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Using the Web to Integrate Ethics in the Engineering Curriculum

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USING THE WEB TO INTEGRATE ETHICS IN THE ENGINEERING CURRICULUM

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Abstract *— With a crowded engineering curriculum, it's difficult to justify three credit hours for a new course in the comprehensive instruction in applied ethics. Partial coverage of ethics in undergraduate engineering seminars, or the "Introduction to Engineering" course also has obvious drawbacks. In contrast, a modular integration of ethics throughout the engineering curriculum, although it demands coordinated coverage and relevant links to many diverse computational courses, seems like a logical alternative. This paper will discuss a web-based module created to introduce the ethical perspective of Nietzschean perfectionism to engineering undergraduates in a junior-level, Civil Engineering course in Structural Analysis. I will also discuss the usability testing of this module, and plans for additional ethics modules to be integrated into other engineering courses at Boise State University.*

Index Terms — Engineering ethics, Nietzsche, theoretical ethics, web-based instruction.

THE PROBLEM OF INTEGRATING ETHICS INTO THE ENGINEERING CURRICULUM

The Accreditation Board for Engineering and Technology (ABET) features ethics as a prominent criterion in undergraduate engineering education. While often neglected in the past, concern for engineering ethics has been growing since the Depression, along with our sense that many *social* problems have *technological* roots. This sense is strengthened every time there is a widespread burden attributed to poor engineering. Yet it's always been critical for engineers to *understand* the ethical dilemmas encountered in engineering, and to *articulate* their values concerning those dilemmas using the established language of ethical thought. It remains critical for young engineers to see engineering as something deeply concerned with ethics—something human and humane. Without a background in theoretical ethics, ethical values will either be poorly understood or poorly expressed (or both). The cost associated with neglected ethics, in terms of human suffering, should be obvious.

Often, what passes for engineering ethics instruction, might more aptly be described as an introduction to engineering professional practice. In my own [1] humble opinion, the most salient deficiency in engineering ethics instruction is the lack of comprehensive theoretical grounding, tied to a developing student vision of engineering as an ultimately human (rather than mechanical) pursuit. As a consequence, I believe that engineering ethics instruction should support the integrated course goals

- to give students the sense of engineering as a *human* pursuit; and
- to give them the ability to articulate their developing ethical perspective in terms of the western standards of ethical thought.

Engineering education began to change significantly in the 1950's and 1960's, as more engineering topics gained the rigor of engineering science and were added to the curriculum. By the 1970's, the 4-year engineering curriculum had ballooned beyond reasonable limits. To make their programs more competitive, professors went through the painful process of dropping cherished topics. Engineering ethics, then, has to be added to a delicately packed and freshly sutured program.

One approach has been to cover ethics in engineering seminars, or as part of the "Fundamentals of Engineering" course for freshmen and sophomores. Unfortunately, time allotted to ethics in these *amalgam* courses is typically inadequate by itself, and too remote from the engineer's actual tenure in practice. A second approach has been to integrate the discussion of ethics into required computational courses. While this creates less strain on the engineering curriculum, such an approach demands that expertise in ethics be widely distributed within the faculty, and also requires a significant amount of coordination between the ethics materials taught by different instructors. However, the context provided by an integrated approach also appears to work better from the cognitive perspective of retention and transfer, by giving ethics a wider context.

Modularized materials would facilitate the incorporation of ethics into existing engineering courses. Modules of instruction that don't find a permanent home as components of departmentally required courses can be covered in seminars or as part of "fundamentals," or "capstone" courses. Making modules of ethics instruction web-based would facilitate both their integration into existing courses, and their accessibility as independent or asynchronously mastered topics.

Because of the variety of ways that engineering ethics might be taught, both in terms of limits on class time and alternate locations within the broader curriculum, course materials should be

- accessible (modular and self contained)

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- expandable (supplemented with additional "suggested" materials and exercises)
- relevant (with a single ethical theory tied to one or more of the diverse topics in a specific, required engineering course); and
- comprehensive (covering all of the fundamental ethical perspectives within the combined collection of integrated modules).

THE GENERAL SOLUTION OF A MODULAR, WEB-BASED FORMAT

I have outlined the content for 16 modules that I consider representative of a minimum, comprehensive coverage in engineering ethics. The titles of these 16 modules are listed in the "Plans for Additional Course Development" section at the end of this paper. Each of the modules will contain components similar to those outlined in the following subsections.

Biographical Sketch of a Prominent Engineer

The intent here is to show the human face of engineering—to relate these "high-profile" engineers to the ethical problems they encountered. I'm counting pretty heavily on the biographical sketches as a relevant link between the engineering content of the computational courses, the inherant *human* dimension of engineering science in these courses, and the ethical theory of the integrated module. In thinking about some of the modules that I want to develop, I've been gathering background material on Walter Chrysler, William Mulholland, Robert Moses and Buckminster Fuller. Werner Von Braun, Galileo Galilei, and Spiro Agnew also seem to naturally evoke ethical discussion. "Presidentially" involved engineers include Herbert Hoover, Jimmy Carter, Salvador Allende, and Yasir Arafat. I will probably also want to look at the lives of lesser known engineers like Fazlur Kahn, Ellen Richards, Leslie Groves, Grace Hopper, and Valery Fabrikant. Module Nine (discussed briefly in the next section, and the subject of the usability testing discussed in the subsequent section) introduces the life of Walter P. Chrysler as an engineer with a lasting impact on automotive design, the corporate structure of technology, and the use of engineering "marvels" to symbolize corporate power.

Generic Statement of the Ethical Problem Encountered

Once the dilemma is developed within the context of a biographical sketch, I want to restate the ethical problem in terms that might make the solutions easier to apply to other, more divergent ethical problems. Again, in Module Nine, the dilemma concerns the trade-off between social harmony and cultural efficacy.

Relevant Background in Theoretical Ethics

While ethical problems might always be approached from a variety of theoretical perspectives, the intent here is to use a single approach in each module. Those few engineering students who are currently exposed to theoretical ethics are usually given simple descriptions of the perspectives applied by Mills (utilitarianism) and Kant (duty ethics). This is inadequate. Engineering students need to understand both "act" and "rule" utilitarianism. They need to understand the *difference* between ethics based on duty and ethics based on rights. They need to understand perfectionism (both "virtue" ethics and cultural perfectionism). They should be acquainted with varying ideas on the social contract (to secure life, to secure liberty, to secure justice, or to secure participation). They need to understand rational versus intuitional approaches to ethics—stoicism versus the pleasure principle—the ethics of care versus obligations created by remote suffering. The core of the course will form around those ethical theories that I consider most crucial for the education of engineers. For example, Module Nine deals exclusively with the ideas of Friedrich Nietzsche concerning the value of perfectionism, which for Nietzsche involved the "overman" and the idea of overcoming the herd mentality of resentment toward those who are able to move toward a higher level of existence.

Reading in Theoretical Ethics

Ethical theories are developed by people working dynamically with other thinkers. Sometimes the writer's articulation of these theories becomes poignant to the point where the writings also serve a literary function (for example, the aphorisms of Heraclitus, Marcus Aurelius, or Nietzsche). While some philosophical writing is dense and nearly unintelligible, ethical theories need to be understood within the context of the writings where they are developed. To facilitate student interaction with ethical theory, three to six short (one to ten pages) relevant and relatively clear readings will be included on-line. These readings attempt to cover the breadth of ideas related to the particular ethical approach. Individual instructors may assign one or more of the on-line reading assignments, depending on time constraints. For example, Module Nine includes excerpts from: the second book of *Untimely Meditations*, *The Gay Science*, books one and four of *Thus Spoke Zarathustra*, *The Genealogy of Morals*, *The Will to Power*, and *Antichrist*.

Study Questions

Three to six study questions will be formulated for each of the on-line reading assignments. After the reading assignment is completed, these questions should be answered by the student in a few sentences or paragraphs and submitted to the instructor. The intent here is to encourage thought about the material and give opportunities for the student to develop cognitive schema *before* the classroom or on-line discussion. This is an independent exercise aimed at the comprehension, application and analysis levels of Bloom's taxonomy. In Module Nine, for example, the following study question might be appropriate

when referenced to the reading assignment from Nietzsche's *Untimely Meditations*:

- In the second Untimely Meditation, Nietzsche seems quite upset about Hartmann's concept of "world-process." From Nietzsche's writing, what do you think Hartmann considered world-process to be?

Classroom/On-line Discussion

The classroom/on-line discussion is designed as a group activity to augment the study questions, and to round out and correct any limited or erroneous cognitive associations. During this time students will have an opportunity to ask relevant questions concerning the theory, to see how others feel about the theory, and to deepen their appreciation for how the theory might be applied to different problems in engineering ethics. Because of their limited exposure to theoretical ethics, most engineering undergraduates are reluctant to comment in class, but feel less constrained on-line. However, the ambiguity of engineering ethics is often new to them and engineering undergraduates initially tend to identify their role as ethical engineers with unexamined goals to support their family and "protect and serve" society. While students should become more reflective with continued exposure to new modules, instruction should focus on two or three general questions. For example, in Module Nine, one of the discussion questions might be:

- *Why does society seem to prefer "leveling" legislation, while individuals seem to prefer legislation that helps them to realize their personal agenda? After all, aren't societies composed of individuals?*

Extended Readings

The extended reading list will contain annotated, bibliographic references to relevant reading assignments other than those included on-line. Most of these will be readings that were considered either too peripheral or a little too long to include on-line. As an example from Module Nine, no readings from *Beyond Good and Evil* will be included on-line. Yet, this is a pivotal work for Nietzsche, and so either chapter five "The Natural History of Morals," or chapter nine "What is Noble?" might be assigned to complement the on-line readings. The works listed in the annotated bibliography (like the selections from *Beyond Good and Evil*) should be found in most university libraries, and may be used more extensively to expand coverage, or (independently) where the student develops a particular interest in one approach, or in one writer.

Examination

The on-line examinations will consist of true/false, multiple-choice and short answer (two or three sentences) questions. To give the student a final chance to synthesis what has been learned, one final, more extended "long answer" question (two or three paragraphs) will also be included. The intent is to test the knowledge, comprehension and application levels of Bloom's taxonomy regarding the ethical theory developed in the module. Exam questions are keyed internally to specific reading assignments, and so the exam may be adjusted to reflect the readings that were actually assigned.

Feedback

The exams will be submitted electronically, and returned to the learner with electronically edited comments and a numerical grade (from zero to 100). In the event that a particular module is used by some instructor other than its developer, as when a module I have developed is integrated into an existing course taught by someone other than myself, the exams should be graded by whoever created the module. Grades might then be relayed to the instructor for use at his or her discretion. Study questions should be collected by the instructor as a way of enforcing the reading assignments, but also as an opportunity for less formal feedback.

Integration between Modules

While the modules are designed to stand alone, there are obvious connections between different theories that will be developed as the modules are studied, and there will be some internal references between modules. It should be assumed that modules, tied to existing courses through a specific engineering topic, are accessed randomly. As a consequence, they have not been designed to illustrate a chronological or conceptual development. However, the first module concerning virtue ethics might be the best place to start, all other things being equal, and modules considered logically prior to other modules might be assigned to lower-division courses.

Development of "The Engineer's Obligation to Cultural Progress"

Module Nine "The Engineer's Obligation to Cultural Progress: Nietzsche and Perfectionism" was developed and used at Boise State University during the fall and spring semesters of 2001-2002 academic year.

Learner Analysis

The Module Nine course materials were designed for engineering undergraduates in the last three years of instruction. These students have a limited background in the humanities; they typically opt to meet their humanities core requirements with broad, survey courses in the "appreciation" of art, music, or theater. Less than ten percent will have had previous coursework in philosophy. They will all have completed their freshman composition courses, and many of them will have taken the English 202 course in technical writing. However, few students will have experienced writing assignments in their *engineering* courses, and they may tend to downplay the importance of writing in their assimilation of the course content. In addition, engineering students tend to see the world dualistically, and often become impatient with the kind of

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ambiguity encountered in the discussion of engineering ethics.

Engineering students show a learner's preference for lecture and "chalk-and-talk" class sessions, with quantitative homework assignments. Nevertheless, I have been reasonably successful in getting some students to appreciate their writing assignments, by sharing edit revisions of both their, and my own work—explaining why their writing either works of fails, and how revisions make their meaning clearer and their prose cleaner. To do this successfully, I have to make them accountable for the quality of their writing.

After the 16 modules were outlined, Module Nine "The Engineer's Obligation to Cultural Progress: Nietzsche and Perfectionism" was tentatively selected as the first module to be developed. A survey of the students in my Structural Analysis class, who would participate in the usability testing (described in the next section) determined that my students in fact knew very little about the writings of Nietzsche. This was to be expected, but I wanted to be sure to start with a module that would be unfamiliar to my students. The survey indicated that their knowledge of Nietzsche was pretty much limited to name recognition, but also that they shared some of the misconceptions generated about Nietzsche during and after World War II.

Nearly all engineering students are familiar with the World Wide Web and various browsers, and many have enrolled in either web-based courses or courses with web-based components. Consequently, web-based instruction should not dampen the discursive and interactive elements of instruction so critical to absorbing ethical concepts. In addition, the flexibility of web-based course materials (particularly the on-line readings and discussion threads) should enhance critical reflection on ethical theory and its application in an engineering environment.

Assessment and Evaluation

Once all the course materials are in place, I will define course "success" as the exposure of all Boise State engineering undergraduates to each of the sixteen basic modules with a passing grade on each of the on-line module exams. A record will be kept of student examination scores for each module completed. While some instructors of "integrated" courses may choose to include these exam scores as part of their own course grades, I will also use student exam records to track possible gaps in instruction for individual students. With these records I might then suggest possible changes to improve course coverage (including the possible development of a stand-alone course in engineering ethics, or an increased content of theoretical ethics in the existing senior seminar, or senior capstone design course). In addition to the on-line testing (a level-2 evaluation, to use Kirkpatrick's taxonomy) I will also administer "student perception" evaluations (level-1 evaluations) to determine how students "feel" about the web-based ethics instruction, and will cap the module with a short focus group discussion.

Description of Sample (Module Nine)

The module begins with a biographical sketch of Walter Chrysler, leading to the ethical dilemma of how he might use the resources available to him. There is a discussion of his feelings about the symbiotic efficacy of the modern business corporation, and about his desire to build the "world's tallest" building. The biographical sketch leads into a discussion of the ethical dilemma of perfectionism: social perfection (where everyone lives harmoniously together) versus cultural perfectionis m (where individuals struggle for the advancement of humanity). The ethical theory of Friedrich Nietzsche is then introduced, along with a series of on-line readings from some of Nietzsche's major works. Each excerpt is accompanied by an overview and a series of study questions that require a written response. The students are then encouraged to participate in the on-line and in-class discussions. After the discussion on the module has closed, the students are required to take the on-line exam, which is graded and returned to the student.

Results of Usability Testing

I surveyed my Structural Analysis students early in the semester before writing the module on Nietzsche and perfectionism, to determine whether or not I would be exposing my students to new material. As it turned out, none of them had any exposure Nietzsche's work, and they had only the most rudimentary understanding of who Nietzsche was. However, the questionaire used to survey the students—perhaps simply the act of asking them questions about Nietzsche—seemed to peak their curiousity, and they showed much more interest in the ethics module (introduced during the last two weeks of instruction) then I had anticipated. Eighteen students participated in the ethics instruction. All of these students completed the module (completed the readings, turned in the study questions, participated in the on-line discussion threads, took the on-line exam, and participated in the assessment discussion held during the last regularly scheduled class period.

Although all of the reading materials were available as html files on the web, they were also available on the web as pdf files (either as individual files, as grouped files of readings, or as a single file containing all the reading assignments, study questions and the list of readings suggested for "further" study). A photocopy of the complete pdf file was made for each student, and they were given the option of reading the materials on-line or from the hardcopy. They were asked to mark the hardcopy, if it were used, to indicate any typos they discovered, and to mark words that they thought might be usefully included in a glossary of terms. These marked copies were reviewed, and became a prime source of information about how students approached the instructional materials.

The most obvious (and unanticipated) advantage of the hardcopy was its use by the students as a learning tool. There was ample evidence in the marginalia that students

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were working back and forth between the readings and study questions, and that this helped them to cognitively process the material. The marginal comments (and subsequent investment in mental effort) were much more extensive than they might have been if the readings had been from an assigned text that students might want to resale to the bookstore—and the fact that the hardcopy was considered "disposable" may also have helped. The pdf copy of the module was 54 pages long, and although it was easy enough to download and print, many of the students might have foregone a hardcopy if it had not been provided in class. I feel confident that the hardcopy enhanced the student's experience of Nietzsche, and therefore creates a dilemma: how do I provide on-line access to html files and still encourage students to access and print (and process) pdf files?

Additionally, marginal comments and the marked copies indicate that some of the students formed *ad hoc* study groups (perhaps just extensions of the groups they had already formed for the Structural Analysis course) to cover the material more collectively. This was apparent from the names of individual study group members penciled in the margins of less well-marked sections from the readings. *My* desire was for everyone to *read* Nietzsche and enjoy the passion of his prose. Parceled reading assignments weren't my intention. However, since the on-line exam was comprehensive, the study groups (to the extent that they were used) seemed to work well. Perhaps the *ad hoc* study groups were a reaction to the perceived length of the readings (there was a fair amount of reading). One reaction on my part might be to reduce the amount of required reading, or to place the module earlier in the semester. Alternately, the possibility of enhanced *ad hoc* study groups is certainly an overall positive, and it may justify the inclusion of lengthier (and more difficult) reading assignments.

My main interest (not having anticipated that marked copy would be such a "window" into the way the material was cognitively processed) was to have students identify terms that might usefully be included in a glossary. While I was thinking mainly of philosophical terms, Nietzsche often used phrases from other European languange, when he felt his native German to be inadequate. I was concerned that these phrases might also be an obstacle for my students.

Students recommended a smattering of philosophical terms to the proposed glossary (e.g. aphoristic, didactic, stoic) and also several foreign language terms (mostly Latin), but they also wanted to know more about some of the people Nietzsche mentions (such as Eduard von Hartmann). As a consequence, I developed a glossary in three parts: philosophical terms, foreign language terms, and biographical entries. However, to my surprize, many of the words that students wanted defined were simply vocabulary that they found unfamiliar. Often these were from *my* explanatory writing, and not from Nietzsche's work. For example, several students thought that I might helpfully include a definition of words like "juxtaposition," "dimunition," "intrepid," "posit," and "vehemence." This creates a dilemma for myself as a writer. First, I'm writing the material to be understood. What percentage of my students need to choke on a word before I simplify my language? But secondly, I want to convey the beauty and depth of the language used (particularly in a module on Nietzsche) and what I write is part of *my* creative signature. How much should I pare away for the sake of students who are unlikely to use a dictionary? A balance here seems difficult to achieve.

PLANS FOR ADDITIONAL COURSE DEVELOPMENT

The following modules have been scheduled for development:

1. Engineering and the Good: The Virtue Ethics of Socrates, Aristotle, Epicurus and MacIntyre
2. Engineering and the Social Contract I: Socrates and Honoring the Law
3. The Engineer and Deep Ecology: Epicurus and the Stoic Will
4. Engineering and the Social Contract II: Hobbes and the Absolute Sovereign
5. Engineering and the Categorical Imperative: Kant and the Kingdom of Ends
6. Engineering Intuition and Rationalism: Hume
7. Engineering and the Social Contract III: Locke and the Rights of Property
8. Engineering and the Useful: Mills and Utilitarianism
9. The Engineer's Obligation to Cultural Progress: Nietzsche and Perfectionism
10. Engineering and the Social Contract IV: Rousseau and Popular Sovereignty
11. Creating Dialogue with non-Engineers: Habermas and Discourse Ethics
12. Engineering and the Social Contract V: Rawls and Justice as Fairness
13. Engineering Decisions and Cognitive Dissonance: Spinoza
14. The Engineer's Obligation to Human Life: Thompson and the Ethics of Dying
15. Engineering Obligations to the Near and Remote: Noddings, Gilligan, and Care Ethics
16. The Engineer's Obligation toward Animals: Singer and the Ethical Life

Sequence of Course Topics and Delivery Schedule

As of this writing, the first module (Engineering and the Good: The Virtue Ethics of Socrates, Aristotle, Epicurus and MacIntyre) is being developed and scheduled for usability testing during the fall semester of 2002 with my Soil Mechanics class (consisting of 40 juniors and seniors). Since I plan to introduce the module with a discussion of William Mulholland and the Owen's Valley Aqueduct, it should blend well with the course content on hydraulics and

embankment design. I will develop Module II (Engineering and the Social Contract I: Socrates and Honoring the Law) for Statics, and Module Four (Engineering and the Social Contract II: Hobbes and the Absolute Sovereign) for the Strength of Materials courses during the year 2003. Module Three (The Engineer and Deep Ecology: Epicurus and the Stoic Will) would work well with the required course in Environmental Engineering. Module eight (Engineering and the Useful: Mills and Utilitarianism) might fit well with the course in Engineering Economics (which I've taught in the past, but am not scheduled to teach anytime in the near future). I will continue to use the ninth module (The Engineer's Obligation to Social Progress: Nietzsche and Perfectionism) with my course on Structural Analysis. Module twelve (Engineering and the Social Contract V Rawls and Justice as Fairness) would be important in any discussion of engineering professionalization, but the preceding four modules (modules two, four, seven and ten) that concern the social contract may seem logically prior and should probably be covered first. As a consequence, Module Twelve should probably be covered with the Senior Capstone course. Other modules might be seen to fit more logically with other classes once the point of entrance with biographical figures have been determined.

All sixteen basic modules would be covered over a three-year period in required engineering courses and seminars. This would average better than two-and-a-half modules per semester, but fewer modules would probably be used in the sophomore year and more during the senior year (when modules not otherwise integrated would be picked up by the senior seminar).

CONCLUSIONS

Engineers tend to become absorbed in the *engineering* of their projects. After all, most of their education and training focus on computations. In addition, the general problem-solving heuristic of breaking large, incomprehensible problems into small, comprehensible problems can obscure the "big picture." This presents three possible "performance" gaps for engineers. First, if engineers lack an understanding of engineering ethics, they will be that much more likely to ignore the ethical impact of their projects. A good example of this might be found in the work of Transportation Engineers from the 1950's, such as Robert Moses of New York, who planned & developed highways through the middle of towns and established neighborhoods, effectively cutting them in two. Second, if *pushed* on ethical issues that seem unfamiliar to them, engineers are likely to respond with some variant of ethical relativism. For example, if Los Angeles needs water to grow, Hydraulic Engineers like William Mulholland may feel justified in taking water from the Owens River that is currently "going to waste," severely limiting the economic future of those who settled in the Owens Valley. Finally, if engineers are *troubled* by an ethical dilemma, but are unable to articulate their perspective, they will be ignored as unconvincing. A good example of this is the Aeronautical Engineer Roger Boisjoly, who became concerned with the ethical problems of a cold-weather rocket launch, but failed to adequately articulate that concern to those who controlled the Challenger launch decision.

Engineers need to be able to recognize ethical dilemmas. Since they are often unaware of such dilemmas, engineers need help recognizing potential problems, and they need to be encouraged to stay with their ethical evaluations long enough to explain their concerns to others. Engineers need to be able to analyze ethical dilemmas from a number of perspectives, and they need to be able to articulate their solution to ethical dilemmas within the recognized theory of western thought (at least with engineering projects in the western world).

Our students will only care about ethics if we give ethics a reasonably prominent place in the curriculum. This isn't going to happen if ethics is dealt with as an ancillary part of a one-hour seminar (often viewed by students as a throwaway). Engineering ethics needs to be *incorporated* in the curriculum, rather than simply patched on. If ethics is treated as a regular 3-credit-hour course, students will at least see that the department considers it a worthy part of the curriculum. However, if we can integrate ethics into the majority of required engineering classes, then ethics might be correctly seen to have a kind of pervasive, *universal* significance.

The engineer's ethical deliberations need to become a meaningful, recognized part of his or her work. Teaching engineers to expend energy on ethical considerations is not as easy as teaching them to perform calculations, or even teaching them how to design. Engineering ethics has to be taught in the affective as well as the cognitive domains—teaching students to view engineering from other perspectives, and giving them access to a common language developed over three millennia of ethical reflection. This, of course, is just the beginning, and ethical engineering requires management and industry support as well. However, with more engineers *trained* in engineering ethics and able to articulate their beliefs and concerns, ethical dilemmas will become apparent much earlier in the engineering process, and will be both easier to resolve and much more difficult to ignore.

REFERENCES

[1] Haws, D. R. "Ethics Instruction in Engineering Education" *Journal of Engineering Education*, 90:2, April, 2001, pp. 223-229.