Philosophy and Engineering — Exploring Boundaries, Expanding Connections
Diane P. Michelfelder, Byron Newberry, and Qin Zhu, Editors
Springer International, (2017),
270 pp., Hardcover, 99.99 USD,
ISBN 978-3-319-45191-6

Upon initiating this review, I immediately felt fortunate to have the opportunity to consider this specialty area of study. The exposure to philosophy and its links to engineering practice has become a valuable learning experience for this reviewer. The book provides data and analysis covering a range of formal studies and surveys, as detailed through the contributions of several supporting writers. The summaries and illustrations are very helpful. The editors have done an excellent job of bringing the diverse work of several authors together into a uniform and consistent package. Overall, this book details the connections between engineers and humanists, essentially linking the approach taken by an ethical designer or scientist, with the value and ethics of a philosopher.

Most chapters in the book address the philosophical, ethical, and policy issues emanating from engineering and technology. There are two main themes presented by the editors. First, philosophy provides some valuable insight into the challenges engineers face in working with their peers, policy makers and other stake holders. Through their day-to-day practice, engineers must address value, reason and emotion to ensure the social good. Second, engineers operate among certain boundaries, often set by policy makers and others from a range of academic disciplines. Engineers must meet the needs of their customer and the public, through the application of proven concepts and suitable language, while avoiding or minimizing potential obstacles towards the collaboration with other fields. In addition, the book describes the unique moral and philosophical challenges related to emerging fields and technologies.

The key supporting papers included in this book were first presented at the 2014 meeting of the "Forum on Philosophy, Engineering, and Technology," held at Virginia Tech in Blacksburg, Virginia. Contributors explore a wide range of topics over nineteen (19) chapters. The following is a brief overview of the details and depth delivered by the book's authors:

1 CHAPTER 1 — PHILOSOPHY AND ENGINEERING: AN UNCONVENTIONAL WORK IN PROGRESS

The opening chapter provides the reader with an outline of the supporting papers and resources used throughout the book, including a description of the vast relationship between philosophy and engineering. There is an interesting look into the future of the developing field of philosophy of engineering, and how it relates to the rapidly evolving field of modern engineering and applied science. Section 1.3 provides an excellent introduction into the forthcoming chapters.

2 CHAPTER 2 — PRAGMATISM AND ENGINEERING

The practical aspects of engineering science are discussed in this chapter. Engineers are faced with the day-to-day challenge to make an effective decision, even in situations before all scientific questions have been answered. This form of problem solving may appear when examining philosophical issues as well, where one tries to solve a complex situation using proven, practical techniques. The close connection(s) between pragmatism and engineering practice is one of the first topics that highlight the connections between philosophy and engineering.

3 CHAPTER 3 — SQUARING PHILOSOPHY OF ENGINEERING THROUGH PERSONAL EPISTEMOLOGIES RESEARCH

A comprehensive review of a survey of engineers is provided with a focus on personal epistemologies.[1] Through direct interviews, the dimension of a personal epistemology is defined. Table 3.1 is a summary that every engineer and philosopher of engineering should be familiar with to appreciate the contrasting views towards the source, structure, certainty, justification and sociality of knowledge. This is a chapter that I enjoyed reading a second time, and will likely discuss the findings with colleagues in the future.

4 CHAPTER 4 — EVIDENCE IN ENGINEERING

In the effort to define how we know what we know, engineers may turn to an evaluation of the quality of the information. This chapter provides a review of the history of engineering science, and the concept of applied science as a precursor to modern engineering. There is a detailed review pertaining to the collection and construction of evidence in philosophy, science, law and engineering. The obvious differences and not so obvious similarities are discussed, including the need for teams of experts to come together and collect, assess and apply any supporting evidence as part of a final solution or product.

[1] The study of knowledge.

5 CHAPTER 5 — IS TECHNOLOGY A SCIENCE? RECENT DEVELOPMENTS IN GERMAN PHILOSOPHY OF TECHNOLOGY AND ENGINEERING

The chapter includes a brief discussion on the key elements of the scientific method and describes engineering as the delivery of the material output from the "scientific way." A discussion and summary follows, towards an advanced understanding of the philosophy of technology and engineering. This includes some helpful historical references. The author describes the virtual border between "pure" and "applied" science. With the apparent rapid expansion of new fields and areas of specialization, engineers are faced with the challenge to meet the acceptance of both a project's proponent (e.g., customer) and the ecological and economic impacts.

6 CHAPTER 6 — THE ROLE OF TECHNOLOGIES IN UNDERMINING THE PERENNIAL PHILOSOPHY

The author describes why and how an engineer may evaluate if adequate epistemology has been achieved. It seems to depend significantly on the context of the applied science and the application itself. Extensive historical references are provided here, including the context of the early scientific observations made by Galileo. For a typical engineering activity, some form of scientific observation is needed, ideally through framing, measuring and interpreting nature.

7 CHAPTER 7 — RETHINKING THE SOCIAL RESPONSIBILITIES OF ENGINEERS AS A FORM OF ACCOUNTABILITY

An engineer's challenge towards socially responsible is discussed in this chapter. With potentially many actors involved, the engineer must be accountable and strive to clearly describe how those responsibilities are constituted. An interesting discussion is included pertaining to an engineer's social obligations, the depth of these responsibilities, and the relationship to the public's safety, health and welfare. Engineering professional responsibilities, ethics and the role of the whistleblower are included.

8 CHAPTER 8 — ON IDEALS FOR ENGINEERING IN DEMOCRATIC SOCIETIES

Engineers may recognize that their decisions have the potential impact on the broader environment and humanity. A discussion is included on how engineering decisions may best encourage human prosperity, equity and democratic goals. Key literature pertaining to scientific decision making and values is included. Society appears to be placing more emphasis on the engineer's ability to handle outside democratic responsibilities and the technical challenges associated with the delivery of work.

9 CHAPTER 9 — ENGINEERS AND THE EVOLUTION OF SOCIETY

The relationship between a professional engineer and the greater society is discussed in this chapter. The philosophical framework for society is described as secular humanism, and forms the basis of the defined role of an engineer working in society. As society evolves, so will humanity's goals for a "better life" and an understanding on what constitutes a good product or service. The chapter describes the interaction between an evolving society and engineers. Figure 9.1 provides an excellent illustration of the relationship between these two groups. Society may express or initiate a need and an engineer may offer options and execute a preferred solution. It then evaluates the outcome of that solution. Results or feedback from that evaluation may help support future work performed by the engineer, to help meet the needs of an evolving society.

10 CHAPTER 10 — ENGINEERING RATIONALITY AND PUBLIC DISCOURSES ON DAM CONSTRUCTION IN CHINA

The author provides a contract of engineering philosophy in the western world and within China. The differences are numerous, no greater than the west's focus on engineering design process, codes, professional accreditation and applied science, versus the focus of Chinese professionals on the delivery of engineering for "building and construction" activities. Engineering practice in China is linked to national pride and a more top-down decision-making process, while the west employs a more referendum style assessment process, especially when large scale projects are under consideration, such as mass transit and dam construction. The author discusses a philosophical approach towards cultivating a kind of "engineering culture," with a focus on a development of the global civilization in the whole society.

11 CHAPTER 11 — INTERDISCIPLINARITY, INCOMMENSURABILITY AND ENGINEERING IN POLICYMAKING: USING PHILOSOPHY TO UNDERSTAND CHALLENGES AT THE ENGINEERING–POLICY INTERFACE

The need to better understand the linguistic, disciplinary and practical relationships between engineers and policy makers is examined in this chapter. One of the areas for

potential conflict includes the procurement process involving engineers, policy makers, and other stakeholders. Often, the triggers for project cost overruns and delays may be attributed to both the language used by the parties involved, and the failure of engineers to communicate the value of the work or tasks to the policy decision makers.

12 CHAPTER 12 — ETHICAL PRESENTATIONS OF DATA: TUFTE AND THE MORTON-THIOKOL ENGINEERS

A very common ethical and professional situation encountered by engineers is the presentation of their technical results and data. A real-life example is provided in the chapter, outlining a specific analysis related to NASA's Challenger shuttle tragedy. A fascinating walk-through of the events associated with O-ring failure as it related to the presentation of critical engineering data. The accuracy, suitability and clarity of the data will help ensure that an end-user makes an informed, engineering design decision. Engineers must take care in making value judgements with respect to disseminating results to customers and related stake holders. The presentation of data is implicit to be a value-laden deliverable. Thus, the engineer must be confident that the values presented or implied are ones that are truly endorsed.

13 CHAPTER 13 — EMPATHIC PERSPECTIVE-TAKING AND ETHICAL DECISION-MAKING IN ENGINEERING ETHICS EDUCATION

The key topics discussed in this chapter include empathy in an engineering practice and the decision-making process, ethics in an ethically challenging environment, and real-life situations that challenge engineers to deliver an ethically justifiable decision. Engineers may face empathetic challenges, with respect to trying to understand and factor in the needs of others as part of one's own work. The authors describe an empathic perspective-taking development, in order advance an engineer's empathy, as complementary part of a decision-making task.

14 CHAPTER 14 — IN PRAISE OF EMOTION IN ENGINEERING

The emotional side of engineering practice is discussed in this chapter. This includes an engineer's ability to analyze their emotions and identify any impacts on engineering ethics. The author describes a successful engineer as one who can control their emotions, during an effort to win others over to their recommendations.

15 CHAPTER 15 — 3D PRINTING AND ANTICIPATORY BUSINESS ETHICS

The implementation of 3D printing has been rapid, and is changing the nature of the product design process and business overall. This chapter describes the potential impacts of 3D printing on future business, and outlines some anticipated ethical issues. The ease-of-use related to 3D printing allows many stakeholders to engage, influence and change designs to suit a wide variety of needs. The challenges include bringing interdisciplinary groups together, to help ensure ethical and social issues are addressed.

16 CHAPTER 16 — 3-DIMENSIONAL PRINTING IN MEDICINE: HYPE, HOPE, AND THE CHALLENGE OF PERSONALIZED MEDICINE

The chapter describes some of the unprecedented advancements in 3D printing within the medical industry. This specialized area includes some unique challenges for engineers and practitioners, including product safety, streamlined medical research into practice, special interest groups, and 3D printing of body parts for non-medical uses. The medical industry anticipates a massive deployment of this technology in the future. The author describes a need for an ethical technology assessment. This may be a rapidly emerging area for engineers.

17 CHAPTER 17 — THE LIMITS OF LOGIC-BASED INHERENT SAFETY OF SOCIAL ROBOTS

This chapter addresses the vast specialty area of human–robot interactions. This includes safely using a social robot, and the responsibilities of the engineer towards public good. The author describes the challenges associated with establishing ethically correct robots and the apparent gap between a robot's logic-based safety and actual human reasoning. The chapter's examples and case studies provide an excellent illustration of this fascinating area of study. The ethical challenges are numerous and present an excellent opportunity for engineers in the future.

18 CHAPTER 18 — A HISTORICAL PERSPECTIVE ON THE EPISTEMOLOGY OF CONTEMPORARY BREAKTHROUGH INNOVATION

Within the fields of technology and engineering, epistemology over the past two centuries has advanced primarily through the efforts of a small group of innovators and talented thinkers. This chapter provides several illustrations

of breakthrough innovations, and the key features of a rare innovator. Key attributes of an innovator include: holistic thinking, intimate involvement in the key issues, and a non-linear approach towards achieving new ideas and dimensions.

19 CHAPTER 19 — OPEN INNOVATION AND THE CORE OF THE ENGINEER'S DOMAIN

There is a greater frequency of innovation within society that does not require the direct contribution of engineers. This chapter considers the role of engineers when they are not fully involved or leading an innovation effort. Through readily available computational modelling, as an example, the author describes open innovation lead by others in society. This includes a discussion on the engineer's domain of influence and responsibility to the public. After all, innovation may be performed by anyone within an open society. As salient partners in this type of innovation, engineers are responsible to maintain ethics, laws and codes, and meet the environmental needs. The engineer's domain appears to be continuously expanding.

This book delivers a consistent theme, impressively finding a balance between epistemic-oriented science and action-oriented science. The topics reinforce the nature of effective communications used by engineers. The authors emphasize the value in employing precise and specific language. In addition to an assessment of how we know what we know, a study of philosophy may teach an engineer the value of precise communications. This book is highly recommended, especially for any engineer striving towards continual learning and being the best possible professional in their chosen field.

Emanuel Mouratidis
VAW Systems Ltd.
Winnipeg, Manitoba, R2X 1P5, CANADA
emouratidis@vawsystems.com