Canons against Cannons? Social Justice and the Engineering Ethics Imaginary

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Abstract

What if social justice were a core value for engineers? Is it possible, or desirable, to canonize social justice in a professional code? In this thought experiment, we borrow directly from the ethics code of the National Association of Social Workers (NASW), for whom social justice is a core value, as well as prior work of scholars in the Engineering, Social Justice, and Peace community (esjp.org), to generate and explore new values, principles, and standards that reflect social justice aspirations for engineers. The following six principles will be explored:

- Engineers' primary goal is to help people in need and to address social problems
- Engineers challenge social injustice
- Engineers practice cultural and epistemic humility
- Engineers respect the dignity and worth of each person
- Engineers recognize the central importance of human relationships
- Engineers seek to live in peace with their individual selves, others, and the planet.

These are meant to exist alongside values and principles expressed in current engineering ethics canons.

We begin with a discussion of the lack of a central social good to which engineers aspire as a profession, and the inadequacies of public paramountcy as an aspirational vision. We argue that engineers do need such a vision, and propose social justice be adopted as this vision's foundational component. The proposed engineering ethics canons center on social justice and include articulation of values, statements of principles, and elaboration of standards. We conclude with a discussion motivating social justice as a value that all engineers can adopt.

Introduction

Social justice is an aspirational value conceptualized in contrast to injustice, and is best defined by those most closely experiencing that injustice.[1] Notions of social justice vary by time and by affected population. Studying previous social justice movements can provide some examples of key principles such as ending systems of oppression like racism, colonialism, classism, ableism, sexism, heterosexism, gender normativities, xenophobia, ageism, and others; resisting the systematic silencing or discrediting of local knowledges and scientific counter-knowledges that challenge dominant ways of thinking, knowing and doing; creating equity and processes of fair treatment of all groups; respecting human rights and the dignity of all persons; respecting autonomy and meaningful participation of all stakeholders; restoring right relationships among peoples and the environment; and fostering peace. Central questions social justice advocates ask about a situation include who wins? Who loses? Who is at the table and who is not? Who is empowered to act and react? Action and theory are connected through praxis, and experiences of injustice often give rise to theories and critiques. For example, theories of intersectionality, critical race theory, feminist theory, crip theory, queer theory, decolonizing theory, deep green resistance and others have grown from these interactions. Critiques of specific phenomena such as the military-industrial-academic complex, the prison-industrial complex, neoliberalism,

privatization and globalization, have emerged and interacted directly with social movements. Engineers play a strong role in enabling and reinforcing each of these latter phenomena but rarely interface with either justice movements or justice theories related to them.

In keeping with these notions of social justice, the title metaphor of this paper – ***canons against cannons*** – goes beyond literal opposition to the profession's practical and ideological connections to the military-industrial-academic complex and war,[2] and refers more broadly to the profession's tendency to marginalize, ignore, silence, and/or atrophy the following central elements of ethical engineering practice:

- Non-technical dimensions of engineering (as if the social and political characteristics, antecedents and implications of engineered systems can be excised)
- Local knowledges and scientific counter-knowledges that depart from dominant paradigms of engineering thought and practice and, at times, even challenge or oppose the profession's status quo
- Emotional, moral, and intellectual agency of all persons (including engineers themselves)
- The public as the profession's primary client.

The public paramountcy clause (engineers' responsibility to "hold paramount the safety, health, and welfare of the public") can result in suboptimal engineering interventions, and even public harm, if we don't ask about a situation questions like, who gets to define "safety," "health," and "welfare" and for whom? In other words, public paramountcy means little if we implement it in ways that replicate the status quo and cannot attend seriously to communities most vulnerable to social injustice. When we teach engineering as if it is culture- and value-free, and train students to undervalue, if not outright ignore, perspectives and knowledges that diverge from dominant engineering points of view, we institutionalize cultural and epistemic injustice. By doing so we risk the erasure of not only publics, but also the intellectual, emotional, and self-reflective lives of engineers themselves that fail to "fit into" prevailing professional paradigms of thought and practice.

Cannons refers then not only to military annihilation but also to the systematic drowning out of voices/perspectives that diverge from, challenge, or oppose the engineering status quo. We propose that these voices and perspectives are essential for the development of technically and morally robust engineering research and practice. In fact, they are the very thing that would enable engineering to truly hold paramount the safety, health, and welfare of the public, and realize philosopher Charles Harris' proposed ideal of bettering "the material basis of human well-being or quality of life."[3]

This paper engages in a thought experiment of moral imagination: what if the profession of engineering held social justice as a central aspirational ethical tenet? What if such a tenet formed the cornerstone of the public paramountcy clause? To explore this idea, we borrow directly from the ethics code of the National Association of Social Workers (NASW), for whom social justice is a core value, as well as prior work of scholars in the Engineering, Social Justice, and Peace community (esjp.org), to try things on for size. Our goal is to generate and explore new values, principles, and standards that reflect social justice aspirations for engineers.

We begin the paper by motivating the need for a clear social good to which engineers can aspire as a profession, and argue that the current default use of public paramountcy alone as an aspirational vision is inadequate. Using three case studies, we show how in each case an overall lack of a well-defined social good for engineering as a profession, the vagueness of public paramountcy, and a specific absence of focus on social justice, all played a role in engineers' moral disengagement and associated public harm.

We propose social justice be adopted as the foundational component of engineering's aspirational vision, and look to the profession of social work for guidance, because of its commitments to public welfare and the social good, built around social justice as an organizing vision. We then propose new engineering ethics canons centering on social justice as an exercise in ethical imagination. We conclude with a discussion motivating social justice as a value that all engineers can adopt, and consider how social justice might be practically operationalized in engineering ethics.

To What Does the Profession of Engineering Aspire?

Examinations of the social good to which the engineering profession aspires have given rise to numerous compelling critiques. Scholars from different disciplines including engineering, philosophy and ethics, and science and technology studies have approached the issue from diverse angles, but in the end they tend to home in on the same general question: if the social good to which physicians aspire is human health, and the social good to which lawyers dedicate their work is legal justice, what is the social good that guides engineers in the application of their technical expertise? In other words, what is the engineering profession's aspirational vision?

To be sure, a foundational directive in engineering codes of ethics is what is referred to as the public paramountcy clause: engineers' responsibility to "hold paramount the safety, health, and welfare of the public." Does public paramountcy alone, however, make for an aspirational vision, and if so, are engineers equipped to promote it?

Philosopher Charles E. Harris, Jr., among others, has argued that the directive reflects more of a preventive than an aspirational value because it urges practitioners to avoid causing harm.[3] Indeed, responsibility to hold an ideal paramount is substantively different from responsibility to promote the same ideal. For example, teachers, pilots, and doctors must all hold paramount the health and safety of the individuals in their charge, but among them only doctors must dedicate their work to the promotion of these individuals' health and safety. The American Medical Association's (AMA) Code of Medical Ethics states that physicians are obliged to provide "competent medical care, with compassion and respect for human dignity and rights."[4] The American Bar Association's (ABA) Model Rules of Professional Conduct urge lawyers to function as "representative[s] of clients, [officers] of the legal system and [public citizens] having special responsibility for the quality of justice."[5] Where does the public paramountcy clause leave engineers? Harris reminds us that, "One does not enter a profession merely to avoid engaging in professional misconduct or harming the public. The best way to comply with these essentially negative aims would be to avoid becoming a professional altogether" (179).[3]

Public Paramountcy Fails as Aspirational Vision

Attempts to entertain the public paramountcy clause as a potentially workable aspirational vision have also resulted in unsatisfactory results. If the social good to which engineers aim is the

safety, health, and welfare of the public, does engineering education equip practitioners to make informed judgments about what constitutes "health," "safety," and "welfare" in different contexts and for different publics, and how to best promote these ideals through the application of engineering expertise? Do engineering ethics education and professional codes of conduct render engineers competent in matters of the social good? Do engineering societies and associations serve as effective guardians of the profession's aspirational commitment?

Scholars who have grappled with these questions point to important deficiencies:

1. Conventional engineering education places almost exclusive emphasis on technical knowledge. The material taught is routinely presented as if it exists separately from society, in an insulated sphere of quantification and objectivity. Social and political influences over this knowledge, and ways in which engineering decisions, practices, and products might affect the social good, are usually ignored.[6,7] Philosopher Carl Mitcham offers the following critique:

   > Engineering is commonly defined as the art or science of "directing the great sources of power in nature for the use and the convenience of humans" (*McGraw-Hill Encyclopedia of Science and Technology*, 2008). [...] But there is nothing in engineering education or knowledge that contributes to any distinct competence in making judgments about what constitutes "human use and convenience." Engineering as a profession is analogous to what medicine might be if physicians had no expert knowledge of health or to law if attorneys knew nothing special about justice.[8]

   Robert Zussman makes a similar observation in his sociological study of engineers, *Mechanics of the Middle Class*:

   > The technical rationality that is the engineer's stock-in-trade requires the calculation of means for the realization of given ends. But it requires no broad insight into those ends or their consequences. Engineers are aware of, are trained to be aware of, these limitations; insofar as they do consider ends, they cease to act as engineers.[9]

   It has been argued that the marginalization of the social in technology-based engineering curricula tends to be so severe that it atrophies practitioners' ability to integrate technical with non-technical; cultivates a sense that technical and non-technical are incompatible, if not in outright conflict; and fosters a "culture of disengagement" that attenuates rather than strengthens engineers' commitment to the social good.[7,10]

2. Conventional engineering ethics education has also been criticized for failing to instill in engineers competency in promoting the public's health, safety, and welfare.[8,10] Focused heavily on the examination of codes of ethics through fixed and predetermined case studies, engineering ethics education tends to center on micro-ethical dilemmas to the exclusion of the larger societal forces that might be at play. In 1990, philosopher of technology Langdon Winner offered a tongue-in-cheek example of an engineering ethics case study in which an engineer is faced with a decision about whether or not to blow the

whistle on a toxic-paint coating on a cruise missile. Winner notes that case studies such as this "usually point students toward specific troubling incidents within what are assumed to be otherwise harmonious patterns in ongoing institutions. The patterns themselves, however, are not identified as anything problematic."[11] He further explains that because of the structure of case studies, the context is never critically considered. For example, in the case of the cruise missile the decision to participate in building nuclear weaponry is not only rendered invisible, but is tacitly sanctioned.

Similarly tacit in the case study approach is the presumption that engineers are technological stewards who have the capacity to make informed judgments about appropriate professional conduct without consulting with the publics that their judgments may affect. Indeed, engineering ethics education does little to bring engineers into contact with diverse – technical and non-technical – points of view, failing to expose that concepts such as "health," "safety," and "welfare" are socially constructed, value-laden, fluid, and informed greatly by one's particular history, values, circumstances, and position in the world. As English scholar Julia M. Williams suggests, it is not a "big leap" to turn expectations of engineering stewardship into a "technological paternalism, an 'engineer knows best' perspective that puts the engineer at odds with society."[12]

3. Lastly, the engineering profession at large and professional engineering organizations more particularly have been criticized for failing to engage in critical self-reflection on the close ties between engineering and warfare and to take a stance on war-related engineering decisions, practices, or products that violate clearly the public paramountcy clause.[1,2,13] For example, in contrast to groups like the American Psychological Association (APA), which in 2009 prohibited the use of psychological expertise to facilitate human torture "in any form, at any time, in any place, and for any reason,"[14] and the British Medical Association (BMA), which in 2007 issued a report condemning the use of drugs as weapons and affirming that "healthcare professionals have a duty, in addition to promoting individual and public health, to promote international law especially in relation to weapons and violence,"[15] engineering societies and associations have had little to say about the application of engineering expertise toward immoral, if not illegal, military actions. In his discussion about this failure, engineer and ethicist W. Richard Bowen points out the engineering profession's conspicuous silence regarding evidence that modern weapons technologies have killed and injured hundreds of Iraqi civilians, including women and children, and drone strikes in Pakistan have been, in most cases, regarded as illegal under international law.[13]

Do We Need an Aspirational Vision?
The engineering profession's ill-defined and anemically-embraced greater purpose has led to impassioned calls for the creation of a clear aspirational vision that engineers know they have a special obligation to promote.[3,13] One could ask if such a vision is necessary. We believe it is. In its absence, engineers are left on their own to define how exactly they will serve society and to apply their expertise as best as they see fit (or convenient). Without a strong sense of moral direction from their profession, they are left vulnerable to assuming that their work promotes the social good just because they are engineers. Indeed, we have witnessed our own engineering students hand-wave through ethics discussions on this premise: "Engineers serve society; thus our actions are ethical."

The risk we see in this arrangement is that it tacitly sanctions technological paternalism (i.e., engineering interference with an individual's or community's articulation of their best interests for the implied good of the individual or community), not unlike the paternalism documented in the history of the medical profession. Indeed, the force that gave rise to bioethics was skepticism among professionals inside and out of medicine about the ability of the AMA's 19th and early 20th century Code of Ethics to guide doctors through modern medical dilemmas with potentially significant implications for their patients.[16] Revelations about, on the one hand, horrifying misuses of medical power (e.g., systematic abuses of concentration camp prisoners during World War II, experimental injections of live cancer cells into US prisoners and elderly patients in the 1950s and 1960s) and, on the other hand, promising but perplexing advancements in medical research and practice (e.g., discovery of the DNA molecule, first human organ transplantation), prompted a diverse group of scholars to pioneer a new ethic that aimed at employing universal principles to address complex new developments in the use of medical expertise. Informed by the civil rights movement, bioethics was founded as an interdisciplinary field that acknowledged the capacity of any medical action to violate fundamental patient rights and questioned authoritative applications of physician power, even when these applications were well-intentioned.[17]

Today, it is frequently claimed that engineering "advances the human condition," "improves the quality of human life," and "enhances human welfare."[18,19,20,21] Harris makes a powerful case for an aspirational vision that centers precisely on these claims. He states, "...engineering is especially associated with the material or physical factors that are important in enabling people to achieve a high quality of life or well-being. Therefore we can say that *the social good of engineering is the promotion of the material basis of human well-being or quality of life*. I propose that this is the good in view in aspirational ethics in engineering" (emphasis in original) (181).[3]

We agree that the social good of engineering could be "the material basis of human well-being or quality of life." But we believe that such a vision can perpetuate techno-centric presumptions both about the advantages of engineering technologies and about the public's steady and monolithic desire for them. The question for us is, how does an aspirational vision like the one proposed by Harris protect the public from paternalistic applications of engineering decisions, practices, and products in the name of human well-being and quality of life? If engineering is an exercise in social experimentation, as some have asserted,[22,23] how does Harris' vision protect the most vulnerable from harm? We suggest that one possible step toward a more robust aspirational vision might be the adoption of social justice as a core value for engineers. Our aim is to generate and explore new values, principles, and standards that could throw into sharp relief the inextricable link between promoting "the material basis of human well-being or quality of life" and advancing social justice.

Why Social Justice as Aspirational Vision?
Below are three cases in which engineers act in morally disengaged ways, with deeply unjust consequences for affected communities. Consider how an overall lack of a well-defined social good for engineering as a profession, the vagueness of public paramountcy, and a specific absence of focus on social justice, all play a role in each case.

Case 1: The Peace Bridge is an international border crossing for approximately 6 million cars, trucks, and buses a year, connecting the City of Buffalo, NY to Fort Erie, Ontario over the Niagara River.[24] It is owned and operated by the tax-exempt Buffalo and Fort Erie Public Bridge Authority (PBA), which draws its revenue primarily from toll charges, duty-free sales, and lease payments on its property.[25] For the past 7 years, PBA has been trying to implement a major expansion project that would widen the Bridge entry point into the US in order to improve vehicle access to the 16-lane US customs plaza in the Lower West Side of Buffalo. PBA's plans have been met with fierce resistance from residents living close to the plaza. One of the residents' main concerns is that the planned expansion would increase vehicle traffic and worsen air pollution. At the April 25, 2014 audio-taped meeting of the PBA board of directors, the New York State program manager for Peace Bridge projects, an engineer and former Vice President of the American Society of Civil Engineers (ASCE),[26] was recorded making recommendations for ways to push PBA's plan forward without attracting public attention. After referring to resident requests for informational materials in multiple languages as a "crazy thing" with which New York State complied simply to "check the box," the engineer advised PBA to refrain from issuing celebratory announcements about the project until the window of opportunity for public challenges closed. "I think some of [the rationale] has been a conscious decision not to kick sleeping dogs that otherwise might not be paying as close of attention as they are," she said, referring to project opponents.[27,28] Buffalo's Lower West Side is one of the poorest and most ethnically and nationally diverse neighborhoods in the city. Residents there suffer from increased rates of asthma, which has been reported to afflict 1 in 3 households and one quarter of the children in the local elementary school. Studies have linked the problem to traffic pollution from the Bridge, and especially diesel trucks.[24,29] In a recent letter to The Buffalo News, an environmental health scientist and educator wrote: "Benefits arising from the bridge and proposed plaza expansion accrue to people who live far from the Lower West Side, while residents of the area suffer the health risks and lower quality of life from bridge traffic. Gaining a voice for residents in the plaza planning process has been an uphill battle, and residents' concerns are usually dismissed or ignored."[30]

<p style="text-align:center">***</p>

Case 2: Between 2003 and 2014, automotive engineers at the National Highway Traffic Safety Administration (NHTSA) received over 260 consumer complaints about General Motors' (GM) cars suddenly shutting down while in motion. The engineers deemed the evidence insufficient for opening an investigation. NHTSA's chief counsel later explained that the agency investigates only those cases that pass a legal test of "unreasonable risk to safety." He further specified that the "'term 'reasonable' is a legal term, which is very elastic and means a lot of different things in a lot of different contexts.'"[31] The engine shut downs were subsequently attributed to a faulty ignition switch, which has been blamed for 30 deaths and 31 injuries, and has resulted in over 2.5 million automobile recalls.[32]

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Case 3: In late 2000 to mid-2001, water samples from consumer taps in Washington, DC alerted the local water utility that lead-in-water levels had risen to hazardous concentrations that could affect tens of thousands of District homes.[33] Rather than notify residents about the contamination and instruct them on how to best protect themselves from exposure, scientists and engineers at the water utility illegally invalidated several elevated lead-in-water measurements and issued a false report claiming that the city's drinking water met all federal standards.[34] The contamination remained unexposed and unaddressed until January 2004, when the Washington Post made it public.[35] In a subsequent investigation, the utility's Chief Engineer recalled that signing the false report gave him a reassuring sense that the "crisis" had been "averted" (47).[33] From his perspective, the "crisis" was the utility's obligation to meet federal Lead and Copper Rule (LCR) remediation requirements that mandate extensive public education and costly lead service line replacements. Later research by two engineers and a pediatrician linked the Washington, DC 2001-2004 water crisis to an increase in fetal deaths and to elevated blood lead levels (>10 micrograms per deciliter) in hundreds, and possibly thousands, of District children 2.5 years of age and younger.[36,37,38,39]

Cases like these beg the question: How can engineers hold paramount the health, safety, and welfare of the public without a sophisticated understanding of who the public is, and how public health, public safety, and public welfare are locally situated and mediated through systems of power in which inequality is manifest? How can engineers advance the human condition without a clear understanding of the fact that all engineering decisions, practices, and products serve larger interests, and of the moral imperative to know whose interests these are, whose they are not, and what would be "better" and for whom? How can engineers begin to achieve such an understanding in the absence of systematic training in the social and political dimensions of their work and in skill sets and ethical practice guidelines required for listening to the voices of diverse stakeholder communities – and especially the disempowered?

Looking to the Ethics Codes of Social Workers
Several professional codes of ethics mention social justice explicitly. The American Counseling Association (ACA) assigns to counselors the responsibility to "[treat] individuals equitably and [foster] fairness and equality."[40] The American Occupational Therapy Association (AOTA) requires "personnel [to] provide services in a fair and equitable manner."[41] The American Institute of Certified Planners (AICP) names as a practitioner's primary obligation the pursuit of "social justice by working to expand choice and opportunity for all persons, recognizing a special responsibility to plan for the needs of the disadvantaged and to promote racial and economic integration." The AICP code further states that occupational therapists "shall urge the alteration of policies, institutions, and decisions that oppose such needs."[42] Other professional codes, like that of the American Psychiatric Association (APA), emphasize practitioners' right to fight social injustice.[43]

The one profession that names social justice as central to its moral mandate is social work. NASW adopted social justice as a central organizing principle in 1996.[44] Even though social

workers employ a different disciplinary framework, worldview, and toolset from engineers, much of their ethics code is instructive for the engineering profession. Social justice provides, at a minimum, one answer to the question "what would be 'better'? for whom?" NASW's mission is "to enhance human well-being and help meet the basic human needs of all people, with particular attention to the needs and empowerment of people who are vulnerable, oppressed, and living in poverty."[45] But the profession's commitment to social change and social justice is tied to four important ethical standards: self-determination, informed consent, cultural competence and social diversity, and public participation. These standards place social workers *in relation to* their clients, be they individuals, families, groups, organizations, or communities. They create a framework in which clients have agency and the right to define their own needs and aspirations, and make informed decisions about what services to seek and when. Specifically (quoting from the NASW Code[45]):

1. Self-determination calls on social workers to support clients in clarifying their goals and to respect clients' right to make autonomous decisions in pursuit of these goals.
2. Informed consent urges social workers to offer clients clear and accessible information in a language they understand about the nature and purpose of the services available to them, related risks, associated costs, alternative solutions, and the right to decline or withdraw from services.
3. Cultural competence and social diversity requires social workers to be aware of the culture of all their clients, provide services that are sensitive to this culture and respectful of diversity within every culture, and seek to understand forces and relationships of oppression between and within cultures.
4. Public participation asks social workers to facilitate the public's influence over policies and institutions affecting public welfare and the social good.

Under this construction, which combines a broad vision of the social good with moral standards that require public participation in the articulation and implementation of this vision, the NASW code of ethics tells its practitioners the following: that "what would be better" and "for whom" must be defined in dialogue with the very people social workers are out to serve, and always with close attention to the needs of those who are "vulnerable, oppressed, and living in poverty" in the context of systems of power that promote and perpetuate injustice. From this perspective, the social good of an international bridge expansion, or a new line of cars, or the delivery of drinking water to a large metropolitan area cannot be assessed, and certainly cannot be celebrated as a modern social feat, without taking into account the following: a) whose interests are served from the improved vehicle access to the customs plaza, or the determination of insufficient evidence to conduct an investigation into driver complaints, or the invalidation of high lead-in-water measurements, b) what the self-defined needs are of individuals who are excluded from the decision-making table but are suffering from asthma, or experiencing their car engine shut down in the middle of the road, or using unfiltered tap water to make infant formula and prepare food for toddlers, and c) what value, if any, and by whom, is assigned to scientific studies showing public harm from contaminated air or water.

In addition to borrowing from social work, our thought experiment includes ideas put forward by the Engineering, Social Justice, and Peace network, and particularly the work of George Catalano.[46]

Proposed Canons
The canons below are modeled directly after the NASW code[45] and Catalano's work.[46] We purposefully use a great deal of their language verbatim. Scholarly attribution is given here rather than quoting specific phrases below so as not to break the flow of the presentation. Comparing canons of different professional societies in engineering will reveal that near-verbatim adoption of phrases and canons from one another is not uncommon.

Ethical Values and Principles

- **Value:** *Service*
- **Ethical Principle:** *Engineers' primary goal is to help people in need and to address social problems.*
  Engineers elevate service to others above self-interest. Engineers draw on their knowledge, values, and skills to help people in need and to address social problems. Engineers are encouraged to volunteer some portion of their professional skills with no expectation of significant financial return (pro bono service).

- **Value:** *Social Justice*
- **Ethical Principle:** *Engineers challenge social injustice.*
  Engineers pursue social change, particularly with and on behalf of vulnerable and oppressed individuals and groups of people. Engineers' social change efforts are focused primarily on issues of poverty, environmental racism and classism, and other forms of social injustice. These activities seek to promote sensitivity to and knowledge about oppression and cultural and ethnic diversity. Engineers strive to ensure access to needed information, services, and resources; equality of opportunity; and meaningful participation in decision making for all people.

- **Value:** *Cultural and Epistemic Humility*
- **Ethical Principle:** *Engineers practice cultural and epistemic humility.*
  Engineers recognize that sociotechnical problems, solutions, and innovations are oftentimes complex and value-laden, even when developed by competent and well-intentioned engineers. Engineers acknowledge limitations in engineering understandings about the world and try to redress inequalities by privileging and partnering with silenced voices. In keeping with this principle, engineers acknowledge the imperfection and incompleteness of these canons and strive to improve the profession's values, principles, and standards through inviting open feedback from others.

- **Value:** *Dignity and Worth of the Person*
- **Ethical Principle:** *Engineers respect the inherent dignity and worth of the person.*
  Engineers treat each person in a caring and respectful fashion, mindful of individual differences and cultural and ethnic diversity. Engineers promote clients' socially responsible self-determination. Engineers seek to enhance clients' capacity and opportunity to change and to address their own needs. Engineers are cognizant of their dual responsibility to clients and to the broader society. They seek to resolve conflicts between clients' interests and the broader society's interests in a socially responsible

manner consistent with the values, ethical principles, and ethical standards of the profession.

- **Value:** *Importance of Human Relationships*
- **Ethical Principle:** *Engineers recognize the central importance of human relationships.* Engineers understand that relationships between and among people are an important vehicle for change. Engineers engage people as partners in the helping process. Engineers seek to strengthen relationships among people in a purposeful effort to promote, restore, maintain, and enhance the well-being of individuals, families, social groups, organizations, and communities.

- **Value:** Peace
- **Ethical Principle:** *Engineers seek to live in peace with their individual selves, others, and the planet.*
- Engineers are continually aware of the profession's history of militarism and environmental annihilation and seek to resist it. Practicing an ethic of peace begins with the self, and extends to interpersonal, intergroup, and ultimately global relationships. It includes relationships with non-human entities and ecosystems.

Ethical Standards
Responsibilities to clients
- Engineers' primary responsibility is to promote the well-being of the public. Engineers respect and promote the right of the public to self-determination and assist communities in their efforts to identify and clarify their goals.
- Engineers should provide sociotechnological services to the public only in the context of a professional relationship based, when appropriate, on informed consent. Engineers should use clear and understandable language to inform communities of the purpose of the services, risks related to the services, relevant costs, reasonable alternatives, and communities' right to refuse or withdraw from the services offered.
- Engineers shall demonstrate competence in the provision of sociotechnological services that are sensitive to dynamics of difference, power, and privilege among people and cultural groups.
- Engineers shall acknowledge limitations in engineering understandings about the world and shall partner with silenced voices to place marginalized views at the center of engineering practice, allowing for re-imaginings of the engineer's professional identity, authority, role in society, and definitions of "public health," "public safety," and "public welfare" in a just world.

Responsibilities to the broader society
- Engineers shall act to resist hegemonic power and systems of oppression, and work to prevent and eliminate domination of, exploitation of, and discrimination against any person, group, or class on the basis of race, ethnicity, national origin, color, sex, sexual orientation, gender identity or expression, age, marital status, political belief, religion, immigration status, or mental or physical disability.

- Engineers shall volunteer some portion of their professional skills with no expectation of significant financial return (pro bono service). This pro bono service shall constitute at least 5% of their employed hours in engineering positions.
- Engineers may engage in organized social and political action, including the formation of and participation in labor unions, to improve services to clients and society, and to improve their own working conditions.
- Engineers shall facilitate informed participation by the public in sociotechnical projects, policies, and institutions, with special regard for vulnerable, disadvantaged, oppressed, and exploited people and groups.
- Engineers shall not participate in nor remain complicit with projects that privatize public goods, and projects that further the military-industrial or prison-industrial complexes in the United States and abroad.
- Engineers shall promote the general welfare of society, from local to global levels, and the development of people, their communities, and their environments on their own terms. Following the lead of communities, engineers shall advocate for and work to bring about living conditions conducive to the fulfillment of basic human needs and shall promote social, socio-technical, economic, political, and cultural values and institutions that are compatible with the realization of social justice.

Discussion

While this effort is largely a thought experiment intended to expand the engineering ethics imaginary, it is worth briefly considering whether and how one might operationalize social justice in engineering. One of the first challenges would be the necessarily contextual nature of any definition of social justice. As noted above, social justice is an aspirational value conceptualized in contrast to injustice, dependent on time and location, and best defined by those most closely experiencing that injustice.[1] Engineers and others will have to resist a desire to "nail down" a fixed definition rooted in, for example, a Rawlsian notion of distributive justice, [47] or a capabilities-based definition like that of Sen and Nussbaum[48,49] or some other commonly accepted conception. It is essential that engineers listen attentively to communities experiencing injustice to learn what social justice means for them.

A second challenge comes from the perception of social justice as necessarily political or ideological in nature. Because of engineering's assumed "view from nowhere,"[50] the introduction of social justice may appear as though one is taking sides. However, engineering has already taken a side; it is only because it takes the side of the mainstream, of those in power, that this positionality is rendered invisible. Introducing social justice as a value in engineering, would, at the very least, make engineering's existing political commitments legible. At best, it would shift the profession's extant allegiances to those who are in greatest need of sociotechnical interventions or protection from the risks that such interventions can pose. Indeed it is this awareness of political and social contexts, and of systems of power, that will ultimately enable engineers to ensure competent and successful implementations of their expertise.

It is in fact absurd to assume that disengagement with the world is a prerequisite to technically and morally robust decisions, products, and practices. Engineers, regardless of their individual beliefs and political commitments, must move to a place where their work is unapologetically

engaged and unapologetically intolerant of social injustice. Only from such a position will the power, privilege, and trust that society grants to the profession be justified and deserving. Integration of social justice as a core engineering value is important not only for the societal level outcomes, but also for engineers themselves. While we are concerned about engineers' professional privilege and power and the use and misuse of this privilege and power, we also question what the profession's systematic erasure of diverse knowledges and perspectives might do to engineers themselves. How do engineers develop moral agency, moral leadership, and moral courage when they are trained to devalue or dismiss voices that diverge from, challenge, or oppose the profession's status quo? How do they learn to trust their own moral compass during moments of unease with routine ways of thinking and doing? How do they even learn to refrain from distorting or drowning out their moral compass when it raises unsettling questions about issues with which colleagues seem complacent?

This is all easier said than done, given the reality that most engineers a) are currently employed by corporations, universities, and government organizations very much embedded in the military-industrial-academic complex and complicit with neoliberal values, and b) currently contribute to varying degrees to economic, social, and ecological injustice and war. Family responsibilities, educational debt, and other obligations make walking away or resisting from within difficult, and sometimes even impossible. We must, however, remember that moral action does not always necessitate extreme confrontation, nor is it always met with the institutional wrath that is frequently feared. A training program for courageous leadership in corporate settings that has been used by companies like Google and Kaiser Permanente, emphasizes precisely this point: that employees often have an exaggerated sense of what can go wrong if they speak up. When they adjust their fears to reflect more realistic consequences, they experience a strengthened ability to do what they deem right.[51] To be sure, moral imagination and courage to act on an individual basis must be accompanied by a commitment on the part of the engineering profession as a whole to work collectively with local communities at a structural level in order to vision and build new sociotechnical systems that are responsive to a different set of values, and construct new livelihoods around this vision.

What has to change about engineering education and engineering practice?
Something that may differentiate social work from engineering is that social work has a social reform mandate that emerged in the late 19th century and was formalized in the mid-1960s. Rooted in the premise that individual problems are inextricably connected to "social conditions and the quality of life for individuals, families, groups, organizations, and communities,"[52] the mandate solidified the profession's conviction that individual change necessitates social change. It further gave rise to: a) official calls for social reform and social justice in the NASW's 1996 Code of Ethics and the Council on Social Work Education's (CSWE) 1994 Curriculum Policy Statement, and b) scholarship confirming social work's commitment to the promotion of social conditions that allow individuals and communities to thrive. Given that engineering is also committed to the promotion of public welfare and the public good, does the fact that it lacks a social reform mandate reflect a difference in worldview from social work? A recent sociological examination of engineering education in the US found widespread adoption of a "meritocratic ideology," which accepts existing social arrangements as fair and just.[10]

In comparing the two professions then, we are seeing that social work's efforts to better the human condition and engineering's efforts to do the same locate "the problem" of the human

condition differently. Where social work views the problem as one of individual/community deficits created at least in part by unfair and unjust social structures, engineering views the problem as one of individual/community deficits created at least in part by a "technological poverty" of sorts, which can be addressed from a socially disengaged position of technological innovation and intervention. Social workers have to understand structural processes to help individual clients and local communities. Engineers need to understand sociotechnical systems in their larger historical, sociological, and political contexts, how these inform their designs, and how their designs impact those systems and the individuals who use them. How power operates within each of these settings is a critical consideration for social justice. We do not pretend that our proposed canons can change these deeply engrained differences between the two professions, but they do call attention to them and offer a place for thoughtful reflection.

Despite (or perhaps in reaction to) the engineering profession's existing political commitments, communities across the country are demanding social engagement and accountability from engineers.[53,54] In August 2014, for example, residents of Buffalo, NY filed an ethics complaint with three professional engineering organizations against the New York State program manager for Peace Bridge projects for violating engineering codes of ethics.[55] In September 2014, the House Energy and Commerce Committee of the US House of Representatives issued a report blaming NHTSA for contributing to the public harm caused by GM's defective vehicles. In a press release, the committee's chairman asserted that "the evidence was staring NHTSA in the face and the agency didn't identify the warnings."[56] In 2009, a Washington, DC father of 8-year-old twins filed a $200 million class-action lawsuit against the local water utility for failing to properly disclose the lead-in-water contamination and endangering the city's children.[57]

What has to change about engineering education and engineering practice to help the profession better meet the public's demands and adopt a clear social good to which engineers aspire?

- We need a paradigm shift redefining engaged engineering as good engineering, and emphasizing the technical and moral imperative of engaged practice. We need to reject the presumption that disengagement equates to technical rigor.
- We need an engineering education that integrates the technical with the ethical and the social, acknowledging that engineering comprises all of these. Learning from social work, we need to emphasize engagement in preparation for the profession. Time and attention needs to be paid specifically to how engineering students:
  → Prepare for substantive and effective action with individuals; individual groups; organizational and community clients, partners, and stakeholders
  → Develop empathy, listening, and collaboration skills to enable power-sharing and mutually agreed upon work plans and outcomes.

  Tools need to be developed to teach students how to identify diverse stakeholders, solicit all voices, and challenge systems that do not afford deliberation, decision making power, or public attention to the knowledges, values, and views of particular individuals or groups.
- We need an engineering ethics education that centers on social justice; fosters cultural and epistemic humility in both technical and moral matters; and teaches engineers to make moral determinations from a position of engagement with the public and with clear

understanding of locally situated definitions of public health, public safety, and public welfare.

- We need professional engineering organizations that engage in critical self-reflection on the profession's stated and unstated political commitments, and that take a public stance on engineering decisions, practices, and products that violate clearly the public paramountcy clause.

To operationalize these changes, the engineering profession would need to involve the public, social institutions, and especially disempowered communities as advisors and stakeholders in the transformation of the technical core of the curriculum, engineering ethics education, and the profession's role in society as a whole.

In borrowing from social work for this thought experiment, we by no means want to suggest that social workers have perfected their practice or even come near to reaching their aspirational goal of social justice. Like engineers, social workers are typically employed in organizations and systems they do not control and which often challenge and constrain their ideals. For example, a social worker seeking to end homelessness may be able to connect clients with temporary housing but may not be able to address systemic economic inequality, widespread lack of resources for education, job training, mental health or addiction services, and more. Obstacles such as these, however, do not render worthless the NASW's adoption of social justice as a core value in social work. To enact a shift to social justice in any profession that will ultimately produce changes requires guidance and support from the profession.[3] Embracing social justice as a foundational component of the profession's aspirational vision and taking concrete steps to operationalize it constitute precisely this guidance and support.

In closing, we must acknowledge two sobering realities: a) that engineers sometimes struggle with aspirational ideals like social justice, craving concrete results, and b) that given the committee-based processes by which engineering ethics codes are revised, it is unlikely that social justice will be incorporated into engineering codes of ethics until and unless there is a widespread movement calling for a cultural shift in the profession. Such a movement would require the hard work of organizing: gathering people together, fostering relationships around our common interest and shared values, building power as a community, developing a change strategy with shared relational commitment, and enabling each other to act. It is our fervent hope that this special session can provide a spark and impetus for such a movement to take hold and grow to provide the engineering profession with a clear moral purpose and direction.

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