Hall, 1 South Third Street, 5th Floor beginning at 7:00 p.m.) – should be an issue that relates to a ***change in policy***. If you did not attend the Planning Commission meeting then you need to find a recent science/tech/eng policy for the City of Easton over the last three months – the Morning Call may be a source for information and you will need to attach the article(s).

   Answer the following questions in no more than one page following the writing guidelines:

   1. clearly summarize the public policy objective (note: make sure you focus on the actual public policy in place, or being proposed as opposed to a problem that may have resulted from such policy)
   2. what is the basis for the policy - and explain the rational for your answer e.g. public good, redistribution, etc.
   3. what characteristics made (or can make this) this an "institutional" policy
   4. what agenda-setting model best describes this issue ***and why*** – make sure to describe the main players and this should help you determine the model – this is the toughest part of the homework

EP 251: Assignment #5 (to be done individually)

1. Refer to the issue on the attached page for these questions – ***do not conduct additional research***. Assume that the original policy in Connecticut was to prohibit drivers from using hand-held cellphones while behind the wheel with fines of $100 for each incident. Assume the policy described in the handout is an example of a ***recent change to an existing policy***. Answer the following questions in no more than 2 pages:

   1. summarize the basic controversy in terms of the precautionary principle
   2. describe 4 evaluation measures (1 from each of the 4 types of evaluation measures) that could have been used to determine that a policy change was needed; categorize each evaluation measure by type
   3. based on the attached article, what factors (1 or more of the 7 in your notes) led to the changed policy – justify your answer
   4. what type of policy change (1 of 4 described in notes) does this example represent – justify

EP 251: Assignment #7

Define the fundamental issues posed by the article "African Food for Africa's Starving is Roadblocked in Congress". Organize according to following steps:

- Describe the problem
- Understand context of the problem

- Define magnitude of problem
- Determine what can be done

Please provide bulleted answers rather than paragraphs and limit this assignment to two typed pages.

EP 251: Assignment #9- Cost Benefit Analysis

- LANTA is considering a project to develop a light rail system that connects Easton, Bethlehem, and Allentown. The objective of the project for LANTA is "*to provide efficient transportation for the increasing population in the Lehigh Valley*".
- Answer the following:
  - Qualitatively in a table:
    - List at least one direct, indirect, tangible, intangible, and pecuniary ***cost AND benefit*** for the alternative listed above. Note in the table which category applies to each cost and each benefit: direct vs indirect, tangible vs intangible. ***You will be graded on how complete your analysis is***.
    - State one realistic way you could assign a monetary value for each of the benefits and costs identified above, and state the limitations of the method. You do not have to actually quantify any of the benefits/costs.
    - Please explain in the table so that I don't have to guess what you mean.
    - Please be comprehensive.
  - Assuming you could get the monetary values you want (for all costs and benefits), what other information would you like to have to complete a well-done cost-benefit analysis? Be specific in terms of this assignment.
  - Only consider the no action alternative (what applies) and this project.

Appendix B
Example Project Assignments

ENERGY POLICY: A CASE STUDY IN SETTING POLICY WHILE CONSIDERING TECHNOLOGY, SOCIAL, AND ECONOMIC PARAMETERS

OVERVIEW: According to your text, "energy policy is part environmental protection and part natural resources policy, but most analysts would probably agree that the United States has no real energy policy…Instead, individual and corporate decisions in the marketplace largely determine energy use with each sector of energy influenced to some extent by a variety of government subsidies and regulations"[1] One can argue that a federal energy policy is needed because of the impact energy prices have on the economy, the environmental impacts of energy choices, and the foreign policy issues associated with foreign oil dependence. On July 29th 2005, the US Congress passed the Domenici-Barton Energy Policy Act of 2005 – the first federal energy policy in at least a generation.

PROJECT OBJECTIVES: *Does the 2005 Energy Policy Act address the future needs of the USA?* A Congressional Subcommittee on Energy has convened a public hearing to discuss if the recently passed 2005 Energy Policy Act is sufficient for the next decade. A bill is not under consideration, but the Subcommittee hopes that the discussions from the hearing will help them decide if amendments are needed to the 2005 Act. Each group represents a different stakeholder in this very controversial discussion. Each group will present (10 minutes) its opinion on the following:

a) a critique of the 2005 Act focusing on any public policy issues (at the federal level) that still need to be addressed …you need to present a rationale for your conclusion
b) possible solutions (alternatives) and their pros and cons
c) your group's opinion as to the best solution(s) for the future (next decade) - each group should develop a set of evaluation criteria to prioritize the alternatives
d) a justification to the Subcommittee about why your criteria and your ordering are reasonable while considering the technical, social, and economic parameters

The group representing the Subcommittee will manage the meeting – call the various groups and make sure they adhere to the 10 minutes – and will question the stakeholder groups to get as much relevant information from them to formulate a decision on if public policy needs to change. This is a good case study for you to see how difficult public policy can be when dealing with a very controversial issue that affects many aspects of society.

REGULATING HEART TRANSPLANTS: A CASE STUDY IN SETTING POLICY WHILE CONSIDERING TECHNOLOGY, SOCIAL, ECONOMIC, AND ETHICAL PARAMETERS

OVERVIEW: Heart transplants using available human hearts are becoming an increasingly more common medical procedure. However, a heart transplant is an extremely expensive and complex procedure, and there are fewer organs available than needed – demand is much greater than

[1] Kraft, M.E, and S.R. Furlong, 2004. Public Policy: Politics, Analysis, and Alternatives, CQ Press: Washington D.C., p. 338.

supply. In the USA, about 5,000 people die each year waiting for organ transplants (not just hearts), almost 70,000 people are waiting for transplants, and about 20,000 organs are donated each year. The arguments to support heart transplants for one patient over another include issues of rejection, medical history, as well as a host of socio-economic, psychological, and other non-medical parameters.

PROJECT OBJECTIVES: In this project, your group (heart surgeons and other related medical professionals) is told by your *non profit hospital's* governing board to design a policy for accepting a heart transplant patient and placing that patient on the UNOS national waiting list for a heart donation. The hospital recently added a heart transplant center that is approved for Medicare. Your group must develop a set of selection criteria for your hospital that incorporates, but expands on, national criteria. You must demonstrate how the criteria would be applied to the case studies described below, and you must prioritize those cases that you decide are eligible for an organ. You must justify to the governing board why your criteria and your ordering are reasonable while considering the medical, social, economic, and ethical parameters of your policy, as well as the hospital's role as a public facility. This is a good case study for you to see how difficult public policy can be when dealing with what may be considered a "public good."

PRESCRIPTION DRUGS: A CASE STUDY IN SETTING POLICY WHILE CONSIDERING TECHNOLOGY, SOCIAL, ECONOMIC, AND ETHICAL PARAMETERS

OVERVIEW: According to your text, spending for prescription drugs tripled in the United States between 1990 and 2000, the USA is on of the few industrialized nations that does not have national health insurance, 14.6% of the US population had no health insurance in 2002, studies show that quality of life is different depending on if you have health insurance, Medicare exists to help senior citizens with basic health care needs but does not cover prescription drugs, and all health care costs continue to rise above inflation in the USA. These are just some of the issues related to the project topic. As your text states, prescription drugs "reflects the larger struggle over health care policy issues." Prescription drugs represent the benefits that technology provides for the improvement of health care and our overall quality of life. Even more benefits are expected as biotechnology matures. At the same time, prescription drugs are expensive and costs continue to rise as new technology develops. *Who should receive the benefits of such technology and what role should public policy have?*

PROJECT OBJECTIVES: A Congressional Subcommittee on Health care has convened a public hearing to discuss various options for public policy related to prescription drugs. A bill is not under consideration, but the Subcommittee hopes that the discussions from the hearing will help them decide if a bill is needed to change current public policy regarding prescription drugs. Each group represents a different stakeholder in this very controversial discussion. Each group will present (10 minutes) its opinion on the following:

e) the main problem and its cause
f) the possible solutions (alternatives) to the problem and their pros and cons
g) each group's opinion as the best solution(s) (each group should develop a set of evaluation criteria to help prioritize the alternatives).

h) a justification to the Subcommittee about why your criteria and your ordering are reasonable while considering the medical, social, economic, and ethical parameters

The group representing the Subcommittee will manage the meeting – call the various groups and make sure they adhere to the 10 minutes – and will question the stakeholder groups to get as much relevant information from them to formulate a decision on if public policy needs to change.

This is a good case study for you to see how difficult public policy can be when dealing with what *may* be considered a "public good" but there are limited resources to provide such a good.

REGULATING SATELLITE RADIO: A CASE STUDY IN SETTING PUBLIC POLICY WHERE NONE EXISTS

The number of complaints about indecency to the FCC rose from about 202,000 in 2003 to 986,000 in 2004. Some of this is attributed to the Janet Jackson episode. Top-ranked shock jock Howard Stern said Wednesday that he will abandon his syndicated morning radio show to join Sirius satellite radio in 15 months, freeing him from government regulators and allowing him to "bring my fans my show my way."

FROM THE FCC WEBSITE: The FCC issues broadcast licenses specifying the community of license, the channel, and operating power of the station. The conditions of the license ensure that the broadcast will be picked up without interference within a specified service area. *Generally, the FCC does not govern the selection of programming that is broadcast.* The main exceptions are: restrictions on indecent programming, limits on the number of commercials aired during children's programming, and rules involving candidates for public office.[2] It is a violation of federal law to broadcast obscene programming at any time. It is also a violation of federal law to broadcast indecent or profane programming during certain hours. Congress has given the Federal Communications Commission (FCC) the responsibility for administratively enforcing the law that governs these types of broadcasts. The Commission may revoke a station license, impose a monetary forfeiture, or issue a warning. [3] Similar rules apply to broadcast television. The prohibition is set forth at Title 18 United States Code, Section 1464 (18 U.S.C. § 1464). These rules do not apply to satellite radio and cable/satellite television.

PROJECT OBJECTIVE: *How should the FCC regulate Satellite radio for indecency?* Each group is to provide an objective public policy analysis of the issue. The public policy analysis must address the following:

i) the main problem, its cause, its effects
    a. need to use evaluation criteria to assess the current situation
    b. need to consider the various stakeholders and those affected
    c. need to consider not just indecency but also other relevant factors related to the broadcast industry

j) the possible solutions (alternatives) to the problem and their pros and cons; at a minimum:
    a. no regulation

[2] http://www.fcc.gov/cgb/radio.html
[3] http://www.fcc.gov/cgb/consumerfacts/obscene.html; http://www.fcc.gov/eb/broadcast/opi.html

   b. regulation identical to what exists for broadcast radio
   c. regulation different from what exists for broadcast radio

k) a recommendation based on application of evaluation criteria to prioritize the alternatives; the criteria should assess the impact each alternative will have on the problem (considering the various stakeholders); impacts should include direct, indirect, tangible, intangible

l) a justification about why your criteria and your ordering are reasonable
   a. regardless of your position, you need to make a strong argument as to why public policy is or is not needed in this situation

On the due date, each group should be prepared to explain its recommendation to the class and the reasons for that recommendation. Don't use power point; instead be prepared to discuss.

LAND USE PLANNING PROJECT

Lafayette College recently purchased several properties along Third Street. The College is considering various alternatives for the various land parcels. Since Lafayette College is always concerned about ***minimizing impacts to the wonderful campus environment***, the Board of Trustees has asked that all development use low-impact techniques. Your group has been asked to develop a conceptual alternative for two of the land parcels as shown in the attached figures. Land development planning begins with an investigation of pertinent land use policy. This project introduces you to typical local policy that affects engineering, however it also allows you to use your creative skills (and practice your graphical communication skills) as you develop the best alternative.