# Getting Started with Ethics

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## Introduction

Few would disagree that ethics is an intriguing subject, one that students should experience. Perhaps, we think, if engineering and technology students were more familiar with professional expectations regarding behavior, real-world outcomes would be more positive and some of the more spectacular failures—such as the recent bridge collapse in Genoa, Italy—would become relics of an unenlightened past.

However, as curious newbies enthusiastically dive in, they soon discover that the field is vast, as are available resources. This paper offers suggestions, from the perspective of what students really need to know as they begin their professional careers, for technical instructors new to the field of ethics, focusing on the following: resources, approaches, and case methodology.

## Context

While many colleges and universities offer ethics classes through specialized departments, this paper advocates an "ethics across the curriculum" (EAC) approach. Similar to the writing across the curriculum movement of years past, EAC proponents integrate the study of ethics into courses in the major, rather than farming it out to a philosophy department. As Cruz and Frey, University of Puerto Rico at Mayaguez, note, EAC is "a holistic and interdisciplinary approach to integrating ethical concerns throughout the university academic program."[1]

The underlying assumption is that students will more readily understand, and perhaps even appreciate, ethics material presented in a technical context. For example, learning about the design flaw that caused the Challenger disaster in a mechanical engineering/technology classroom differs from information imparted in a philosophy course, where the professor may not be intimately familiar with joint rotation and the effects of cold weather on O-rings.

An EAC approach not only contextualizes ethical content but also allows for vibrant class discussions in an already overcrowded technical curriculum, whereas adding a required course in ethics may not be a possibility due to credit limitations.

While many EAC resources are available on the Web, Illinois Institute of Technology's Center for the Study of Ethics in the Professions (ethics.iit.edu), an engineering ethics center, offers an enormous collection of materials, including examples of courses, class assignments, teaching methodology, and assessment. Due to NSF-sponsored workshops led by Michael Davis and Vivian Weil from 1991-2003, the center has collected many tried-and-true classroom materials, as workshop participants were required to submit final reports detailing their efforts on their home campuses. All are adaptable to various classes and are offered at no cost.

*Why Teach Ethics?*

Using an EAC approach does not mean relying on guest speakers to provide ethical content. Rather, technical instructors act as facilitators to accomplish what Michael Davis has identified as primary goals:

- Increased ethical sensitivity
- Increased knowledge of relevant standards of conduct
- Improved ethical judgment
- Improved ethical will-power (that is, a greater ability to act ethically when one wants to)[2]

For faculty, this means engaging in self-improvement, for teaching ethics is difficult if instructors know little about the field. Fortunately, even though ethics has a 2,500-year history, resources abound, as detailed throughout this paper.

*Why Study Ethics?*

ABET outcomes offer a pragmatic reason for learning (and teaching) ethics; as noted in Criterion 3(f) in the engineering program criteria, students should demonstrate "an understanding of professional and ethical responsibility."[3] ETAC criteria for four-year programs are similar; among numerous outcomes, Criterion 3(i) includes "an understanding of and a commitment to address professional and ethical responsibilities including a respect for diversity."[4]

Beyond practical concerns of addressing ABET or even FE exam requirements, there are more compelling reasons for studying ethics. As Michael Davis notes, ethics is inherent in engineering: "Knowing engineering ethics is as much a part of knowing how to engineer as knowing how to calculate stress or design a circuit is."[2] In that sense, every engineering decision is also an ethical decision, every design change involves ethical deliberation, and every engineering action has an ethical companion.

In fact, students studying engineering and engineering technology already have achieved a modicum of ethical reasoning courtesy of their technical curriculum. They are familiar with an ethical decision-making pathway due to the design process. They are familiar with alterative actions and the need to examine the viability of each. They are familiar with risk possibilities. What they are not familiar with is the language of philosophy. As an ancient field of study, philosophy has a rich technical vocabulary, one generally foreign to our students. But that deficit is easily overcome.

**Resources**

As noted above, resources related to engineering ethics are depressingly vast. A simple Google search of the term yields more than half a billion sources, unsearchable in multiple lifetimes. Even narrowing the search to just one event, such as the Challenger disaster, yields five million sites, including some ethically questionable photos of astronauts' *in situ* remains. In addition,

thousands of traditional books and articles detailing various aspects of engineering ethics exist for the curious scholar to peruse. The net effect is overwhelming.

Technical instructors, however, do not need to be intimately familiar with all ethical theories, historical trends, cases, and eminent philosophers. In fact, to adequately prepare their students for professional life, a limited number of items are relevant. Gleaned from this author's 20 years of experience teaching ethics, the following are most relevant for engineering and technology students.

*Theories*

Three theories, in particular, are most appropriate for an analysis of questionable engineering situations: deontology, consequentialism, and utilitarianism. Deontology and consequentialism (or teleology) offer contrasting approaches to an ethics situation. "The ends justify the means" is a consequentialist statement, with the focus on product (ends). Deontology, however, focuses on the process (means) to the ends. The distinction is crucial in ethical analysis. Utilitarianism, or making a decision that yields "the greatest good for the greatest number," was first articulated by Jeremy Bentham in the 18th century and later expanded by Victorian ethicist John Stuart Mill. For instructors unfamiliar with moral philosophy, the *Internet Encyclopedia of Philosophy* (www.iep.utm.edu), with entries contributed by more than 300 doctoral-level ethics scholars, offers easily digestible information on a host of ethics-related topics, conveniently alphabetized.[5]

*Issues*

While any ethical situation evidences numerous ethical issues, the technical nature of engineering work makes the following most applicable for students.

*Whistleblowing*. This action occurs when a current or former employee reports wrong-doing to an outside entity, such as a media outlet or an appropriate government agency. Students are particularly interested in this topic when applied to cases such as Challenger (whistleblowing before a Congressional investigatory committee), Karen Silkwood (whistleblowing to a newspaper), various pharmaceutical companies (whistleblowing to government agencies).

*Impacts of Technology*. The dizzying pace of technological development is attended by a whole host of ethics concerns. In addition to the obvious issues in the computer industry, such as hacking or identity theft, unintended consequences may cause anxiety or apprehension. Security concerns, for example, have spawned a new industry of protection, along with previously unconsidered workplace impacts. As reporter Jonathan Listner has suggested, "Technology moves at a pace that can easily outruns ethical standards surrounding its use."[6] Instructors interested in this topic should consult Langdon Winner's *The Whale and the Reactor*, a very thoughtful, compelling rumination on technology and society.[7]

*Moral Responsibility*. This attribute relates to either an individual or a corporate explicit assumption of accountability for a given action. For example, one of the most famous ethics cases in structural engineering is the 1981 collapse of the Hyatt Regency walkways in Kansas City, when more than 100 people were crushed by tons of cascading concrete. Engineer of

record, Jack Gillum, commented in an interview decades after the disaster, "Responsibility and ethics go hand in hand. All engineers or engineering candidates must learn the enormous responsibility they assume to earn the right to be called Engineer of Record or Engineer in Responsible Charge."[8] While the cause of the tragedy was attributed to a design change emanating from the steel manufacturer, Havens Steel Company, the event changed the course of Gillum's life and haunted his post-disaster actions. John Ladd, Brown University, has written extensively on the issue of moral responsibility and serves as an important resource.[9]

*Macro and Microethics*. Distinguishing between these two subjects may help instructors organize the ethical content of a technical course. According to Herkert et al., microethics are associated with the actions of individual engineers.[10] Macroethics, as the name suggests, involve larger considerations, such as the "inherent (and unavoidable) impact on society."[11] For instructors using the case method (detailed below), choice of an approach dictates case selection.

Or instructors may choose a hybrid approach, as some cases encompass both. For example, the 1928 St. Francis Dam collapse illustrates microethical concerns related to self-made engineer William Mulholland, as well as macroethical considerations regarding dam construction in deep valleys without appropriate soil testing or geological investigation for evidence of paleo-earthquake/landslide activity, and rerouting water from the Owens Valley in northern California to benefit the rapid expansion of Los Angeles and environs. This case led to important outcomes: registration of engineers, Proctor soil compaction test requirements, and mandatory geological exploration.[12]

*Safety*. If students assimilate only one thing from ethical material in a technical class, it is that safety is their primary professional obligation. In all engineering codes of ethics, it is the first fundamental canon: "Hold paramount the safety, health, and welfare of the public."[13] Especially as entering freshmen, many engineering and technology students are simply interested in designing, building, and tinkering with physical objects without regard for use and impact. However, since we live in a technological cocoon of sorts, the fruits of engineering ingenuity affect us all, every hour of every day, in multiple venues;[14] technology defines who we are and how we live. Since engineers and technologists create that technology, recognition that their primary professional obligation is enhancing and maintaining safety standards is essential. While many resources are available, instructors new to ethics may find Vesilind and Gunn's student-oriented *Hold Paramount* (2015) to be of particular interest. This slim volume offers multiple scenarios, suitable for classroom usage, associated with an engineer's duty of safeguarding the public.[15]

*Sustainability*. Statements regarding sustainability are the most recent additions to engineering ethics codes. The ASCE, for example, added an essential phrase to the first fundamental canon in 2009: "strive to comply with the principles of sustainable development in the performance of their professional duties,"[16] representing a distinct departure from the prior "rape and pillage" mentality of land developers or the planned obsolescence built into electronic gadgetry, which has spawned mountains of electronic waste. Again, numerous resources are available on this very contemporary topic, including a number located on university websites. Vanderbilt's Center for Teaching, for example, includes a wealth of information on sustainability and teaching tips, along with links to other sources.[17]

*Concepts*

In addition to the items explained above, some overall concepts are helpful to orient instructors new to ethics.

*Do No Harm.* As the prime directive of ethics, all professionals should refrain from actions that result in harm of any type: physical, psychological, financial, legal. Initially associated with medicine and erroneously ascribed to the Hippocratic Oath, *primum non nocere* came into widespread usage in the early 20th century[18] and has served as a guide for professional practice in any area related to the public good. Engineering codes capture this concept in Fundamental Canon #1, and public safety is at the forefront of a designer's mind, especially those working with structures and consumer products.

It is important to note, however, that changing times and fluctuating social/political mores may redefine what constitutes "harm." During World War II, German engineering firms designed items that would be unconscionable now: IG Farben (Zyklon B), Topf und Soehne (crematoria), Krupp (military machinery and armaments), and Siemens (electrical components), among the most prominent. All was accomplished in the name of the public good (that is, Aryan public good). More disturbingly, notable American firms were also involved: Ford Motor Company, IBM, Bayer, to name but a few. Instructors interested in this aspect of engineering ethics should consult Eric Katz's excellent anthology, *Death by Design*.[19]

*Moral Imagination.* This is an extremely important concept related to the varied "realities" of an ethical situation. Coined by Pat Werhane of the Darden School of Business, the term "moral imagination" refers to an ability to examine a situation from multiple points of view. An automobile accident, for example, may involve several people: the person(s) who caused the crash, the person(s) in the other vehicle, bystanders, perhaps even nearby law enforcement. Authorities attempting to reconstruct the incident must take into consideration the observations of participants and bystanders, each of whom "saw" something slightly different and each taking on different social roles, according to their proximity to the incident and as defined by an overall "framing narrative" that allows us to organize perception.[20]

Werhane and Moriarty use the example of Dennis Gioia, Ford Motor Company recall coordinator in the 1970s. Despite complaints from Ford Pinto owners and a number of deaths, Gioia did not issue a recall notice for the vehicles; he had morally blinded himself to the ethical issues, he said, "mainly because they did not fit an existing script."[20] Had he been aware of his myopia, he might have concluded differently. Overall, note Werhane and Moriarty, "Moral imagination enables one to assess a situation, evaluate the present and new possibilities, and create decisions that are not narrowly embedded in a restricted context or confined by a certain point of view."[20]

*Professionalism.* Ask students what a professional is, and they will probably respond that it's a person who has a steady job and makes a living wage. In addition, they may suggest, professionals dress nicely, can speak well, get to work on time, and reliably do their jobs. In ethics, however, "professional" has a very different meaning, and "professional ethics" is a specific field, distinct from ordinary morality.[2]

According to the literature, professionals display certain primary traits: Michael Bayles mentions extensive training (including advanced degrees), a "significant intellectual component," and an obligation to provide a service to society;[21] for John Kultgen, professionalism involves an responsibility to repay society, a sense of altruism reinforced by offering service in the public arena, including *pro bono* work.[22] Continuing education is also an essential characteristic, as is autonomy in practice and a duty to support intellectual activity via professional organizations, publications, and conferences.[23] Joan Callahan best summarizes professionalism when she equates it to a "calling,"[24] a deep, lifelong, passionate commitment that emanates from an "intrinsic motivation."[25]

## Approaches

As one of the ancient fields of study, ethics includes many approaches to analyzing moral quandaries have been developed over the centuries. Those explained below indicate major approaches, which may or may not prove successful in an integrated environment.

### *Moral Theory*

Typically, a stand-alone ethics course offered through a philosophy department involves students learning about moral theories and then applying them to the cases being examined. However, as Lawlor notes, this approach "could lead to a particularly crude form of relativism, where students take the answers to ethical questions to be relative to moral theories, such that they think the idea is to pick a moral theory and then simply follow it to its conclusions."[26] Viewing ethical decisions as relativistic is a common response, especially from students new to the field. If anything, however, moral theories contribute to ethical deliberation by providing a common standard for judgment and consistency in decision making.

### *Principles*

Ethical principles provide an underlying framework for analyzing ethical situations. Introduced in 1979 by Beauchamp and Childress as a way of resolving biomedical problems, the four original principles of autonomy (self-governance in matters relating to an individual including respect for persons), beneficence (doing good), justice (maintaining equity), and non-maleficence (avoiding harm)[27] apply equally to other professional fields.

In engineering, several additional principles are useful in ethical deliberation, especially in cases involving whistleblowing or corporate ethics:

- Disclosure: revealing confidential or proprietary information
- Fidelity: adhering to agreements
- Truth-telling: avoiding lying and misleading statements

Since engineers typically work for organizations, disclosure assumes an importance, as does autonomy. In whistleblowing situations, for example, whistleblowers typically release proprietary documents, thus disclosing essential materials that substantiate allegations of wrong-doing. In the 1970s, Karen Silkwood, a technician and union activist at Kerr-McGee's Cimarron

Fuel Fabrication Site near Crescent, Oklahoma, collected documentation to illustrate the assembly of faulty fuel rods for the Hanford breeder reactors, the absence of some 40 pounds of plutonium pellets, and lax health and safety safeguards for plant workers. For her efforts, she was deliberately contaminated with plutonium[28] and killed on her way to meet with a *New York Times* reporter. Silkwood's car was run off the road and into a concrete culvert. When the car was discovered later that evening, Silkwood was dead and the documentation missing.[29] The Silkwood case is a stunning example of violations of the principles mentioned above.

*Professional Codes*

According to Michael Davis, introducing ethics with a discussion of professional codes is appropriate, especially in lower-division courses.[2] In fact, Davis suggests holding students accountable for the class behavior according to the codes, to help students internalize their professional obligations.

Familiarity, however, is not enough. Deborah Johnson, University of Virginia, explains that interpretation and application are also necessary skills. She recommends a four-fold approach:

- Knowledge (of codes and standards)
- Skill (the ability to identify ethical issues)
- Reasoning (the ability to make moral decisions)
- Motivation (the will to take action) [30]

Students also need to understand a professional code does not provide a roadmap for action (with notable exceptions, such as the American Medical Association) but rather focuses on advice and guidelines. Indeed, when I ask my students what they think about their codes, the typical answer is "vague" or "short"; they expected more detail and specific guidance about what to do in a given situation. Sharing ethicist Caroline Whitback's comments is helpful, "codes embody the profession's accumulated wisdom about its practice, the morally significant problems that arise, and appropriate limits, priorities, and prudent measure for avoiding potential moral pitfalls."[31] Rather than a specific roadmap, they are more like helpful hints.

**Case Methodology**

Of all the methods for teaching applied ethics, case studies have enjoyed great success, especially when integrated into technical courses.[32] Cases have a rich history, dating to the ancient Greeks, initial Christian parables, and early Chinese philosophers, such as Confucius; all depended on short narratives with a moral message that required mental deliberation to uncover.[33, 34] The narrative element is seductive, as humans are naturally drawn to stories as a way to discern meaning. As Jonathan Gottschall, author of *The Storytelling Animal*, explains, "Humans live in a storm of stories. We live in stories all day long, and dream in stories all night long. We communicate through stories and learn from them. We collapse gratefully into stories after a long day at work. Without personal life stories to organize our experience, our own lives would lack coherence and meaning."[35] Stories provide structure, add borders to raw experience, and help us recognize significance. In the classroom, stories—cases—can dramatically affect how students learn and add an emotional element to what some assume is a dry, perhaps irrelevant, subject.

In 19th century America, Christopher Columbus Langdell, dean of the Harvard Law School, introduced cases into law classes, which constituted a "pedagogical coup" (p. 307) compared to the ponderous lecture and textbook methods then in vogue. The former was compared to "pump[ing] laboriously into sieves. The water may be wholesome but it runs through" (p. 318). Even though the case method, which has become the cornerstone of legal education, had and has its detractors, its chief benefit is teaching students to "think like lawyers" (p. 325), focusing on reasoning rather than rote memorization and recitation.[36]

While cases remain a staple in legal education, they have filtered into other academic fields as well: business, medicine, ethics, engineering. As a teaching methodology, cases present a number of advantages compared to the standard lecture method, including

- Actively engaging for students, rather than passive listening[37]
- Learning from the experience of others[38]
- Exercising the moral imagination by examining a problem from multiple perspectives[39]
- Developing analytical skills[40]

Cases exhibit an impressive variety: some are short and simple while others are long and complex; some are hypothetical while others are real; some focus on one area while others are multidisciplinary; and some have one obvious answer while others invite a variety of responses.

A course will typically dictate which cases are most appropriate. However, this seasoned ethics instructor recommends some guidelines:

- Choose a case that meets course objectives. Otherwise, students might be confused about the purpose of including it.
- Consider time. Planning to examine a large case, such as the Chernobyl disaster, in one class period is fanciful. Big cases require more time, both for initial information and analysis.
- Use real cases or those based on real incidents. "Real" ethics is messy; confected scenarios in textbooks generally lack complexity and may focus on one "right" answer.
- Research the case. Know detailed information and consider ethical perspectives.
- Have students work in groups. This technique will help to develop their moral imaginations and allow them to learn from their peers.
- Allow students to guide the discussion. For chatty instructors, this may be difficult but letting go of power helps students to "own" the ethics information.

 As with any topic associated with ethics, resources abound. The following websites, however, offer engineering-oriented cases that are very useful for class. All are real cases, and many include discussions of code violations.

*National Society of Professional Engineers*

The NSPE's Board of Ethical Review consists of "a panel of engineering ethics experts that has served as the profession's guide through ethical dilemmas."[41] Members and non-members alike can access hundreds of cases the BER has considered, dating to 1961. Cases range from technical problems encountered on the job to political involvement; each includes an

anonymized description of the case, questions arising from the case, applicable code provisions, and board discussion notes. Since these cases are very specific and narrow, they are ideal for class discussion, especially for instructors with limited time.

*Murdough Center for Engineering Professionalism*

Located at Texas Tech University, the Murdough Center has a wealth of ethics resources, including 42 ethics cases. The first 28 are from the "Ethics Case of the Month" series produced by Ron Bucknam at the University of Washington; the rest were developed by the Applied Ethics in Professional Practice Program of the National Institute for Engineering Ethics.[42] All cases are downloadable in Word, based on real-world scenarios, and include a description of the case (with appropriate documentation, if necessary), alternate approaches, and comments from the original forum participants and the Board of Review members.

In addition to cases, the site includes films, professional development opportunities, a resource guide, and an NIEE reference book, *Engineering Ethics—Concepts, Viewpoints, Cases and Codes*.

*Online Ethics Center*

OEC is a virtual ethics center sponsored by the National Academies of Science, Medicine, and Engineering. While it is not a dedicated engineering ethics center, its 575-case collection compiles a number of engineering cases from a variety of sources, subject indexed. In addition to cases, the site includes bibliographies, teaching materials, assessment guidelines, multimedia resources, videos, workshop materials, original research—in short, the OEC is comprehensive in science, mathematics, and engineering ethics areas.[43]

*Center for the Study of Ethics in the Professions*

While CSEP at Illinois Institute of Technology serves as a major repository for ethics across the curriculum materials, it also includes a sizable engineering ethics collection, including cases collected from various sources, links to ethics centers and university websites, and journals. CSEP also has an ethics library with dozens of valuable sources, as well as a subject-indexed collection of bibliographies. [44]

A major contribution is the center's collection of professional codes. The engineering section boasts 77 different codes, with some international statements as well as domestic. Interestingly, the collection includes different versions of some codes; for example, the NSPE entry has 30 different versions of the code, dating to 1946. An illuminating class exercise could involve students comparing older versions of the code with the most current and linking changes to social conditions or comparing a US code with an international one.

*Other Sources*

The sites listed above are ethics centers; other sites are available for research and preparation, including those of professional societies. IEEE, for example, publishes *Technology and Society*,

which examines the impacts of technology on society and frequently includes articles on ethics.[45] ASME has a link to a short book, *A Guide to Teachers of Engineering Ethics*, available through its website,[46] and the ASCE's Committee on Professional Conduct publishes a column consisting of ethics cases and commentary in its monthly journal, *Civil Engineering Magazine*. They are also reprinted on the ASCE website.[47]

University websites are also helpful sources for ethics cases. Santa Clara University's Markkula Center, for example, has created an organization called "Hackworth Engineering Ethics Fellows." This group has collected 40 ethics-related stories from Silicon Valley engineers.[48] As a final example, professors at Texas A&M University in College Station have received several NSF grants to develop materials for teaching engineering ethics, including large cases (Challenger, Hyatt Regency), smaller cases developed with ethics professors from other universities, and a whole set of numerically-based courses for mechanical engineering courses.[49]

## Conclusions

Integrating ethics into technical courses is, perhaps, an ethical imperative, one that also has personal resonance. As our students will transform into professionals who will assume responsibility for the safety, health, and welfare of the public, it is essential that they understand what that means. "Hold paramount" is a truly enormous obligation. The best students understand that the complexities of engineering and technology extend beyond technical knowledge.

Instructors who educate themselves about ethics may also find it transformative. While ethics is a "value added" to classes, subtle personal development may also occur. The world seen through an ethics prism is a different place. In my own case, I heard a presentation by Roger Boisjoly, an engineer from Morton Thiokol and one of three whistleblowers in the Challenger disaster, at the 1988 ASEE conference in Portland just two short years after Challenger and the ensuing investigation. His presentation was so touching that I spent days afterwards thinking about it. My professional and intellectual life took a left-hand turn after that: Boisjoly and I shared a 20-year friendship, I became active in an ethics professional organization, and every class I taught featured ethics as a major component.

Learning about ethics changed my life: my thinking improved, as did my teaching. I saw my students in a new light, and I felt a renewed sense of commitment. While I'm not suggesting that everyone who studies and teaches ethics will have a similar experience, engineering ethics underscores the interdependency of creators and creation. And this brings us back to the beginning: "Knowing engineering ethics is as much a part of knowing how to engineer as knowing how to calculate stress or design a circuit is."[2]

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## Biography

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