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ENGINEERING ETHICS EDUCATION THROUGH A CRITICAL VIEW

Some philosophical foundations

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Introduction

This chapter presents some fundamental philosophical and religious ideas that serve as the background for thinking about ethics and morality. It also sketches some elements that stress how engineering and technology are shaped by and shape how we live individually and collectively, as well as how we make sense of ourselves, life, and reality as a whole. This should help our readers understand why studying ethics – and philosophy of engineering or technology – is important, especially if engineering is to be used to empower and liberate marginalized persons or communities and construct other possible social arrangements and meanings for life.

The chapter is divided into four sections and relies not only on texts that are part of the 'canon' of philosophy and the social sciences but also on less commonly read sources that we think are worth integrating into the engineering ethics mainstream if we want to have a forward-looking approach more in tune with critical perspectives.

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DOI: 10.4324/9781003464259-11

Why is studying/discussing ethics important for engineers?

Why should engineers study or discuss ethics in general and the philosophy of technology/engineering in particular? One straightforward answer is: 'Higher education should help engineers become better citizens and better human beings, in addition to giving them the training they need to engage in their professional activities.' Compelling as this answer is, it is not the only one, even if we recognize that students are usually still developing their morality at the time they enter university (Clancy & Zhu, 2022).

Technology, society, and worldview: mutual shaping and supporting

A less common yet notable answer to the question of why engineering students should study ethics and philosophy of technology is that both engineering and designing or creating technology are crucial in

1) Supporting or creating any ethical-political order that can be less or more hierarchical, participatory, conservative, diverse, respectful, and so on (Feenberg, 2010, 2017), or
2) Emulating any cosmology or worldview that, for instance, can be individualistic and take everyone and everything as resources or consider everything as interrelated parts of an integrated whole of which one must take care (Hui, 2016, 2017; Hui & Lovink, 2017).

In other words, the reality in which we live is simultaneously social and technical (i.e., sociotechnical), meaning that not only is technology shaped by society and the interests, values, and/or strategies of powerful groups, but technology also, and conversely, shapes society. For example, bridges built low on purpose to prevent buses from using the highway below them (e.g., by Robert Moses in New York City, an idea translated elsewhere) emulate a racially segregated reality intended in the first place by the racial prejudices of their designer (Winner, 1986). Even though non-accessible cities are usually not a consequence of any intended strategy, they still replicate a reality wherein people with a physical disability find much trouble navigating (Winner, 1986). In this case, like in many others, long-lasting socially sustained values and prejudices or preconceptions keep unwittingly driving designers' choices. The reality these technologies help mirror and perpetuate is an oppressing one, supported by such values and preconceptions; an example is the construction of racist algorithms and digital technologies (Poster, 2019).

Further, even the basis upon which we humans make sense of society and everything else (and, consciously or not, take as the fundamental guiding for our living and acting in the world) – that is, our cosmology or worldview – shapes and is shaped by technology. As Arturo Escobar says, "Give me a maloca [i.e., indigenous longhouse], and I will raise a relational world (including the integral and interdependent relations between humans and non-humans); conversely, give me a suburban home, and I will raise a world of de-communalized individuals, separated from the natural world" (Escobar, 2018, p. 111). This understanding holds in many other cases, for instance, if 'maloca' is replaced with 'agroecology' and 'suburban home' with 'modern, mechanized agriculture.'

That is why Hui (2016, 2017) coined the term *cosmotechnics* to highlight the mutual and supporting relation between cosmology or worldview and technology. Hui argues that any cosmology needs specific technologies to be emulated (like the South American Indigenous relational and caring worldview needs a *maloca*) and that any cosmotechnic (like the mainstream one of which American suburban houses are one materialization) builds or emulates the cosmology it draws on

(like the one underpinning the American suburban houses, which takes the individual as a being both de-communalized and separated from the natural world).

Hui's cosmotechnic allows us to see and/or recognize some important things. Hui helps us see that the dominant Western, modern, capitalist cosmotechnic, which emulates a world of natural and human resources to be exploited for profit maximization, is one among *many* other possible cosmotechnics. Such dominant cosmotechnic is shaped by and shapes the dominant cosmology that is individualistic, racist, sexist, and specist (this last term meaning that it places the highest value on humans that are thus taken as entitled to dispose of other species and nature as a whole as humans see fit). Another realization from Hui is that if we want to build different worlds – ones that mimic relationality, solidarity, care, and so on – we must construct other cosmotechnics (starting by appropriating or changing the already available one).

In sum, there is no such thing as neutral technology that can be used to advance any ethical-political order or any cosmology. Engineering is never politically neutral; it either works within, reinforces, and re-creates a political/social and/or cosmological status quo, and is thus conservative, or it challenges it, and is thus progressive, empowering, emancipating,[1] or decolonial)[2]. In other words, being 'politically or cosmologically neutral' in engineering is not a choice, for it is impossible. Doing engineering will always and inevitably be either sustaining or changing reality.

Progressive, empowering, emancipating, or decolonial engineering

To engage in progressive, empowering, emancipating, or decolonial engineering, to help socially and cosmotechnically co-construct any other possible world, requires practicing engineering differently from the mainstream or dominant form (Cruz 2021a, 2021b; see also Chapter 6 of this handbook). Such a practice, and the knowledge systems that support it, can only be achieved by somehow considering or incorporating into engineering the ethical-political and/or cosmological values and fundamentals we want to see respected or served in the world we want to help build (Cruz, 2021a).

It thus seems correct to say that venturing into non-Western or non-dominant cosmologies and developing engineering practices and technical solutions that support them can allow us to work alongside marginalized groups and communities – which nurture or cherish such cosmologies – in the construction of the sociotechnical reality they want. It also means widening our capacity for 'doing' engineering and for developing technology, even if we stick to our worldview, whatever that worldview might be (Cruz, 2021a). Yet we also stress the need to relearn and examine the worldviews and world histories we encounter, as a first step toward open dialogue allowing for a plurality of worldviews (for more on this, see Chapter 6).

There are countless ways to widen (or decolonize) Western, capitalist, dominant engineering. One option is using Scandinavian participatory design (Simonsen & Robertson, 2013) in its emancipatory strand (Robertson & Simonsen 2013). Another, which arose in Latin America, is *popular engineering* (PE) – meant as *grassroots* engineering – and named after Paulo Freire's 'popular education.' It is an educative process aimed at helping to emancipate people (Freire, 1970) that is taken as a guiding principle for *popular engineers*. PE draws on *action research* (Coghlan, 2021) and social technology's *sociotechnical adequacy* (Dagnino et al., 2004) to both help the supported group and community dream the world(s) they might find worth building and sociotechnically or cosmotechnically build this (these) world(s) alongside them. As part of that process, a dialogue of knowledge is established between the supported group or community and the technical team. Both 'sides' teach and learn, thereby enriching each other's capacity to know, be, and act. This dialogue widens (or decolonizes) engineering (Cruz, 2021b).

PE seeks to help empower/emancipate the supported group or community as much as possible. Empowerment through sociotechnical intervention or design has at least eight dimensions, ranging from *sociotechnical inclusion* (e.g., giving people access to a service that improves their basic conditions for living well) to *political emancipation* (i.e., community capacity and support for self-determination aimed at its members' flourishing and not harming anyone else) (Kleba & Cruz, 2021). The more these dimensions are addressed, and the more caring and critical or questioning this process is, the more empowering and emancipating its outcomes (Kleba & Cruz, 2021). PE aims at the highest possible emancipation.

Accomplishing that level of emancipation is far from easy; it demands much more than just well-established methods. To practice PE, engineers need training complementary to the traditional, technocratic education they usually receive at the university. In undergraduate courses, such training can be obtained through socially and environmentally committed extension activities. That is the main form PE takes today in Brazil. Indeed, many of Brazil's most successful PE teams are found in extension centers and are formed by teachers, techno-administrative employees, and graduate and undergraduate students (Cruz, 2021b).

Progressive engineering, ethics, and the remainder of the chapter

The remainder of this chapter reflects deeply on ethics to illustrate how diverse the human ethical and cosmological landscape is and can be. These sections can help denaturalize the mainstream or dominant ways of conceiving rightness and fulfillment and making sense of reality, allowing us to critically question what might seem unquestionable. This is to help the reader build skills and the ability to imagine other possible ways of being and flourishing. Such de/re-construction is a fundamental first step toward any progressive, empowering, emancipating, or decolonial engineering (or engineer).

Ethics as a tug of war between philosophical and religion traditions

Ethics and religion: a brief historical perspective

Throughout human history, religion and ethics have closely intertwined. Many ethical systems have been based on metaphysical conceptions of nature and human beings, aligned with specific religious beliefs. Although ethics education is often presented as secular (i.e., separate from religious influence and beliefs), it can be influenced by religious beliefs and prior moral experiences (such as powerful experiences that students have via informal learning contexts like study abroad, service learning, social groups, etc.).

The relationship between religion and moral philosophy has a long history. In ancient Greek philosophy, piety was considered a moral issue, as seen in Plato's *Euthyphro* (2017). During the European Middle Ages, the teaching of ethics and religious doctrine was interconnected due to the intimate association of theology and philosophy.[3] Some of what is now taught in secular ethics classes was taught as part of the theology curriculum at the first universities (Marenbon, 1990).

Religious creeds have had significant impact on ethical systems. Christians, Jews, and Muslims, for example, all rely on some form of the Divine Command Theory of meta-ethics (Hare, 2015). But the boundaries between religious beliefs and ethical reasoning are not always clear. The *Euthyphro dilemma*, which makes one wonder whether a certain way of acting is right because the gods command it or rather if the gods command it because it is right (Plato, 2017, *Euthyphro*,10a), has been taken up in secular, philosophical discussions of ethics. In the European Middle Ages, natural law theories added a theistic aspect to Aristotle's theory of the four causes:[4]

by referring to a belief in a god involved in the creation and workings of the universe and who thus influences human life and experience, these theories have claimed that natural law is not merely descriptive but also prescriptive, because God is the ultimate source and final cause of creation. The Decalogue, often referred to as 'the Ten Commandments' that form a significant part of the religious and moral foundation of Abrahamic religions (Exodus 20:1–17; Deuteronomy 5:6–21), finds a parallel in deontological ethical systems such as Kant's (Sandberg, 2013). The so-called 'Golden Rule' (i.e., 'treat others as you would like to be treated') found in many religious traditions across the globe, for instance, finds parallels in many philosophical moral systems (Blackburn, 2001, p. 101) and even in evolutionary psychology (Hare, 2015, 2019; Greene, 2013). Numerous philosophical theories have emerged from contemplation of religion and doctrine, and conversely, religious and doctrinal thought has also been influenced by philosophy (Hare, 2019).

However, not all ethical theorists ground their systems in religious claims. Some make a point of distancing themselves from religious beliefs, declaring that they rely on reason alone. This is often the case with consequentialist theories. Jeremy Bentham criticized religion and its institutions (Bentham, 1818/2011, 1822, 1823/2013). John Stuart Mill proposed a moral theory that was not grounded in religious beliefs, advocating a purely scientific or philosophical approach, a "religion of humanity" (Mill, 1874/1974, pp. 69–124).

Ethics: a current perspective

Ethics, also called moral philosophy, is nowadays taken to be the philosophical discipline concerned with distinguishing between right and wrong or good and bad, regardless of religious beliefs. It encompasses the study of moral systems, beliefs, and practices. It requires higher-level thinking to engage in reflection, critical thinking, argument building, justification, and application of moral beliefs, ideas, and systems (Kaurin, 2018). Ethics is not reducible to personal opinions or preferences, and is often understood as a normative discipline that deals with the obligations individuals have towards themselves and others, including future generations, non-human animals, living beings, supernatural entities, and ancestors' souls. Ethical discussions often include providing reasons for our choices and considering "what it means to be a conscientious moral agent" (Rachels & Rachels, 2018, p. 13).

While scholars in fields such as biology, economics, and cognitive science have tried to describe and explain morality, the capacity for a moral sense in humans is believed to have arisen through an interplay of biology and culture. Although foundational ethical beliefs, such as the proscription of the murder of innocent persons, have remained constant and consistent throughout human history, how ethical standards are interpreted and applied can differ over time and across geographical contexts, and may be influenced by religious views and cultural variables, such as history, institutional regulations, and social ecologies. Every ethical system is based on and reflects a particular cosmology or worldview, which includes beliefs about human nature, the ontological and moral status of other beings, and the essence of reality. As noted earlier in this chapter, some people may view reality as solely material and mechanistic, while others view it as an interconnected web of living entities or a sacred whole. These assumptions can lead to different attitudes toward the natural world. Some may see themselves as exceptional beings, superior to other species and entitled to dominate and exploit nature for their own benefit. Other people may view themselves as part of a tightly interrelated and interdependent reality, responsible for its well-fbeing, and possessing a nature that is not fundamentally different from that of other living beings.

The relationship between ethics and religion has been briefly discussed above, and the remainder of this chapter will focus on 'properly' philosophical ethics, independent of religion, unless otherwise stated.

Engineering ethics: then and now

As a philosophical inquiry, ethics is nowadays divided into three main fields: (1) *meta-ethics*, which deals with the nature and meaning of ethical terms such as 'the good,' 'rights,' and 'obligations'; (2) *normative ethics*, which prescribes norms upon which ethical action ought to be based; and (3) *applied ethics*, which involves the application of moral philosophy, often of a normative nature, to practical issues. The latter is where engineering ethics often finds itself.

Historically, ethics, or moral philosophy, was less compartmentalized than it is today. In Classical Greek philosophy and its Latin medieval development, ethics was concerned with all questions regarding morality and the virtues. Take the case of craft (τέχνη or *tékhnē* – whence we get terms such as 'technique' and 'technology,' so important in engineering), known to ancient and medieval people in the Aristotelian tradition as the intellectual virtue of production (1934, *Nicomachean Ethics* VI.5 1140a *et passim*). Unlike the other intellectual virtues (namely, prudence, understanding, knowledge, and wisdom), which are concerned with the ability to reason and make correct decisions, *tékhnē* involves a practical dimension in the sense that it is the ability to produce something according to a pre-established set of rules and which is in accordance with a pre-established goal (1934, *Nicomachean Ethics* VI.5). Aristotle's distinction between craft and the other intellectual virtues is relevant to engineering ethics in that it highlights the unique ethical challenges posed by the production of technology. While the other four intellectual virtues are concerned either with the individual's theoretical intellect or with guiding moral choice, *tékhnē* involves the creation of artifacts that can have a significant impact on society and the environment. Just as there is virtue in producing conclusions from premises, there is virtue in producing something out of something else (like a statue out of a piece of marble, or a building from stones or bricks). An important caveat, however, is that Aristotle and the tradition that followed did acknowledge that it was possible for someone to be good with regards to this kind of production – that is, to have the *virtue of craft* – without necessarily being wise or being good *absolutely* (1934, *Nicomachean Ethics* VI.5 1140b; Medeiros Ramos, 2021). This raises important questions about the responsibilities of engineers and their obligations to consider the broader ethical consequences of their work, not simply the aptness or 'fit' of what they produce or design. Aristotle's argument that one can be skilled in craft without being wise or good *absolutely* underscores the importance of developing a comprehensive understanding of the ethical dimensions of technology beyond mere technical expertise and the need for investing in engineering ethics education.

Moreover, nowadays, we tend to look for sources beyond the 'Western canon' to inform our practices. Philosophical foundations from various parts of the world offer a diverse tapestry of ethical frameworks. In Asia and parts of the Middle East, sociotechnical systems and practices have evolved in contexts where philosophical and religious traditions such as Confucianism, Buddhism, Taoism, Hinduism, and Islam have been dominant. While the mutual shaping between these traditions and technological developments may not always be evident, understanding these traditions can offer insights into the rich cultural, ethical, and societal milieu in which sociotechnical systems and practices operate. The same is true for South American and African traditions, as discussed below.

Ethical systems and their presuppositions

Western and non-Western

As we have seen in the previous section and as some philosophers have noted more thoroughly, ethics and religious traditions share many foundational beliefs (Hare, 2019). In this section, we will explore some commonalities shared by some religious doctrines – both Western and 'non-Western' – and philosophical moral theories.

Western and the so-called 'non-Western' ethical traditions are rich and diverse, reflecting the historical, cultural, and philosophical influences that have shaped them. While there are some differences between these traditions, it is important to recognize that some ethical values and principles (such as compassion, justice, and respect for human dignity) can be seen as somewhat universal and can be found across most – if not all – cultures and societies.

Western ethical traditions have been influenced by various philosophical and religious perspectives, such as ancient Greek and Roman philosophy, Christian theology, and Enlightenment rationalism. These traditions have emphasized the importance of individual autonomy, reason, and human rights, among other values. In the contemporary Western context, secularism and liberalism have also played key roles in shaping ethical values and principles, to the point where we can no longer "look to Aristotle for any elucidation of the modern way of talking about 'moral' goodness, obligation, etc." (Anscombe, 1958, p. 2).

'Non-Western' ethical traditions, on the other hand, have been influenced by various philosophical and religious perspectives, including Confucianism, Buddhism, Taoism, Hinduism, and Islam. These traditions often emphasize communal and collective values, such as harmony, social order, and respect for authority. Like Western moral philosophy, 'non-Western' ethical traditions are also often closely tied to religious practices and beliefs. Confucianism, Taoism, and Buddhism are often regarded as the fundamental pillars that underpinned the social fabric of ancient Chinese society. Elements from these traditions can be seen as intertwined; for centuries they have co-existed and interacted. Individuals may exhibit reverence and adherence towards all three traditions simultaneously. As philosophies and religions, they had an impact not just on matters of spirituality, but also on domains such as governance, science, arts, and social structure. In recent academic discourse, the cultural and social traditions of East Asian societies, communities, and individuals are sometimes represented under the concept of the 'Global East,' a concept that moves beyond mere geographical boundaries and Euro-centric or North-Atlantic-centric understandings to encapsulate the essence of East Asian thought, its diaspora, and its interactions with the Global Community (Yang, 2018).

There is a common misconception that Western ethical traditions are philosophical and secular, while 'non-Western' traditions are primarily religious and thus second-rate. This misleading and oversimplified view ignores the rich and complex ethical traditions of 'non-Western' cultures. This view ignores that non-European cultures have also developed complex philosophical and ethical systems and that both traditions have been shaped by their respective religious and philosophical contexts. For instance, Western ethical thought, as we have seen, has been deeply influenced by the works of philosophers such as Aristotle, Kant, Bentham, and Mill, often nourished by or read through religious lenses. In contrast, so-called 'non-Western' ethical traditions, such as *Buen Vivir* and *Ubuntu*, as we shall see below, have their own philosophical and religious sources.

Another prevailing misconception, and the reason why we have used 'scare quotes' to talk about 'non-Western' ethics, is that non-European ethics is homogenous. Non-European cultures are often viewed as monolithic and lacking diversity, leading to oversimplified generalizations, while there actually exists a wide range of ethical traditions across different non-European cul-

tures, each with its own unique characteristics and philosophical influences. Grouping them under the generic 'non-Western' label grossly reduces their richness and diversity to a generic form of dissension.

Antithetically, some wrongly see European ethics as universally applicable, while non-European ethics is seen as culturally specific or limited. However, both are shaped by cultural, historical, and philosophical factors and cannot be generalized without understanding their context. On another misinterpretation, non-European ethics is viewed as 'primitive' or outdated, suggesting that non-European cultures are less developed. However, non-European cultures have complex, relevant ethical systems and supporting worldviews on par with European ones.

Seven ethical traditions

Neither European nor non-European ethical traditions are static; rather they evolve and change over time in response to new social, political, and philosophical contexts. We will now examine some Western and 'non-Western' ethical traditions side by side, considering some of their religious or cosmological assumptions. Virtue ethics, deontology, and consequentialism are presented in some more detail in Chapter 2 in this handbook. Since *Buen Vivir*, *Ubuntu*, and Confucianism are typically less familiar to Western readers, we will allocate space here to these three 'non-Western' traditions.

Virtue ethics can be traced back to Ancient Greece, specifically to Aristotle's inquiry in the *Nicomachean Ethics* about what virtues, or traits of character and intellect, make a person good. Aristotle draws on the classical Greek worldview according to which the fulfillment of whatever exists – human beings included – has to do with its fitting into its natural place or realizing its natural *telos* (i.e., the ultimate end or purpose towards which something is directed or aimed), with the human *telos* being flourishing or *eudaimonia* (εὐδαιμονία).

Virtue ethics is not a normative ethical theory per se, for it does not establish a norm that ought to be followed in our deliberation regarding actions. Instead of focusing on actions, virtue ethics focuses on the development and improvement of character through considering our motivations and reasons for acting, as well as our intended goals (Hursthouse & Pettigrove, 2023). Virtue ethics continued to be the standard moral theory in Europe through the Middle Ages, when it was made to accommodate the context of Divine Command Theory and the so-called '*law* conception of ethics' (Anscombe, 1958). It was also in the Middle Ages that the theological virtues of charity, faith, and hope[5] were added to Aristotle's scheme of moral and intellectual virtues. Virtue ethics became less popular after the Renaissance (Grönum, 2015) and, from the seventeenth century on, ethics became more concerned with properly normative theories, such as deontology and consequentialism, which are action focused. Since the mid-twentieth century, however, a revival of virtue ethics has been underway, propelled mainly by Catholic philosophers like Elizabeth Anscombe (especially her 1958 article, "Modern moral philosophy," which was germinal to this revival) and Alasdair MacIntyre.[6] These twentieth-century contributions have sparked ongoing debate and brought virtue ethics back on the map as a theory worth considering in contemporary reflections, regardless of religious beliefs. Proponents of virtue ethics like Philippa Foot and Rosalind Hursthouse, for instance, came to virtue ethics from outside the framework of Catholicism, and their ideas are now ubiquitously taught in ethics classes (see, e.g., Foot, 1978; Hursthouse, 1999, 2007).

Deontology can also seem to share some common ground with religious beliefs (Hare, 2019). Since it is a duty-based ethical theory, it relies on the idea that, at least on some base level, we all owe each other something. The most famous proponent of deontology, Immanuel Kant, is a

thinker from the Enlightenment who considers reason to be the most elevated and distinguishing characteristic of human beings. He takes human autonomy, which derives from reason, to be a requirement for the fulfillment of human nature (Kant, 2019). He also takes human reason and autonomy to be the foundations of the universality of the moral law. Kant's version of deontology, famously expressed through the categorical imperative (Kant, 2019), is grounded on reason (or the universalization of Western, modern reason). He argued that it is a person's reasoning and motives for acting that make an action morally right or wrong – and never the consequences of a given action. There are, however, other versions of deontology that are compatible with *Divine Command Theories* (Alexander & Moore, 2021, section 7). In those cases, it is not human rationality but God's authority that establishes the covenant that binds us to ethical obligations. Deontological ethical theories often serve as a foundation for constructing professional *codes of deontology* or *codes of conduct* in various fields, including engineering. These codes outline the ethical duties and responsibilities that individuals within a specific profession should uphold. They provide a framework that articulates the inherent obligations and rules governing professional conduct, acting as a compass for professionals to navigate ethical challenges and ensure adherence to moral principles.

Consequentialism is a kind of teleological moral theory according to which the criterion for determining the moral value of an action lies solely on the consequences of that action (Sinnott-Armstrong, 2023). Its famous maxim that 'the end justifies the means' dates back to Antiquity, but it is Chinese Mohism which is usually credited with being the earliest recorded form of consequentialist reasoning found in a religious tradition (Fraser, 2022), with its emphasis on impartiality and on the production of beneficial consequences of actions. Modern Western consequentialism traces its origins to Bentham and Mill,[7] classical utilitarians who sought to establish the basis of morality by calculating the positive and negative consequences of actions in order to identify the course of conduct that embodies the principle of utility, that is, the act that maximizes pleasure and minimizes pain for the greatest number of individuals. Modern Western consequentialism takes pleasure and pain as the fundamental drivers for human action and values each individual life equally. A classic example of utilitarian reasoning is seen in cost–benefit analyses (Audi, 2005). Such analyses are often used to tackle issues like the trolley problem, a famous thought experiment proposed by Foot (1978), in which an individual is faced with a moral dilemma: they must choose between switching a lever to divert a trolley and save five people at the cost of killing one person on an alternate track, or doing nothing and allowing the trolley to continue and kill the five people while sparing the one on the alternate track. Utilitarians would typically argue in favor of pulling the lever. This decision is based on the belief that sacrificing one life to save five results in a net gain in overall happiness, as the greater number of lives saved contributes to a more favorable outcome from a utilitarian perspective.

Ethics of care is a relatively new normative ethical theory but one that is fast-growing in popularity. It first sprung from feminism but soon developed into a more general and comprehensive account of both individual and political morality (Engster, 2007; Gilligan, 1982; Held, 1993; Noddings, 1984; Slote, 2007; Tronto, 1993, 2010). It is grounded on a relational understanding of life, either human or non-human, and on our responsibility toward people and nature around us. Although *ethics of care* is usually grouped together with *virtue ethics* because both are non-principial ethical systems, care is a practice more fundamental than cultivating a virtue. It has been argued that without care, there will be no justice, for human development and flourishing hinge fundamentally on the care that those needing it receive. In contrast to the dominant Kantian and utilitarian ethics, which require universality and impartiality in the application of moral principles – and take them as achievable – ethics of care is sensitive to contextual nuances of concrete situa-

tions, the web of relationships a person finds themselves in, and the interrelatedness of the interests of carers and cared-for. Emotions such as empathy, compassion, sensitivity are appreciated; they are relational capabilities that enable morally concerned persons. However, "we need an *ethics* of care, not just care itself," argues Virginia Held: "The various aspects and expressions of care and caring relations need to be subjected to moral scrutiny and *evaluated*, not just observed and described" (Held, 2006, p. 11).

One example of non-Western ethics is Andean *sumak kawsay*, a Quechuan expression translated into Spanish as *Buen Vivir* (Good Living). With some variations, this ethics continues to be practiced and advanced by many Indigenous peoples in South America. *Buen Vivir*'s supporting cosmology presents and enacts reality as a deeply interconnected whole governed by four main principles: relationality, correspondence, complementarity, and reciprocity (Estermann 2006, pp. 125–147). Humans are not exceptional beings detached from nature or superior to other animals. In fact, according to its perspectivism, other animals see themselves as humans and other animals as non-humans (Viveiros de Castro, 2014, chap. 2). Humans, though, have a specific role in the South American Indigenous world. We must act as cosmic shamans, mediating not only the conflicts created by our misconduct, excesses, or disturbance of natural balance but also other beings' misconduct, excesses, or imbalances (Estermann, 2006, pp. 214–215; Kopenawa & Albert, 2013, chap. 2).

We share with other beings – for example, animals, plants, mountains, rivers – the similar spirit and capacity for agency (Viveiros de Castro, 2014, chap. 2). That is why these other beings can also act wrongly. Even though the essential paradigmatic relationship among all beings (humans included) is that of hunter and prey, that does not lead us into a Hobbesian war of all against all because there is a natural tendency toward balance or cosmic order and because breaking the natural laws or balances leads to punishment (e.g., drought, flooding, lack of prey, disease) (Kopenawa & Albert, 2013).

Buen Vivir is thus closer to Stoicism than to Aristotle's virtue ethics or to Kant's deontology. "The moral order as a system of reciprocal relationships corresponds to the cosmic order as a system of complementary and corresponding relationships. Therefore, [*Buen Vivir*] is not so much a reflection on the normativity of human behavior but on its 'being' within the holistic whole of the cosmos" (Estermann, 2006, p. 246). Then, *Buen Vivir* is "both teleological and deontological ethics: the purpose of acting ethically (*telos*) is the conservation of the [cosmic] order, which at the same time is the fulfillment of a normativity felt as a duty" (Estermann, 2006, p. 252).

Buen Vivir's uniqueness, which makes it worth presenting in this handbook, primarily concerns its supporting cosmology and the distinctive way South American Indigenous peoples have lived for centuries and keep living when allowed to do so, compared to the hegemonic Western, capitalist, urban ways of life. Based on *Buen Vivir*'s principle to "Act in such a way that you contribute to the conservation and perpetuation of the cosmic order of vital relationships, avoiding disorders thereof" (Estermann, 2006, pp. 51–52), South American Indigenous peoples have shown how our ways of living can be more than only harmless to 'nature,' they can help it grow stronger, more diverse, resilient, and complex (Cunha & Almeida, 2004).

Nothing could be more appealing to us today than to (re)learn ways of living that promote nature instead of destroying it. Agroecology and malocas, as mentioned earlier, are but two examples of technology that help us get closer to fulfilling this ideal. They are two versions of a South American Indigenous cosmotechnic, drawing on and enacting or supporting the relational and interdependent cosmology they possess and allowing them to structure their collective and individual lives accordingly. An engineering practice capable of producing or improving these and other versions of South American Indigenous cosmotechnics seems highly desirable not only

for the sake of working with these peoples in sociotechnical projects of their interest but also to increase non-Indigenous peoples' capacity to conceive and construct, for instance, 'nature-improving' sociotechnical solutions.

Crossing the Atlantic, we arrive in Africa, the homeland of *Ubuntu*, a unique ethics found in communities of virtually every Sub-Saharan country and rooted in notions of communitarianism, reconciliation, relationality, and interdependence (Mabele et al., 2022, p. 2). *Ubuntu*'s cosmology, like that of *Buen Vivir*, presents and enacts reality as a deeply interconnected and interdependent whole. Therefore, it makes no sense to consider an individual as an autonomous being or to take human beings as exceptional (or superior) and detached (or different in their nature/essence) from every other living being, as many Western ethics do (Mabele et al., 2022, p. 8). Unlike *Buen Vivir*, though, the central stage is not occupied by a naturally ordered cosmos and by the continuous duty of harmonizing unbalances (or injustices) caused by this cosmos' constituents, that is, human and non-human beings. Instead, *Ubuntu* focuses on the community, which starts with the community of other human beings that a person belongs to but also encompasses the person's ancestors and descendants (current and future), every other living being, and the gods (Mabele et al., 2022, p. 5; Ewuoso & Hall, 2019, p. 99). Humanness is not something a person possesses in themselves but something they accomplish through – and as – caring and life-fostering relationships with all the members of their (widened) community (Le Grange, 2019, p. 325; Ewuoso & Hall, 2019, p. 98).

The centrality of community does not mean the negation of oneself. Instead, taking the good of the (widened) community or well-being as one's primary duty means acknowledging that one cannot be well if one's community is suffering and, conversely, a community is not well if it causes suffering to (some of) its members. In other words, if one causes harm to the community, they cause harm to themselves; if one seeks good for the community, they benefit themselves (Dju & Muraro, 2022, p. 248; Ewuoso & Hall, 2019, p. 97). Therefore, *Ubuntu* does not stand for resignation concerning possible social injustices but rather for always having in mind the affirmation of others' lives and humanness as part of our search for affirming our own lives and humanness (or the conjugation of others' needs with the search for fulfilling one's own needs) (Ewuoso & Hall, 2019, p. 96; Mabele et al., 2022, p. 6). In sum, "The struggle for individual freedom, social justice and environmental sustainability is one struggle" (Le Grange, 2019, p. 325). For *Ubuntu*, "the morally right action is one that connects, rather than separates" (Ewuoso & Hall, 2019, p. 99). Thus, for some scholars, *Ubuntu* is a form of ethics of duty, while for others, it is a virtue ethics (Dreyer, 2015, p. 199; Le Grange, 2019, p. 324; Metz, 2007, p. 383).

As with *Buen Vivir*, *Ubuntu* brings forward aspects frequently forgotten in average dominant Western ways of life, so obsessed with individual autonomy and happiness. In the case of *Ubuntu*, core aspects have to do with the necessary commitment to a community's well-being, the sacredness of life-fostering relationships (to all living beings and to our descendants, ancestors, and gods), and the centrality of life and life fulfillment in our existences.

When it comes to technological development, *Ubuntu* was and still is taken as a paradigm for producing technologies attuned to, or supporting, other possible sociotechnical realities (or cosmotechnical orders). That is the case – or at least was at the beginning – of the free software Ubuntu. Many free software communities also (claim to somewhat) draw on the *Ubuntu* philosophy and ethics, understanding that "while a single company is responsible for all enhancements in a program, free software is not only free but there is a community ready and willing to improve it and distribute these improvements" (Augusto-Vieira, 2016, p. 44). More recently, *Ubuntu* has also been taken for the enrichment of artificial intelligence (AI) governance, emphasizing processes of co-operation and social harmony through the inclusion of communities most affected by AI's potential harms (Mhlambi, 2020).

Transitioning from the communal ethos of *Ubuntu*, we now journey to East Asia, exploring the tradition of *Confucianism* (also explored briefly in Chapters 32 and 33 in this volume, on accreditation of engineering ethics). This ancient yet enduring philosophy offers another relational perspective on ethics, emphasizing the role of individuals within society and the cultivation of virtues that nurture both personal and societal harmony.

Confucianism is one of East Asia's foundational ethical and philosophical systems. This tradition emphasizes a relational ontology wherein individuals exist within a dense web of duties and responsibilities. These duties are defined by various societal roles, whether familial, as seen in parent–child dynamics, or societal, as observed in friend–friend and ruler–subject interactions. Central to Confucian thought are virtues like *Ren* (仁, often translated as benevolence or humanity), *Yi* (义, righteousness or justice), *Li* (礼, ritual propriety), Zhi (智, wisdom), and Xin (信, trustworthiness). *Ren* is regarded as one of the highest values incorporating kindness and human-heartedness. According to Confucius, it is achieved through "loving others" (1998, Analects 12.22) and "overcoming oneself and returning to ritual propriety" (1998, Analects 12.1), meaning that *ren* operates within a web of virtues, rooted in traditional familial and social networks.

Contemporary Confucian society places a strong emphasis on *he* (harmony). Confucian harmony is both a metaphysical and a moral concept. It is not about uniformity but rather about the co-existence of different diverse elements, about working through creative tensions and establishing favorable relationships among them. In comparative philosophy, Confucian harmony has been discussed as a cosmic, personal, and social virtue, an ideal in relation to nature (Bell & Metz, 2011; Li & Düring, 2022). According to one of the most comprehensive scholarly introductions to Confucian harmony. authored by Li Chenyang, *he* consists of a dynamic process of harmonization instead of conformity to a pre-set order (Li, 2013). The human world, composed of individuals, families, communities, and societies, is not naturally harmonious. In this sense, the development of moral character and the attainment of harmonization may coincide within the Confucian person-making philosophy; a person of *ren* is capable of harmonizing within oneself, with others, and with the world.

When Confucianism is juxtaposed with *Ubuntu*, we see that both ethical systems clearly underscore relational ethics. However, while *Ubuntu*'s spirit 'I am because we are' underscores interconnectedness and mutual respect for one another, Confucianism delves deeper into the structure and dynamics of social roles and the duties arising from them. In a comparative analysis with Western philosophical traditions, it becomes evident that both Aristotle's virtue ethics and Confucianism champion the cultivation of virtuous character and self-examination (or *zixing*). However, the virtues which Aristotelian ethics seeks have a teleological basis: contributing to individual flourishing or *eudaimonia*. Confucian philosophy lacks teleology in the sense of a preconceived cosmic design. While Aristotle endeavors to offer an account of human relationships in the context of justice and friendship, his emphasis remains on the individual (Sim, 2007). In contrast, in Confucian philosophy, the development of virtues is contingent upon social interactions, ritual observance, and the emulation of exemplars (Lai & Lai, 2023). A lifelong process of "learning to be human," as neo-Confucian scholar Tu Wei-Ming puts it, occurs through the "creative tension" between our social context and our potential for self-transcendence (Wei-Ming, 1985, p. 15).

In the Chinese context, many academics have used historical traditions to explain a Chinese philosophy and ethics of engineering and technology. Li Bo-cong (2002) first brought the Dao–Qi relation to the forefront. Here, the Dao symbolizes the heavenly pattern and the natural laws, while Qi embodies the material, the tangible, and the instantiation of Dao. This dialectic hints at a tripartite system where science is for understanding, technology for creating, and engineering for application. Similarly, Pak-Hang Wong (2012) proposed reconstructing the Confucian notions of

Dao, harmony, and personhood, so that an alternative ethics of technology based on the Confucian tradition may then offer an antidote to the atomistic view of humans. Such an interpretation causes engineering ethics to transcend the bounds of professional ethics, as it necessitates the identification of both harmony and discord in technology–society relations, and a closer examination of the nature of affected social roles and the responsibilities attached to them.

Closing remarks

As stated at the beginning, this chapter intended to provide some philosophical foundations that could help us – engineering teachers, researchers, and engineers – not to take the ethical-political and cosmological bases of the dominant engineering practices for granted but to consider them critically. As seen, those bases are, to a non-negligible extent, contingent, particular, local, and non-universalizable. What is more, not only is engineering practice (and the technology produced via engineering practice) shaped by the dominant ethical-political and cosmological values and understandings, but it also supports or emulates a reality that reinforces both aspects to the benefit of the powerful who profit somehow with them and to the detriment of a vast majority of disempowered people(s). That is why one cannot be politically or cosmologically neutral when engaged in engineering, for the activity and its outputs either support or confront the status quo. The only real choice is between being (or trying to be) conservative or progressive.

Whatever choice one makes, that choice will be free, informed, and/or justified if it is not based on illusions or misconceptions but on serious, supported critical reflection. With this chapter, we aimed to offer an opportunity for our readers to become acquainted with or go deeper into some well-founded, up-to-date thoughts on engineering, technology, and ethics. Hopefully, such reflections can help you be better positioned to choose how you will practice, teach, or do research on engineering in a more informed way – or in better accordance with your worldview, political perspective, ideals, and so on.

Throughout the chapter, even though we acknowledged systemic forms of power (like capitalist structures and religious actors and institutions) that force the world (and engineering with it) to be one way or another, much emphasis was given to individual and local disruption (like progressive engineering and popular engineering) as though they could be achieved without any constraint, as the result of a mere acknowledgment of how reality is. That is deceiving. There are no individual superheroes capable of overcoming oppression, of freeing or emancipating any given marginalized group or community. But there can be collective initiatives, even small ones, that manage to face these systemic forces and, if only locally and for some time, succeed. Even when they do not last much longer, their success is (or can be) a powerful reminder that other worlds, with these other forms of engineering they demand, still are – as they have always been – possible.

Notes

1 Empowerment can be defined as the "multi-dimensional social process that helps people gain control over their own lives" by fostering power in people and groups/communities to operate the changes they may want in their own lives, territories, and society (Page & Czuba, 1999). Empowerment is liberative or emancipatory whenever it allows individuals and groups to improve their lives – i.e., "being more fully human" (Freire, 1970, chaps. 1–2) – and/or fight for their rights or for building other possible social realities and/or ways of living, without dwarfing other people's and groups' rights or legitimate search for self-determination.

2 'Decolonial' and 'emancipating' can reasonably be taken as synonyms. For more on Decolonial Theory, see Chapter 9 of this handbook.

3 At that time, philosophers from different traditions considered philosophy to be subordinate to theology. Al-Ghazâlî, writing in the philosophical tradition of the Islamic world, upheld such a belief, as did Bonaventure, a Franciscan friar and professor at the University of Paris. But not all philosophers in the Middle Ages held the same view. An obvious counterexample is Ibn-Rushd's retort to Al-Ghazâlî (de Libera, 2019).
4 In short, Aristotle's theory explains that everything has four fundamental aspects (called 'causes,' αἴτιᾰ): *material cause* (what a thing is made of), *formal cause* (what it is, its structure or form), *efficient cause* (what caused it to be or where its change comes from), and *final cause* (what its good, purpose or goal is) (Falcon, 2023).
5 In reference to Paul of Tarsus' letters, such as 1 Thess, 1:3, 1 Thess. 5:8, and 1 Cor. 13.
6 See, e.g., MacIntyre's (1981/2013) renowned book *After Virtue*.
7 Although Bentham and Mill used somewhat different criteria in their calculations, both of their approaches remain influential in contemporary ethical theory.

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