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Philosophy of Technology and Macro-ethics in Engineering

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Abstract The purpose of this paper is to diagnose and analyze the gap between philosophy of technology and engineering ethics and to suggest bridging them in a constructive way. In the first section, I will analyze why philosophy of technology and engineering ethics have taken separate paths so far. The following section will deal with the so-called macro-approach in engineering ethics. While appreciating the initiative, I will argue that there are still certain aspects in this approach that can be improved. In the third, fourth, and fifth sections, I will point out three shortcomings of engineering ethics in terms of its macro-level discourse and argue that a number of certain insights taken from the study of philosophy of technology could be employed in overcoming those problems. In the concluding section, a final recommendation is made that topics of philosophy of technology be included in the curriculum of engineering ethics.

Keywords Philosophy of technology · Engineering ethics · Macro- and micro-approaches in engineering ethics · Engineering ethics courses

What is, or should be, the relationship between philosophy of technology and engineering ethics? While the link between these two areas of scholarship and practice may appear intuitively apparent, subject matters in each area share strikingly

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few common elements. The purpose of this paper is to diagnose and analyze the gap between the two disciplines and prescribe certain interdisciplinary measures in bridging them in a constructive way.[1] The need for this sort of efforts has already been suggested by Harris et al. [2, p. 631] who noted the "integration" with philosophy of technology as one of the future directions that engineering ethics should take.

In the first section, I will analyze why philosophy of technology and engineering ethics have taken separate paths so far. The following section will deal with the so-called macro-approach in engineering ethics. While appreciating the initiative, I will argue that there are still certain elements of the proposal desirous of future improvement. In the third, fourth, and fifth sections, I will point out three shortcomings of engineering ethics in terms of its macro-level discourses and argue that the insights from philosophy of technology can contribute to overcoming those problems. In the last section, I claim that topics of philosophy of technology should be taught in engineering ethics courses.

Engineering Ethics and Philosophy of Technology

One might think that engineering ethics and philosophy of technology are closely connected disciplines, because ethics is considered as an important part of philosophy and engineering almost equivalent to technology.[2] However, researches of engineering ethics and philosophy of technology, as well as the courses of these disciplines rarely refer to each other.

Several interrelated explanations could be offered. Most importantly, they have different historical origins. Philosophy of technology was developed out of reaction to fast-growing modern technologies since the Industrial Revolution and took on various forms. Philosophers, sociologists, and novelists joined to express their concerns about modern technology, which later led to become a sub-discipline of philosophy. Engineers themselves did not contribute very much to the formation of philosophy of technology.[3] On the other hand, engineering ethics emerged in the form of codes of conduct for engineers, mainly designed by engineers themselves in the 19th century [2, p. 625].[4]

[1] In 1997, Durbin has addressed the failure of philosophers to engage in discourses of engineering ethics [1]. The situation does not seem to have improved since.

[2] The distinction between technology and engineering is not always easy. Generally speaking, the definition of technology is broader than that of engineering. Engineering refers to more specific type of activity that has clearly defined goals and is based on natural science.

[3] Mitcham introduces some engineers who contributed to the formation of philosophy of technology such as Andrew Ure (1778–1857), Peter K. Engelmeier (1855–ca. 1941), and Eberhard Zschimmer (1873–1940) [3, pp. 20, 24–29]. Their reflection was limited to analysis of mechanical aspects of technology and Mitcham calls them "engineering philosophers of technology." However, once established and recognized as a sub-discipline of philosophy, most discourses of philosophy of technology do not reflect on their works except in cases of historical references.

[4] Mitcham presents a detailed history of engineering ethics [4]. He explains that there are three distinct ideas developed in engineering ethics, namely those of company loyalty, technocratic leadership, and social responsibility. He notes that the idea of social responsibility has been characterized by paternalistic undertone and disputes the notion of its capacity as a democratic model of engineering design wielded by the influence of public participation.

Inevitably, these two areas of scholarship did not share their basic assumptions or aims. Questions raised in philosophy of technology concerned the essence or characteristics of modern technology as well as the appropriate direction that technological development should take. The codes of conduct by associations of engineers or scholarly research in engineering ethics concentrated on the internal issues of engineering society, such as integrity, decency, and conflict of interests, to name but a few. Furthermore, the legitimacy and desirability of technological development were taken for granted by engineers, but not by philosophers of technology. Philosophers of technology such as Heidegger and Ellul questioned the humaneness of modern technology and doubted whether humans could maintain complete control over it.

This has to do with another gap between these two areas of scholarship, namely, the generally reserved attitude towards technology in philosophy of technology, which reflects the nature of philosophy. By definition, philosophers view their objects of inquiry from a critical stance and this usually leads to a conclusion that is not necessarily welcome by those who are familiar with the subject matter. Given that engineering ethics began as an occupational ethics, it is predictable that philosophical approach to technology causes tension.

The notorious notion of "autonomous technology" could be the best example [5, 6]. "Autonomous technology" refers to the idea that modern technological development is out of the reach of human control. Any human interference cannot make meaningful changes in the process of technological development, according to this idea. This is a radical or impossible idea to engineers or anybody who has a normal view on technology, as it is taken for granted that technology is an instrument made by human for human purposes.[5]

While the present gap between engineering ethics and philosophy of technology is quite understandable, recent studies in both disciplines show that the distance can be reduced. There have been movements in philosophy of technology to make the radical assertions of classical philosophers of technology more realistic, concrete, and constructive.[6] The recent development in engineering ethics also signals that there might be a possibility of mutual development in both areas.

[5] Although autonomy of technology is often confused with technological determinism, it emphasizes the complex and interconnected mechanism of our contemporary technological society, which renders human intervention to the process of technological development virtually meaningless. One should understand, however, that the autonomy of technology is advocated in the context of the critique of dehumanizing technological society. It should not be taken as a metaphysical claim, but as a plea for realization of the devastating reality [7].

[6] This new trend is called the "empirical turn" contrasted with "the classical philosophy of technology." "The classical philosophy of technology" refers to philosophical reflection on technology by thinkers such as Lewis Mumford, Martin Heidegger, Jacques Ellul, Herbert Marcuse, Hans Jonas, and some others. Their perspectives are characterized by the distinction between traditional and modern technology, a broad understanding of technology, their diagnosis of modern technological development as autonomous, and generally pessimistic tendency concerning the future of the technological society. Those who belong to the "empirical turn" movement criticize their predecessors' pessimism and obscurity, arguing that philosophy of technology should conduct more empirical analysis of technological phenomenon and provide concrete solutions for problems of the technological society [8, Chaps. 1 and 2].

From Micro- to Macro-level Discourses in Engineering Ethics

One recent development in engineering ethics is the expansion of its subject matter to include macro-level issues or social responsibility. Herkert analyzes several forms of the efforts to distinguish micro- and macro-ethics in engineering formulated by different authors and summarizes them as follows.

> Engineering ethics can be viewed from three frames of reference—individual, professional and social—which can be divided into "microethics," concerned with ethical decision-making by individual engineers and the engineering profession's internal relationships, and "macroethics" referring to the profession's collective social responsibility and to societal decisions about technology [9, p. 374].

Considering its history aforementioned, it was natural that traditional engineering ethics took primarily micro-level approaches. It was only in 1980s when the macro-level approach in engineering ethics began. The concern for macro-level issues in engineering ethics is reflected in recent versions of codes of ethical conduct implemented by several professional associations such as National Society of Professional Engineers (NSPE), Institute of Electrical and Electronics Engineers (IEEE), and Institution of Engineers, Australia (IEAust). They all present "safety, health, and welfare of the public" as their priority of engineering activity.[7]

This is a welcome change. Apparently, this has to do with the increasing influence of science and technology on society or, more correctly, with the belated recognition of such influences. As engineering has such power to shape our lives in contemporary technological society, there is much more at stake than the decency and truthfulness of individual engineers who happen to be in a certain situation [10, pp. 218–220; 11, p. 386]. By concentrating on the ethical conduct of individual engineers in particular circumstances, one can lose sight of the larger context and social responsibility of the given technology or technology as a whole. Landon Winner argues that "[a]ny effort to define and teach engineering ethics which does not produce a vital, practical, and continuing involvement in public life must be counted not just a failure, but a betrayal as well" [12, p. 64]. This implicitly refers to the possibility that the codes of conduct and engineering ethics focused on individual cases are used as rhetorical devices that defend and justify engineering projects, when confronted with the sort of fundamental critiques that philosophy of technology raises.[8]

Nevertheless, it is uncertain whether these efforts have been successful. Various authors refer to the emergence of macro-approach in engineering ethics since the

[7] See http://www.nspe.org/ethics/code-2006-Jan.pdf; http://ieee.org/portal/pages/about/whatis/code.html; and http://www.engineersaustralia.org.au/shadomx/apps/fms/fmsdownload.cfm?file_uuid=F0647595-C7FE-7720-EA17-70AC27062E0B&siteName=ieaust. And also note that the IEAust's code of ethics adopts a different order concerning the prime goal of their activities: "welfare, health and safety" rather than "safety, health and welfare" as presented by NSPE and IEEE (Mitcham, personal communication 2007).

[8] Ellul's notion of "techno-logical bluff" specifically refers to this problem [13]. For example funding an ethical research on a certain technology could be arranged and used in order to justify the innovation and to avoid further scrutiny.

1980s, but all describe it as anything but in nascent, rudimentary stage [10–12, 14, 15]. Textbooks of engineering ethics refer to macro-level issues to a certain extent, particularly the environmental problems, but it is obvious that their primary concern remains on micro issues. The reference to macro-ethical issues in their textbooks often remains to be a grand proclamation without much content [16].

How could we hold meaningful discussions on the macro-level issues within the context of engineering ethics? My suggestion is that we should draw inspirations a number of insights from philosophy of technology. Once engineering ethics turn to the macro-level issues, engineering ethics begins to take more shared concerns with certain aspects of philosophy of technology. The social responsibility of science and engineering can be best recognized when one knows *how* technology affects society and human values.

In the remainder of this paper, I will present some shortcomings in the macro-level discourses in engineering ethics and how they could be complemented by philosophy of technology.

Macroethics in Engineering and Understanding of Technology

First, the extent of social responsibility is not yet clarified in engineering ethics. What is "public"; "welfare"; "safety"; or "health"?[9] These terms are too broad to yield any tangible contents [18, p. 268; 19]. Apart from the problem of defining these concepts, there is another issue of time, space, and the context. (i) If one estimates long-term consequences of a technology, how long should one have in mind? We have seen many unpleasant consequences of technologies that were praised for their efficiency in the past. Environmental issues or nuclear waste issue, for example, show that public welfare and safety could be understood on a long-term basis. (ii) Furthermore, there is the question of "how far?" The impact of a technological project often goes beyond its original boundaries. When it is said that public health and safety should be protected, or when the social responsibility is referred to, it is not clear who belong to the "public" and the "society." It might be found unethical to wipe out a small local forest for an engineering project. However, what if a simple project conducted in Europe causes damage to the Amazon rain forest? (iii) In addition, the "macro-level considerations" in engineering ethics seem to be concerned mostly about unintended physical consequences of a given technology rather than non-physical consequences such as dehumanization, destruction of community, or problems of globalization. While this would only make the discourse of engineering ethics more complicated, no one would deny that the state of the public's well-being should include these non-physical elements.

While these uncertainties are not likely to be clarified, it is important to address and understand these issues. The most apparent contribution that philosophy of technology could make for engineering ethics in this respect would be those insights

[9] According to *Code of Ethics for Engineers* by the National Society of Professional Engineers, "Engineers, in the fulfillment of their professional duties, shall hold paramount the safety, health, and welfare of the public [17]."

concerning the nature or characteristics of modern technology. It is problematic that most discourses in engineering ethics only deal with individual cases that limit the scope of their consideration, which lead to the lack of reflection on technology as a whole. Many problems of the technological society, however, are irrelevant to individual ethical decision-making according to philosophers of technology. In order to discuss in depth about macro-level issues including the social responsibility of engineering practices and the impact of technology in larger contexts, it is necessary to reflect on the nature or general characteristics of modern technology [see 14, 18].

Theories of engineering ethics are often based on the common and uncritical understanding of technology. The philosophy of technology criticizes the common understanding of technology, such as neutrality of technology, technology as mere instrument, and controllability of technology [5, 20]. This can shed different light on discourses on engineering ethics in terms of the extent of technological development and the interconnected nature of modern technology.

Winner's famous article "Do artifacts have politics?" [21, Chap. 2] eloquently reveals the political implications of technology. The low overpasses over Long Island parkways built by Robert Moses shows how political bias can be translated into common artifacts. Winner exposes that the overpasses were built low so that only the "automobile-owning whites or 'upper' and 'comfortable middle' classes" can have access to the road [21, p. 23]. It is not to say engineers should be politically correct. Even when there is no intention involved, a certain technology could have particular social effects. According to Winner, technological innovations should not be considered to have purely instrumental values only, as they influence the framework of human lives. Winner compares technology with law. Law is made by people, but once established, it regulates people. To a certain extent, using a technology means leading a certain type of life-style.

Winner's theory provides a possible starting point for engineering ethics to clarify the abstract notions in its macro-approach. This might not lead to an immediate solution for or answer to concrete problems raised in the field. However, since increasing number of people are concerned about macro-level issues in technological society, it is important for engineering ethics to scrutinize the subtle and indirect influence of modern technology on society. Otherwise the phrase included in codes of ethical conduct concerning public health, safety and welfare will end up being a noble proclamation without much substance.

Individual and Collective Responsibility in Engineering Ethics

Second, there is an interesting discrepancy between micro- and macro-level approaches in engineering ethics. Individual engineers are encouraged to think about what is ethical on a micro-level, while they seem to have been given exemption from any ethical consideration on a macro level. Wulf argues that since the "behavior" of modern technological system has become unpredictable, we are confronted with new ethical challenges [11, pp. 386–387]. These challenges are, however, for profession rather than for the individual engineers. Hudspith claims

that the macro-ethical questions and issues "relate primarily to the whole profession and our responsibility as a group" [14, p. 210]. He even argues that "Neither are these questions primarily moral issues; rather, they address concerns at the cultural level, reflecting what we believe about life and the role of technology in life."

Consequently, the discourse on macro-level issues in engineering ethics tends to end with some policy suggestions or propositions for modifications in the institutional structure to resolve the issues in question. For example, Herkert emphasizes the function of professional associations in dealing with societal aspects of technology [22]. Mitcham suggests public participation in the process of the development of technological projects and technology assessment in order to ensure socially responsible development of technology [23]. However, these recommendations are constructed upon the presupposition that the current situation of engineering practices, namely, division of labor, specified expertise, high competition in the market, budget issues, the complexity of the technological system, and so on, is a pre-established condition.

In other words, scholars who take macro-approach in engineering ethics are not eager to ponder on the role of individual engineers in that situation, because their effort to make change in terms of the given condition is rather redundant. Even when they refer to an individual action such as whistle-blowing, their main focus is often not on the act of whistle-blowing itself, but the system to protect the whistle-blowers.[10] This is problematic in two senses. First of all, it is hard to designate a moral agent. Can a group of professionals who have similar expertise but different jobs hold moral responsibility? Second, the issue of being ethical and unethical fades away if one emphasizes a structure that can deal with the macro-level issues. The bounding power of engineering ethics disappears.[11]

Philosophy of technology, however, raises questions about this impasse itself. One of main concerns of philosophy of technology is what good technology (or technological innovation) is or how to establish it. Especially, contemporary philosophers of technology are focused on the possible constructive change of technological society.[12]

Different versions of democratizing technology theory can represent this kind of effort. Based on the social constructivist theory of technology, Feenberg [26] argues that a technology can be modified at every stage of its innovation through intervention of developers and users. This kind of construction has been always there in the history of technological development, only without being recognized, according to him. Therefore, only by being involved in the process actively and consciously, we can lead the technological innovations to a more desirable direction.

[10] There is a subtle difference between Shrader-Frechette's strong emphasis on the moral responsibility of individual engineer "to engage in whistle-blowing whenever the situation warrants it" [15, p. 72; 24, p. 224] regardless of the personal risk in doing so, and the IEEE Directors assurance that nobody using the new "ethics hotline" will jeopardize their job or finance [25]. Weil reports other authors of engineering ethics who refer to scientists' social responsibility, Melanie Leitner and Ullica Segerstråle, consider "what scientists can reasonably be expected to do" [24, p. 226].

[11] Shrader-Frechette's position is exceptional in this sense. She advocates individual scientists' (and most probably engineers') extensive obligation to the larger society. See footnote 10.

[12] See footnote 6.

As aforementioned, Winner compares technology with law. Accordingly, technological innovations can be seen as a kind of legislation. He argues that the main problem of technological society has been that nobody cared about technology. According to him, modern technology seems to be autonomous because it is not directed properly. Winner diagnoses the current state of technological society as "technological drift" [6, p. 88f]. The solution is public participation in the process of technological development from the early stage. His suggestion has been more concretized by Sclove [27].[13]

Regardless of being in agreement or not with these suggestions, their ethical implication is huge. Questioning the current structure of technological development as a whole, individuals including engineers and non-engineers are obliged to contemplate on their role in making ethical changes in the structure. Individual engineers will not be exempted from the duty to consider larger contexts and consequences of their activity. They will not be allowed to hide behind the protection of professional organizations or vague codes of conduct and not to feel burdened by macro-level issues. On the contrary, engineers are required to take more responsibility in reflecting the future of the society, as they are in the forefront of technological innovations.

By integrating with philosophy of technology, engineering ethics will be able to impose a stronger ethical commitment on individual engineering, thus promotes a more balanced understanding on their part in regards to the micro and macro issues.

Technological Progress and the Idea of a Good Society

Third, while being sensitive to long-term effect and broad influences of technology, the macro-approach in engineering ethics still presupposes the necessity of further technological development in most cases. Since the macro-level approach deals with broader context of the given technology, one can easily imagine the situation in which a certain technological development is found to be unethical. There are only few indications, however, that proponents of macro-level approach in engineering ethics realize the possibility of fundamental changes in the current form of technological development. There are some exceptions such as Shrader-Frechette and others who implicitly suggest that somehow technological development should be slowed down, but most engineering ethics textbooks do not refer to this possibility. In a sense, this is an inevitable characteristic of applied ethics as a whole, because it deals with ethical issues within the exiting systems, but does not necessarily try to change the system itself. This poses a kind of dilemma, because macro-level concerns are likely to require macro-level solutions or changes.

Philosophy of technology challenges engineers to think much further than the societal long-term consequences of the given technology or engineering practice. Since its beginning in the 19th century, the influence of technology on human beings has been the main concern of philosophy of technology. The question concerning man and society always underlies the question on technology. So far,

[13] His suggestion has been more concretized by Sclove [27].

however, the insight of philosophy of technology on technological society has not been recognized by engineering ethics.

Engineering ethics is different from traditional ethics in the sense that it clearly has some instrumental character.[14] Engineering ethics does not necessarily pursue the good in itself. As a part of professional ethics, engineering ethics is applied in order to sustain the privilege, integrity, and interest of engineers in a socially responsible manner. Given the fact that modern technology has an enormous influence in shaping the structure of our contemporary society, the social responsibility should be considered not only in terms of the direct consequences of what they are doing, but also in further context of the social, political, economical, cultural, and symbolic meaning of their work. The social responsibility of science and engineering can be best defined, when one knows how technology affects society and when one determines which human values should be protected. This inevitably invites theorists of engineering ethics and engineers themselves to think about the eventual goal of their work, namely, what kind of society they want to build. In other words, philosophy of technology leads engineers to the idea of a good society.

This does not mean, of course, one should agree upon the ideal of a good society. Nonetheless, based on these suggestions, one could argue, for example, that the pursuit for a good society is an ethical duty of both individual engineers and professional institutions. Individual engineers will be obliged to reflect on what kind of society is desirable, to produce sound arguments for their ideas, and to conduct and justify their engineering practices accordingly. The function of professional societies in terms of dealing with macro-level ethical issues will become less vague than adhering codes of ethical conduct. Their duty would be to formulate the idea of a good society that represents and accommodates their members' perspectives. In this way, the aforementioned discrepancy between micro- and macro-level approaches in engineering ethics will be resolved.

Philosophy of Technology in an Engineering Ethics Course

Based on the argument presented in this paper, I suggest that some elements of philosophy of technology should be taught in engineering ethics courses. Most engineering textbooks give a short introduction to ethical theories which can be used as a guideline for moral judgment. However, few of them deal with the topic of what technology is and its profoundly transformative effects on a given society at the most fundamental level. This indirectly shows that these textbooks take a common instrumentalist view of technology, namely that technology is a mere

[14] Traditional ethical theories do not pay much attention to why one should be ethical. Their primary concern is how to demarcate being ethical and how to justify ethical principles. Even for utilitarian approach, the principle of "greatest happiness of greatest number" justifies a certain act as ethical, but it is not clear whether this explains the reason to be ethical. Kant's ethics takes a clearer stance in this respect. He contrasts hypothetical imperative that is conditional and categorical imperative that is unconditional. According to Kant's moral theory, norms of engineering ethics and other applied ethics could be classified as hypothetical imperatives.

instrument to achieve human goals. Although there is no clear-cut definition of technology, it is as important for engineers to reflect on the question as it is to understand some basic ethical theories or concepts. In the same way that basic knowledge of general ethics help engineering students with "designing" their moral problem and solving them, elementary training to think about the meaning of modern technology for man and society can widen their perspective. This will enable them to make a sound judgment when confronted with ethical problems in their professional lives.

This suggestion is not submitted without reservation. It would be another empty proclamation, if one guarantees an immediate and visible change in engineering students' eyes when philosophy of technology is taught. Engineers who reflect upon the significance of engineering in terms of its fundamental influences on human being and society might reach the same conclusion in a concrete situation as those who happen to have taken a mandatory engineering ethics course. If we treat the two cases as being exactly the same, however, then we put ethics in danger of becoming one of engineering projects.

Teaching philosophy of technology in engineering ethics course will challenge the "paradigm of problem-solution" itself, which refers to the idea that "If there is a problem, it can and will be solved. If there is no solution, then there was no problem in the first place." (cf. [8, pp. 242–245]) Philosophy of technology can supplement engineering ethics by revealing the simple fact that engineering cannot solve *all* problems, especially those caused by engineering practice.

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