ETHICS IN ENGINEERING PRACTICE AND RESEARCH

Second Edition

The first edition of Caroline Whitbeck's *Ethics in Engineering Practice and Research* focused on the difficult ethical problems engineers encounter in their practice and in research. In many ways, these problems are like design problems: they are complex, and often ill defined; resolving them involves an iterative process of analysis and synthesis; and there can be more than one acceptable solution. In the second edition of this text, Dr. Whitbeck goes above and beyond by featuring more real-life problems, stating recent scenarios, and laying the foundation of ethical concepts and reasoning. This book offers a real-world, problem-centered approach to engineering ethics, using a rich collection of open-ended case studies to develop skill in recognizing and addressing ethical issues.

Caroline Whitbeck is the Emerita Elmer G. Beamer–Hubert H. Schneider Professor in Ethics at Case Western Reserve University. Dr. Whitbeck teaches in both the Philosophy and the Mechanical and Aerospace Engineering departments. Her research spans numerous fields, such as philosophy, engineering, technology, medicine, and feminist philosophy. Dr. Whitbeck is currently the Director of The Online Ethics Center for Engineering and Science at the National Academy of Engineering. Dr. Whitbeck has published numerous articles on bioethics and is the author of the first edition of *Ethics in Engineering Practice and Research* (1998, Cambridge University Press).

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Second Edition

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To the memory of James R. Melcher (1936–1991)

Contents

PART 2: ENGINEERING RESPONSIBILITY

Note to Students

The educational goal of this book is to help prepare you for your professional responsibilities as engineers. It is designed to help you recognize and think through ethically significant problem situations that are common in engineering and to evaluate the existing ethical standards for engineering practice.

The central subjects that guide this work are the ethically significant problems that arise in engineering, the ethical and other values at stake in responding to them, and the concepts necessary to clearly understand those problems and respond to them. As a philosopher (and former mathematician) I have contributed conceptual clarifications necessary to understanding the ethically significant problems that commonly arise in engineering and I cite useful clarifications by others. The problems themselves are ones I have gathered from engineering societies and individual engineers who have generously shared their experience with me. These engineers are thanked in the preface to the first edition. Although some concepts, such as a conflict of interest, are common to many areas of professional ethics, engineering ethics differs from medical ethics or legal ethics in that the ethically significant problems encountered in engineering practice are different from those problems commonly encountered in medical or legal practice.

As aids to learning I have added sidebars that emphasize main points, and at the beginning of each section is a query to raise issues that are helpful for you to think through. At the end of each section is an exercise question similar if not identical to the opening query. The section will have given you help in formulating at least one good answer to the question, but there may be other good answers, and *you should feel free to give the best answer you can*.

Throughout the text I have added sidebars like the one here to emphasize main points because I have found some of my students benefited from such emphasis.

> The goal of this book is to prepare you to recognize and think through the problems you will encounter as an engineer and to evaluate the existing ethical standards for engineering practice.

The definitions offered in this book are primarily philosophical or **conceptual definitions**; that is, they show how one concept or idea is related to or composed of others. When a definition is offered in this book, it appears in **bold type**. You have encountered conceptual definitions in geometry, which define a concept in terms of other, simpler concepts. For example: A straight line is the shortest distance between two points. A dictionary occasionally gives a

conceptual definition but more often will just tell you how a word is *used*, perhaps simply by giving a synonym for it. The conceptual definitions given here are like those given for concepts in physics and unlike the definitions in, say, a Spanish–English–Spanish dictionary.

Throughout this book, you will find boxes with thick borders, which contain brief but complete accounts of situations that illustrate or expand on some point discussed in that section of the text. Other boxes with thin borders contain open-ended problem situations to which you are asked to respond. These open-ended problems are often based on problems that engineers and my previous engineering students have found salient, perhaps because they experienced them on the job. You are asked to think about how best to respond to them both to build your problem-solving abilities and to help you recognize and anticipate problems that actually do arise in the engineering workplace. Occasionally, when some background information about the problem is useful but not explicitly discussed in the text, I have added that information in a section at the end titled "Getting Started." However, what you learn from the text is often not enough to construct a complete response to these open-ended problem situations. When actually faced with such a problem, you would need to interrogate both the problem and the resources available to you in that circumstance. (Such interrogation is discussed in Chapter 3, Ethics as Design.)

Foreword to the First Edition

I want to die proud of having been an engineer. Since that can happen only if we engineers behave ethically, and since I see a connection between this book and gracious professionalism, I am very enthusiastic about Dr. Whitbeck's effort to help us think effectively and somewhat pragmatically about professional ethics. Everyone, professionals in particular, must expect ethically complex situations to arise. When that happens, each of us badly needs a self-image that includes conviction that our intellect and heart can help make choices that will dramatically affect the course of events. That point of view will not materialize out of the ether. It must be nurtured and encouraged. This book will help seasoned professionals clarify their approach to their own behaviors, and this book can profoundly affect those who face a messy situation for the first time.

Caroline's arguments penetrate some of the fog around ethics. Most people think of it as an obscure topic belonging to an elite few who can spend their lives in deep and abstract thought. Even many professors of engineering regard ethics as a somewhat untouchable topic. "Students will never listen! Why waste our time and theirs?" Several have argued that post–high school is too late to influence students' proclivity to behave in society's best interest. I strongly disagree. Since I have spent most of my teaching career encouraging students to trust their own creative abilities, I have developed a thick skin about comments like "You cannot teach creativity!" I do not debate that assertion. I think I know that one can unleash creative behavior by ensuring that it is overtly rewarded and by providing people with an assortment of "tools" that facilitate creativity. Likewise, after ten years of knowing Dr. Whitbeck and listening to her discussions, I am convinced that one can develop a self-image that includes self-confidence in dealing with ethically complex situations. I think that self-image is part of the foundation for a role as one of the protectors of society. It is essential to one who derives satisfaction from doing the thing that is right rather than easy or lucrative in the short term.

If students are told about an ethically complex situation and asked what course they would take if they found themselves in such a plight, they are quite likely to argue that they should call a press conference and blow the whistle on the bastards! Only after some discussion do they start to visualize the many scenarios that might accompany the choices made by the players. In a successfully guided discussion, they see that their creative and problem-solving talents are important resources and start to propose actions that minimize damage without "selling out." They start to synthesize solutions rather than judge the players. Thus, as Caroline argues, there is a strong parallel between the process of design and

the process that should be used to guide one through fate's hammer-locks. The "problem" is ill-defined and resplendent with ambiguity and untruth; creativity and the wisdom to recognize what is important are critical, the iterative process of synthesis and analysis applies, and the solutions are not likely to be perfect, especially as judged by many stakeholders. One is not born comfortable with such a fuzzy and emotional process. Like design, one best learns it through a supervised opportunity to practice. This book provides such a guided opportunity.

The case studies provide very rich examples of successful and unsuccessful attempts to deal with ethical complexity. They illustrate that the right path is sometimes frightening and very rough. In the case of Roger Boisjoly and the *Challenger* disaster, he was forced to endure personal and professional persecution before being recognized as a most exemplary advocate of the "right thing" in an industry obsessed with the "right stuff." Mental experiments, classroom exercises, and personal introspection founded on Mr. Boisjoly's incredible story can be very productive. To borrow from the late Senator Everett Dirkson, an epiphany here, an epiphany there, and before long, we are talking real understanding. Interaction with Caroline has helped me understand what I think about when forced to confront ethical complexity. Thankfully, my ethics and religion are very simple and grow from the notion that we should all behave in a way that enhances the community good. I struggle with deciding the proper scope of "community." To me it includes animals, but what about plants? My most robust observation about "good" is that it is only a function of time until reelection, or it depends only on the time period over which the evaluation is performed. But given those vagaries, I find that Dr. Whitbeck has given me a nice road map for thinking about my actions. I recommend that you enjoy this book and allow it to make your brain hurt a bit to ensure that the message sticks. Many times, we can do well while doing good.

Woodie Flowers
Papalardo Professor of
Mechanical Engineering, MIT

Preface to the First Edition

Ethics in Engineering Practice and Research is about professional responsibilities of engineers and applied scientists. It is about professional responsibilities: the character of problem situations in which those responsibilities must be fulfilled and the moral skills for fulfilling them. Interspersed throughout the text are open-ended scenarios that present ethically significant situations of the sort engineers and applied scientists commonly encounter. These have been set apart in centered boxes to aid the use of them in group discussion and for homework assignments. Also set apart from the text, in boxes, are fine points, which may enhance the reader's understanding but are not essential to the main argument. Most of these fine points concern philosophical issues.

Outline and Summary

The introduction on concepts provides a clarification of many general ethical terms and provides a general framework for considering ethical questions. This framework draws on readers' prior experience of moral life and of moral reflection. Other more specialized ethical concepts are introduced as needed throughout the book.

Chapter 1 discusses what moral problems look like to a person in the situation who must respond to them. The frequent need to cope with an ambiguous situation and to formulate responses to the problem situation shows that addressing ethically significant problems is more demanding than simply evaluating the relative merits of preestablished responses. In many respects challenging ethical problems resemble challenging design problems.

Chapter 2 discusses professional responsibility and its basis and scope, and provides comparison of engineering with other professions. (Beginning with this one, the order of the chapters roughly corresponds to the sophistication of their subject matter.)

The Central Professional Responsibilities of Engineers and applied scientists, especially the responsibility for safety, is the subject of Chapter 3. Public safety, consumer safety, operator safety, occupational safety, and laboratory safety are considered.

Chapter 4 recounts the stories of two engineers who discharged their responsibility for safety in exemplary ways. Their stories are told in detail to show the

development of the problem situation they faced and the appropriate responses that they made at different stages.

Chapter 5 treats workplace rights and responsibilities, focusing on engineers in corporations or governmental organizations.

Chapter 6 on the responsibility for research integrity and later chapters on research ethics carry over the discussion of complaint handling in Chapter 5 to universities dealing with charges of research misconduct.

Chapter 7 examines investigators' responsibilities for the subjects of their research experiments.

Responsibility for the environment, which is the subject of Chapter 8, is found to have a more complex basis than the responsibility for research subjects.

Chapter 9 deals with fair credit in research and scientific publication, and Chapter 10 examines credit and intellectual property issues arising in engineering practice.

The epilog presents two stories of engineers who went beyond fulfilling their professional responsibilities to incorporating their values and aspirations into their work as engineers.

Order of Topics and Use in Courses

The interested engineer, scientist, or scholar may wish to begin by reading the entire Introduction or by simply skipping it. A detailed table of contents is provided as an aid for the general reader who wishes to read selectively, although each chapter does build on previous chapters.

If this book is to be used as a course text, the sections of the Introduction are best considered in concert with the early chapters. For example, Part 3 of the Introduction, on moral character and moral responsibility, is well considered in conjunction with the substantive discussion of professional responsibility and the engineer's responsibility for safety in Chapter 2 or 3. (A scheme for using the book in a single course is provided in the syllabus for *Real World Ethics*, one of the courses in engineering ethics available through the WWW Ethics Center for Engineering and Science (http://ethics.cwru.edu).) Cases and materials marked with "www" may be found in the WWW Ethics Center. The book does not presuppose any particular prior course of study, and its early chapters are accessible to all undergraduates.

Because the book provides a coherent guide to many topics within engineering and research ethics, it is suited to unifying the educational experience of engineering and science students who are learning engineering ethics by the "pervasive method," that is, having topics in engineering ethics and research ethics included in their science and engineering courses. Used for pervasive ethics education, Chapters 2 through 4, together with related case materials on the worldwide web (WWW) and available on videotape, are suitable for use with first- and second-year students. The remainder of the book is best used in upper-level undergraduate and graduate courses.

When the book is to be used as a primary text in a freestanding course in engineering ethics or research ethics, it should be a course for upper-level or

graduate students. Students will best understand the issues if they have some experience handling complex responsibilities. Many students enter college with such experience, but not all do. Summer work experience often provides a very useful experience on which to draw in class discussion.

The only topic I regularly address in my own undergraduate course that I have omitted from the book is the topic of academic honesty. I have omitted it because of my commitment to active learning and the realization that the most effective approach to active learning about academic honesty requires linking problems and cases to specific policies and issues on one's campus. For example, where there is an honor code, it will be important to examine how that functions. If there is a student court, then it may be appropriate to spend some time on questions of procedural justice. Academic honesty is one of the first topics to cover in the pervasive method of teaching professional ethics. I find that the subject of research ethics provides a useful reprise for upper-class undergraduates and graduate students on such topics as plagiarism.

An appendix to this book discusses several major trends in philosophical ethics since 1980. To spare student readers the added expense of a larger book with an appendix that few of them would actually read, I have placed the appendix on the WWW. Engineers, scientists, philosophers, and social scientists who are interested in an explicit discussion of the philosophical position underlying this book will find it there. Here I will simply say that active learning in professional ethics should involve students in hands-on/minds-on learning. Students should learn how to reflectively consider moral problems and moral standards and examine such standards with others of diverse backgrounds. Philosophical work on topics such as trust, responsibility, and harm is useful in such reflection, but theories about how one might found ethics on reason alone are best reserved for courses in the history of philosophical ethics. [In practice, what often happens when terms such as "utilitarian" or "rights theory" are introduced in courses in professional ethics is that students get the ludicrous impression that they are expected to choose between considering consequences and rights (or duties or considerations of virtue) in making ethical assessments.] The view that the reflection that differentiates ethics from mere custom is *social* reflection, and that it is carried out with respect to particular problems and issues, rather than being the reflection of a lone scholar who considers action in the abstract, finds support in the challenges that many of the most distinguished philosophers recently have offered to the abstract and detached model of philosophical reflection. Annette Baier summarizes some of those challenges in the following terms:

> Bernard Williams and Thomas Nagel have both in their recent books[1] raised the question of what philosophical reflection [that is, detached, abstract consideration], especially that which Hume called "a distant view or reflexion" (T 538), does to what Williams calls our "confidence" in ourselves and our mores, and our personal projects and commitments. Is what Nagel calls "objective engagement" a real possibility for us, or will the attempt to be detached and reflective have the effect

[1] Williams, Bernard. 1985. *Ethics and the Limits of Philosophy*. Cambridge, MA: Harvard University Press; Nagel, Thomas. 1986. *The View from Nowhere*. New York: Oxford University Press.

of detaching us from all engagements, destroying our confidence in any project, making all our concerns seem "absurd"? Will the philosophically examined life be found to remain worth living? Williams says "the ideal of transparency and the demand that our ethical practice should be able to stand up to reflection do not demand total explicitness, or a reflection that aims to lay everything bare at once . . . I must deliberate from what I am. Truthfulness requires trust in that as well, and not the obsessional and doomed drive to eliminate it" (p. 200). Though I welcome Williams's emphasis on the importance and fragility of confidence, and his reminder of the close link between the trusty and the true, I would amend his statement to "we must deliberate from where we are"; for, as he himself emphasizes, confidence and trust are social achievements. We may be able more successfully to combine self-trust with explicitness and reflectiveness if we can abandon the "forelorn solitude" of that singular philosophical thought which turns each of us into "a strange uncouth monster" (T 264) and incorporate into our philosophical reflections on morality more of the social and motivational resources of morality itself. For our form of life to be able to "bear its own survey" (T 620), maybe both the life and the method of surveying will have to change.[2]

[2] Baier, Annette. 1986. "Extending the Limits of Moral Theory," *Journal of Philosophy* 77: 538–545.

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Acknowledgments to the First Edition

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