Engineering Ethics in Global Context: Four Fundamental Approaches

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Introduction

As engineering work becomes ever more global, growing numbers of educational institutions, programs, and initiatives are grappling with how to better prepare their engineering graduates to work more effectively across geographic boundaries. Nevertheless, students typically receive very little guidance on how to act ethically and professionally when working with people from cultures different from their own. Among existing engineering ethics textbooks, the topic of engineering ethics in global context is rarely discussed in much depth. One notable exception is the classic textbook *Engineering Ethics: Concepts and Cases* by Harris, Pritchard, and Rabins[1], which includes a final chapter discussing "international engineering professionalism" and some typical ethical issues arising in cross-cultural contexts such as nepotism, paternalism, and exploitation.

Yet without exposure to typical *methods* and *tools* for defining and solving ethical problems in the global workplace, students may find themselves trying to extend what they have learned about professional ethics in their own culture to new contexts, including by adopting a "learning by doing" approach. As a consequence, practicing engineers may be confounded by tensions between the realistic requirement for working ethically across cultures and the fact that their professional ethics education has mainly been based on prevailing conditions in their native sociocultural context.

In order to address this tension, some philosophers and engineering educators have recently written scholarly articles and piloted pedagogical programs to explore ways to improve students' ethical competency in global context. Unfortunately, there remains little agreement regarding what counts as global ethical competency, much less how to cultivate it among students. Further, scholars often fail to clearly articulate and communicate their foundational positions. The goal of this paper is to bring greater clarity to the field by conceptualizing and synthesizing some of the most fundamental and prevalent contemporary approaches to engineering ethics in global context.

More specifically, this paper first argues that discrepancies in efforts to situate engineering ethics in global context often derive from different understandings of what constitutes the *global*. Second, this paper argues that these different understandings have led to four partially distinct approaches to engineering ethics in global context, namely: (1) global ethical codes, or developing a code of ethics that is expected to be applied across cultures; (2) functionalist theory, which posits some fundamental, shared characteristics internal to the engineering profession that apply globally and might prove foundational for creating ethical codes; (3) cultural studies, which emphasizes the importance of cultural differences in formulating effective ethical decisions in the global context; and (4) global ethics and justice, which engages students and professionals in ideas and practices aiming to promote global justice. By examining relevant literature, pedagogical activities, and policy reports, this paper compares and contrasts these four approaches to understand how their assumptions, goals, and methods are relevant to and/or distinct from one another other.

Third and finally, this paper explores the possibility of synthesizing these four approaches in broader contexts of the global engineering profession. With this paper, we hope to start building a platform on which engineering educators and policymakers interested in global engineering education can more effectively communicate with one another and thus work together. Ultimately, we hope to inform development of educational programs and policies that not only have clear objectives around cultivating the ability of students to navigate ethical issues in global context, but also demonstrate awareness for a variety of alternative perspectives and approaches.

Global Ethical Codes

Proponents of the first approach to engineering ethics in global context have been striving to build up a code of ethics that is expected to be applicable across cultures. To a large extent, their major goal is to create a *globalized* engineering profession. It is worth noting that proponents embracing this approach often emphasize the importance of *coordination* among professional societies from different countries in creating a global code of ethics. In this sense, creating a global code of ethics involves achieving agreement among organizations, cultures, and countries.

Since the beginning of the 21st century, countries in the same region or with similar cultural traditions have been exploring regional codes of ethics for their engineering societies. These codes of ethics can be seen as "globalizing" efforts to seek common ground among cultures. For instance, in November 2004, the Chinese Academy of Engineering (CAE), together with two other academies of engineering from Japan and South Korea, issued a "Declaration on Engineering Ethics" that included the "Asian Engineers' Guideline of Ethics." This guideline emphasized "cherishing the Asian cultural heritage of harmonious living with neighboring people and nature"[2]. This code was intended to be shared by practicing engineers in three countries deeply influenced by Confucian culture. This declaration stands as a recent effort to build up a code of ethics for engineers in countries that embrace some shared cultural values.

alZahir and Kombo[3] additionally compare the IEEE code of ethics with 32 international codes of ethics of professional engineering societies in Africa, Asia, Australia, Europe, and Latin America. They found that only four countries completely adopted the IEEE code of ethics, while the other 28 countries have embraced variations of the IEEE code. These variations were mainly caused by sociopolitical and cultural differences in these countries. Nevertheless, they argue that a global code of ethics is conceivable since at least some articles of the IEEE code of ethics are shared among the countries under investigation. If professional societies can work together to accommodate the sociopolitical and cultural differences in these countries (although it is unclear whether this "accommodation" process is easy or difficult to undertake), a global code of ethics is possible. It is also worth noting that the 32 international codes compared to the IEEE code of ethics are in different branches of engineering, i.e., not all in electrical, computer, and other allied fields of engineering that have historically been the primary purview of the IEEE. Disciplinary differences may therefore representing another source of variation in the codes.

As this overview suggests, creating a global code of ethics often requires inter-organizational or international governance and coordination. A typical example in this regard is the code of ethics developed by the World Federation of Engineering Organizations (WFEO). Under the auspices of the United Nations Educational, Scientific and Cultural Organization (UNESCO), the WFEO was founded in 1968 by regional engineering organizations from more than 90 nations. According to the WFEO's official website:

> The WFEO is the sole Body representing the engineering profession of all kind and disciplines at World Level… [It] encourages all of its national and international members to contribute to global efforts to establish a sustainable, equitable and peaceful world by providing an international perspective and enabling mechanisms… [It] is the internationally recognized and chosen leader of the engineering profession and cooperates with national and other international professional institutions in being the lead profession in developing and applying engineering to constructively resolve international and national issues for the benefit of humanity.[4]

WFEO's code of ethics is viewed as a model code for its member organizations to formulate their own codes of ethics. Therefore, "the values and principles in the WFEO Model Code of Ethics are those which are deemed to be applicable universally to the practice of engineering" and "Member organisations of WFEO are encouraged to develop a Code of Ethics for their organisation based on the values and principles set down in the Model Code and to impart the values and principles that individuals need to assist their decision making processes through ethics support programs"[5].

WFEO's model code of ethics is more specifically organized around four different themes: "demonstrate integrity," "practise competently," "exercise leadership," and "protect the natural and built environment." Taking a closer look at the specific articles and their interpretations, one finds that many of these articles (e.g., "practise in a careful and diligent manner in accordance with their areas of competence") are highly similar (if not identical) to articles in existing codes of ethics of many Western, and especially American, professional societies such as the U.S.-based National Society of Professional Engineers (NSPE). Nevertheless, it is difficult to conclude the specific reasons why the WFEO's model code of ethics is similar to these other codes. For instance, it is possible that the American codes of ethics were seen as the "best practices" which WFEO intentionally "learned" from and expected other countries to "learn" as well. Additionally, it might be that American organizations had overwhelming influence when WFEO was drafting its model code of ethics. Finally, it is plausible that engineering societies outside of America and other Western countries lacked a comparable professional tradition, and therefore had little choice but to follow the American societies, which were globally known for a tradition of professionalism in which ethical codes have historically had *the* central role.

However, philosophers such as Michael Davis counter that it is unnecessary to construct these global codes of ethics. To some extent, he argues that building up such codes is somewhat similar to "reinventing the wheel" as there are already "global" standards of engineering practice in the profession.[6] Many of the major professional societies such as IEEE, ASME, and NSPE encourage their members to apply their codes of ethics globally.[1] Some of these societies, such as IEEE and ASME, are essentially international organizations, and the members of these societies are bound by the codes of ethics of these societies wherever they live and work. Additionally, legal acts in the United States such as the Foreign Corrupt Practices Act (1977) require US engineering firms to follow all federal anti-bribery and related laws when performing engineering and related services abroad.[7] Nevertheless, as pointed out by Arthur E. Schwartz, deputy executive director and general counsel of NSPE, "there is a limited exception for ‘facilitation payment’ (e.g., connecting to the electric grid, water, sewage hookup, installation of internet services) to acknowledge local compensation customs and practices”[7].

In light of this overview, the global ethical codes approach still leaves two questions unresolved. First, it is unclear whether it is realistic to expect that the global codes of ethics be used to guide engineering practice in different countries, beginning with their introduction to students in formal coursework and later as guidelines for conduct in the workplace. Second, given that American societies encourage their members to apply their codes of ethics universally, their foreign colleagues might know very little (if anything) about these codes. It might therefore be ineffective or unfair for two sides of a collaboration to have an unbalanced understanding of the codes of ethics that are supposed to guide their collaborative engineering practice. And third, there is the question of how to avoid Western “paternalism” in formulating and implementing these global codes of ethics in ways that override diversity in local values and practices, especially given that many countries do not fully embrace Western ideals of professionalism, expectations of social contracts, closely following laws and regulatory requirements, etc.

Functionalist Theory

The functionalist theory posits some fundamental, shared characteristics internal to the engineering profession that apply globally and might prove foundational for creating ethical codes. These shared characteristics make engineers and engineering in different countries “function” in similar ways. The functionalist theory is mainly represented by two philosopher engineering ethicists, namely Michael Davis and Heinz C. Luegenbiehl.

Davis argues that engineers, no matter where they are from, are identified by “a common curriculum imparting a common discipline (a culture, that is, a shared way of doing certain things, the distinctive way of doing things we call ‘engineering’)”[8]. Thus, this shared culture between Chinese engineers and engineers elsewhere allows Chinese engineers to work well with engineers elsewhere. In this sense, engineering as a culture is more powerful than national culture – it is easier for a Chinese engineer to move from China to the United States than to change her profession from engineering to medicine. The shared culture among engineers from all over the world allows them to understand a common set of ethical values that is linked to the very nature of the engineering profession.

Scholars taking a “cultural studies” approach (which we return to below) may agree that it is easier for an engineer to move from one country to another than for him/her to move from engineering to medicine. However, they may counter that we cannot conclude there are no differences in teaching and practicing engineering between countries. Without such differences, it is difficult to understand why international accreditation agreements such as the Washington Accord struggle to establish and enforce common accreditation standards for signatory nations. If engineering is a global discipline with a common culture, it would seem that mechanisms like the Washington Accord would not be necessary. Yet indeed, we find non-Western countries like China and India working hard to reform their engineering curricula to meet the requirements of joining the Washington Accord. Cultural studies scholars may further argue that engineers from two different countries might *eventually* be able to work well with each other, but they need time (sometimes extensive) to figure out how to coordinate such collaboration.

Similar to Davis, Luegenbiehl points out,

> In thinking about engineering ethics independently of a particular cultural background, it is instead helpful to consider engineers to be a community with a shared set of values. A bond is created among engineers based on these values, whatever their nationality or cultural background, just as there typically exists a set of common core values in other types of societies.[9]

Furthermore, Luegenbiehl argues that a global ethic should be built upon the nature of engineering. Specifically, he proposes six foundational principles of engineering ethics that are independent of any particular cultural context[9]:

- The principle of public safety
- The principle of human rights
- The principle of environmental and animal preservation
- The principle of engineering competence
- The principle of scientifically founded judgment
- The principle of openness and honesty

To say some of these principles are independent of any particular cultural context is to say these principles or the values embedded in these principles are *shared* among most (if not all) cultures. However, some if these values are not equally important in the moral life of different countries. For instance, the idea of honesty in Confucian culture has more contextual and pragmatic connotations. For instance, Confucianists may be more inclined to ask questions such as honest *for what* and *for whom* and *under what context*.

To a large extent, Luegenbiehl's approach is quite similar to the "principlist" approach in biomedical ethics. However, a limitation with this approach is that a given set of principles might generate conflicts in certain situations.[10] There are no general guidelines available for how to deal with such conflicts. For instance, if engineers strictly follow the principle that engineers should only engage in "engineering activities which they are competent to carry out"[9], they may be facing situations in which people in underdeveloped countries are losing some of their human rights such as the right to drink safe and clean water as these engineers working in underdeveloped countries are not "competent" in civil engineering. Philosophers argue that these principles often lack systematic relationships to one another, and there is no unified moral theory from which the principles are derived.[11] As the reader can tell, these principles are not novel and can be found in the existing codes of ethics of most professional societies. For instance, very few "local" professional engineering societies would omit "the principle of public safety" in their codes of ethics. In this sense, Luegenbiehl is close enough to Davis in implying that completely creating a new global code of ethics through coordination among professional engineering societies is not necessary. The reason is simple: engineering itself is a *globalized* profession and our current existing codes of ethics are already global, as engineering societies in different countries share a lot of common values which are central to the engineering profession.

Cultural Studies

Scholars trained in fields emphasizing the importance of culture to professional practice (e.g., anthropology, business) and those who have had extensive experience teaching and researching in other countries often pay closer attention to cultural differences in engineering practice. Thus, they often hold an *anthropological* or a *cultural studies* view of engineering ethics in global context. In particular, cultural studies scholars claim that cultural differences exist in at least three different senses or contexts: *professional*, *practical*, and *sociocultural*.

First, the cultural studies approach argues that concepts central to the Western (mainly American) engineering profession and engineering codes of ethics, such as professional autonomy, are often less valued or even peripheral in other cultural contexts. Luegenbiehl points out that not all societies value moral autonomy to the degree that the U.S. does, and in some cultures such as Japan moral autonomy is discouraged in society and at work.[12] In fact, Luegenbiehl's observation is mostly valid in other countries with Confucian cultural heritage, including China, Korea, and Singapore. In Confucian culture, it is often impossible to view a person as truly autonomous. Everyone has a variety of roles and has different relationships with others in the society. Ethical decision-making is always influenced by the specific relationships one has with others. In other words, for a professional engineer, his/her moral judgment can hardly be "autonomous" or "independent" as it needs to incorporate considerations about the relationships he/she has with others and expectations of how others might respond to his/her moral actions.

Another interesting case is related to the idea of nepotism, which in most codes of ethics is completely prohibited. The principle of avoiding nepotism also applies when engineers are working in the global context.[1] Some scholars might call the involvement of nepotism in the hiring processes as a sort of conflict of interest. Certainly, the hiring manager needs to be specifically careful about whether a candidate is qualified. However, we are arguing that some kind of special relationship between the hiring manager and the candidate is not necessarily the reason that prevents the manager from being involved in the process and the candidate from being considered. Arguably, from the Confucian perspective, it is the *manager* that knows much more about the candidate than anybody else. A good professional should be able to make sound judgments about the credentials of a person with whom this professional shares a special relationship by considering but not being "distracted" by such a relationship. As Confucianists have argued, "*juxian bu biqin* (selecting virtuous people does not avoid relatives)."

Second, scholars in engineering management tend to emphasize cultural differences in implementing and managing specific *engineering projects*. A vast majority of their theories and methods are often drawn from the literature in international business and management. For instance, Wang and Thompson compare cultural differences in business ethics in Europe, US, and Asia.[13] They have found that business organizations (e.g., companies) have varied understandings of: (1) moral agents in business responsibility; (2) key actors in business ethics; (3) key guidelines for ethical behavior; (4) key issues in business ethics; and (5) the dominant stakeholder management approach.[13] As engineers are often employed in such firms, these differences in organizational cultures may affect engineers' judgment in making professional decisions in the workplace. Thus, engineering students are suggested to acquire global experience through *interactions with people in or from other cultures*. Pedagogies for building up global competency in ethical decision-making include field trips to foreign engineering sites, meetings with professionals at work in other countries, and interactions with exchange students and scholars.

A third group of scholars in the cultural studies approach are interested in the "particularities" or "localities" of the broader sociocultural contexts in which engineers are educated, establish their professional identities, do their work, and organize themselves. Representative work in this vein has been carried out by Downey, Lucena and Mitcham. By comparing engineering ethics in France, Germany, and Japan, they argue that the relationship between the identity of the engineer and the responsibility of engineering work has varied significantly over time and from place to place in the global context.[14] To a large extent, the idea of responsibility is extensively contextualized, and it is a cultural and historical concept. Responsible to whom, to what degree, and in what sense always matters to engineers and their everyday practices. For instance, American codes of ethics place significant emphasis on the idea of "contractarianism", which often makes less sense in national/cultural contexts such as China and India. This is not to say that China and India do not have contracts, but these countries view contracts very differently than their American colleagues do. For instance, Chinese engineers tend to view contracts only as the starting point of building up business relationship rather than legally binding documents. The Chinese engineers are often willing to conduct services that are not included in the contract if they think these services are conducive to their partners.

Global Ethics and Justice

Scholars who embrace the global ethics and justice approach to engineering ethics in the global context have often been inspired the idea of *minimal moral realism*. German philosopher Hans Küng's concept "global ethic" is a good example of minimal realism. What Küng means by the concept of global ethic is the "necessary minimum of common values, standards, and basic attitudes." In other words, it is "a minimal basic consensus relating to binding values, irrevocable standards, and moral attitudes, which can be affirmed by all religions despite their undeniable dogmatic or theological differences and should also be supported by non-believers"[15].

The United Nation's list of human rights has been widely considered as a resource for making ethical decisions in engineering practice across cultural boundaries.[1] Similar to Küng, these human rights are seen as minimal standards of living for people living globally. Another relevant concept embracing the philosophy of minimal moral realism is the "human capabilities" framework as originally advocated by philosophers Martha Nussbaum and Amartya Sen. Human capabilities are basic capabilities that "a person needs to be able to satisfy in order to live in a reasonable quality of life"[1]. Engineering ethicists have pointed out that engineers working in the developing context have both a *negative* duty not to interfere with these human rights as well as a *positive* duty to help others achieve these rights.[1]

Philosophers of technology have additionally been exploring ways to assess whether engineering designs in developing countries have extended or hindered the human capabilities of local people. For instance, Oosterlaken, Grimshaw and Janssen studied the introduction of information and computer technologies (ICTs) such as podcasting devices in local villages in Zimbabwe.[16] They argue that a successful development project is not merely about giving local community members access to resources such as podcasting devices and MP3 players but also involves asking *to what extent* these ICTs contribute to the expansion of human capabilities, i.e., "the freedom to do some basic things that are necessary for survival and to escape poverty"[16]. From the perspective of human capabilities, *the* most important approach to evaluating a specific engineering design is to evaluate to what extent and in what ways a given design or solution enhances the human capabilities of the users.

An underlying assumption of this global ethics and justice approach for engineering ethics is that engineering design is critical and essential for promoting (basic) human well-being. This assumption in reality has been articulated in many engineering codes of ethics. For example, the National Society for Professional Engineers (NSPE) code of ethics states that "engineering has a direct and vital impact on the quality of life for all people." Philosophically, this idea of portraying "the formation of engineers as contributing directly to human progress" and equating "the technical contents of engineering practices" with "material advancements" throughout the world for human benefit is what Gary Downey calls "normative holism"[17].

Nevertheless, it is worth noting that technology cannot automatically promote human well-being. In many cases, "conversion factors" exist between technological design and human well-being.[14] Conversion factors are "personal, environmental, or social factors" that may "hinder the conversion of resources as such into valued human capabilities"[18]. For instance, the bicycle will not automatically extend the capability to travel freely unless the rider is bodily-enabled and the road is well paved.

Conclusion

This paper argues that discrepancies in efforts to situate engineering ethics in global context often derive from different understandings of what constitutes the *global*. The global ethical codes approach discusses the global from the perspective of professional societies. Scholars in this approach often tend to examine the similarities among codes of engineering ethics from different countries and try to establish a global code of ethics based on shared values and articles from different international codes of ethics. Their goal is to promote a *globalized engineering profession*. The functionalist theory approach tends to look at the nature of engineering. Scholars in this approach believe that *engineering itself is a kind of global culture*. The reason why engineers from different countries are all called engineers is because they share a common practical culture that allows them to understand each other's work. Hence there are social and moral norms inherently embedded in engineering practice that are understandable and communicable to all engineers wherever they reside. The cultural studies approach examines the global from a more micro perspective and emphasizes the role of cultural differences in shaping the professional, practical, and sociopolitical contexts of engineering work. The cultural studies scholars view the global more in terms of *localized practices that are challenged by processes of globalization*. Finally, the global ethics and justice approach considers the global as *a set of universal ethical values shared by all cultures*. An important goal of engineering is to prevent these values from being hindered or diminished and to design technologies that help promote such values.

We recommend that educators, practitioners, and policymakers in global engineering consider all four approaches in a more systematic and integral way. If we imagine a typical global engineer who is working with engineers from other cultures, certainly the global engineer must have some "common language" with his/her colleagues since they are all engineers. Otherwise, engineering work would simply not happen if multiple cultures are involved. However, we need to notice that they will likely encounter situations in which significant cultural differences do exist. The global engineer needs to be aware of effective ways to navigate these cultural differences, which is crucial for achieving their common goals. We must also admit that not every global engineer is exclusively interested in pursuing economic benefits. Many of the global engineers might also be interested in how their design solutions can advance the well-being and agency of the users.

A limitation of current practices in global engineering is that people often pay attention to only one or two of the four approaches to engineering ethics and ignore or downplay the others. Here we would like to make some general and perhaps even oversimplified assumptions based on our preceding discussion. We acknowledge that these assumptions suggest the need for further empirical evidence to verify their reliability and validity. The assumptions are as follows:

(a) in practice, professional engineers will likely pay more attention to global codes of ethics as they are quite familiar with the existing codes of ethics and have curiosity and imagination about whether these codes of ethics are applicable in other cultures.

(b) so far as we know, only a few scholars (mainly philosophers) have claimed that there are some characteristics unique to the engineering profession that define engineering as a globalized profession. It is unclear if we can conclude that this phenomenon is due to the traditional mission of philosophy that is "seeking the truth" essential for defining an object.

(c) some business leaders, often with extensive experience traveling to different countries and working with or studying people from different backgrounds, often focus more on the cultural differences of engineering practice. Another interesting assumption might be that business leaders or global engineers working are more pragmatic and assume that cultural sensitivity is critical to business success. As a result, they are more interested in the cultural studies approach to engineering ethics. Scholars trained in sociology, anthropology, cultural studies, communication studies, and other "interpretive" social sciences may also be more interested in exploring how cultural differences intersect with engineering ethics.

(d) engineers working for non-profit organizations often tend to amplify the moral and political values that are lacking and need to be further enhanced in developing contexts. They view technologies as *instruments* for well-being rather than profits.

As engineering educators who are interested in preparing future engineers for the increasingly globalized future, we need to be careful about what kind(s) of "global engineers" we are training. Emphasizing one or two approaches to engineering ethics over others represents an incomplete approach that fails to project an appropriately comprehensive view of global engineering practice. Obviously, we are not training every student to become a professional engineer working in a multinational business company, nor do we expect that every engineering graduate will work for an international development or other NGO.

Instead, we propose that educators should strive to prepare students for a wide variety of personal and professional pathways, yet with the goal of enabling them to become truly global engineers capable of navigating ethical issues in diverse job roles and national/cultural contexts. Thus, engineering educators from the four different approaches to engineering ethics in the global context need more communication, collaboration, and coordination among themselves, as how to educate a globally professional and responsible engineer is a very real and daunting issue that has received much less attention than other topics in the field of engineering education.

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