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Engineering and New Frames of Reference

I. Introduction

Engineers make choices in nearly all aspects of their work. As we move farther into the 21st century, engineers will become more directly involved in issues of conflict, development and environmental sustainability. The present work confronts those issues head on and offers a variety of frames of reference for decision making including traditional approaches used in engineering throughout the modern era as well as new ideas which have just recently been applied to the professions. In the spirit of the Diggers from the 1960's, the present work offers new 'frames of reference' from which you can consider your decisions. The Diggers focused on promoting a new vision of society free from many of the trappings of private property, materialism and consumerism. Our hope is to offer a new vision of engineering which takes into account many of the elements of our society and our planet which have been historically ignored.

As described by NSPE, "engineering ethics is (1) the study of moral issues and decisions confronting individuals and organizations involved in engineering and (2) the study of related questions about moral conduct, character, ideals and relationships of peoples and organizations involved in technological development."¹ Harris et al² describe their approach to engineering ethics as bridging the gap between theory and practice using current case studies available such as Hurricane Katrina and global warming. Fledderman³ seeks to provide a text and a resource for the study of engineering ethics and to help future engineers be prepared for confronting and resolving ethical dilemmas that they might encounter during their professional careers. Martin and Schinzinger⁴ provide an introduction to the key issues in engineering ethics, taking account of both specific organizational contexts and broader technological trends. Baura⁵ approaches engineering ethics from an industrial perspective. Vesilind et al⁶ focuses upon the special nature of responsibility that engineers have towards the environment.

There are many other texts and websites which focus upon engineering ethics.⁷ We seek in the present work to build on the approaches taken in the past to engineering ethical dilemmas through first introducing and then examining several additional paradigms for ethical decision making including ones based on freedom, on chaos, on the concept of a morally deep world, on a global ethic and lastly one based on love. Our strong and determined belief is that by adding to the number of available approaches towards examining ethical dilemmas we can only benefit as a profession and ultimately as a society.

The present work is structured in the following manner: (1) new paradigms for ethical decision-making are introduced; (2) a specific ethics case is introduced and examined; and (3) series of reflective questions for the ethics case from the perspective of each of the new paradigms are generated; and (4) final thoughts and commentary are offered. The first approach we shall examine is an outgrowth of the ethics of freedom.

II. Engineering and Freedom

A commonly held perspective is that Western culture is a body of knowledge derived from reason with the foundation of reason serving as a springboard towards a vast accumulation of understanding related to reality or nature, including human nature.⁸ This understanding is represented in several core ideals and values, which include individualism, happiness, rights, and capitalism as well as science and technology. Individualism means emphasis on the individual person. Western culture's embrace of individualism stems from its embrace of reason because the individual — and only the individual — has the ability to reason.⁹

Implications of individualism give rise to our understanding of freedom. One effort to fully explore the notion of freedom can be found in existentialist theory. An existentialist conception of individuality may give rise to the following set of questions relevant for our search for approaches to confronting serious questions in the 21st century:

- What is human freedom?
- What can the absolute freedom of absolute individuals mean?
- What is human flourishing or human happiness?
- What general ethic or way of life emerges when we take our individuality seriously?
- What ought we to do?
- What ethics or code of action can emerge from a position that takes our individuality seriously?

Sartre¹⁰ explores an appropriate ethics code using existentialist theory. According to Sartre, we each individually choose human nature for all humans. Hence, we must choose courses of action that we would wish all humans to take. In choosing for ourselves, we choose for all of humanity. Thus, we must choose in the same way we would want others to choose - another instance of the use of the Golden Rule.¹¹ We speak of acting authentically when we ignore the external differences among ourselves and other people as these differences are merely outward manifestations of who we are --- not the essence of who we are. Sartre also argues that in order to be free, we must desire the freedom of all humanity. It is self-defeating to attempt to use other humans as objects to satisfy our desires, or to protect our freedom at the cost of enslaving others. The person who uses other people as objects to satisfy his desires makes himself or herself an object. To see others as slaves of our desire is to make ourselves a slave of desire. Thirdly, our decisions are not arbitrary as we speak of a coherence of our actions. Our actions must unify the many different influences on our lives into the one life that is to be ours. Our actions, though free, are constrained by our situation in a community with all its relationships and obligations.

The implications of this perspective for engineering and engineering education are several-fold. At the very least it broadens the notion of whom we serve. In essence we now serve our clients, ourselves and the rest of humanity. In addition, it includes all three into discussions from the outset and changes the idea that we solve problems identified by others. In fact we all are involved in the framing of the problem from the outset.

In summary, freedom as constructed from an existentialist perspective, must take on the responsibility of choosing for all of humankind, desire and work for the freedom of all humanity, and create ourselves within the context of the relationships and obligations we have to others

A. Ethics of Freedom: Substantial Freedom

Sen¹² is seen as a ground-breaker among late 20th economists for his insistence on discussing issues seen as marginal by most. He mounted one of the few major challenges to the economic model (capitalism) that has placed self-interest as the prime motivating factor of human activity. Sen describes what he refers to as the basic idea of positive or substantial freedom, distinguishes it from negative freedom on the one side and happiness on the other, and relates it to the notion of "capability," which is distinct from a raw capacity and an actual exercise of a capability. He further states that "the perspective of freedom" is concerned with "enhancing the lives we lead and the freedoms we enjoy." The ethic of freedom calls for, "expanding the freedoms we have reason to value," so that our lives will be "richer and more unfettered" and we will be able to become "fuller social persons, exercising our own volitions and interacting with--and influencing--the world in which we live."

Garret¹³ offers the following clarification of what Sen means by 'substantial freedom.' According to Garret, "Substantial freedoms are valuable things that can be divided up and delivered to human beings (or groups of people in a region) in varying amounts. In that respect they are like money and freedom from coercion, things which can be preconditions for substantial freedom but are not very good indicators of it. In the case of money, a person can have very little, a middle amount, or a lot. In the case of freedom from coercion, the same can be said: one can be a slave, constantly subject to the whims of an overseer, or one can have maximum available freedom from coercion by one's fellow humans in their private or governmental capacities. What society does, and to some extent what individuals do, can determine how much substantial freedom we have."

Continuing, "substantial freedom is distinguished from other things that we 'often have reason to value': money, negative freedom or freedom from coercion, and happiness, on the other. Monetary income alone cannot be used as a reliable indicator of substantial freedom. An increase in income might be converted into an increase in substantial freedom, but the conversion is not automatic or equally easy for everybody. A sick person is normally less able than a healthy one to convert a given increase in income into a wider range of real opportunities, i.e., into greater substantial freedom. The same might be said of a person who lives in a dangerous neighborhood that makes him/her fearful to go outside as compared to a person who lives in a safer neighborhood."¹⁴

B. Ethics of Freedom: Capabilities

Nussbaum¹⁵ has continued to develop the notion of substantial freedom. According to Nussbaum, "At the heart of this tradition is a twofold intuition about human beings: namely, that all, just by being human, are of equal dignity and worth, no matter where they

are situated in society, and that the primary source of this worth is a power of moral choice within them, a power that consists in the ability to plan a life in accordance with one's own evaluation of ends." To these two ideas is linked one more, that "the moral equality of persons gives them a fair claim to certain types of treatment at the hands of society and politics. . . . [T]his treatment must do two . . . things [:] respect and promote the liberty of choice, and ...respect and promote the equal worth of persons as choosers."

A necessary component of Nussbaum's approach is the list of basic capabilities. She answers the question, "What activities characteristically performed by human beings are so central that they seem definitive of a life that is truly human?" Nussbaum's list includes the following:

- The ability to live life to its natural end
- Maintaining health and integrity of the body
- The ability to move freely about and be free from the threat of violence.
- Being able to use the senses; being able to imagine, to think, and to reason
- Being able to have attachments to things and persons outside ourselves; being able to love those who love and care for us while not having one's emotional developing blighted by fear or anxiety.
- Being able to form a conception of the good and to engage in critical reflection about the planning of one's own life.
- Being able to live for and in relation to others, to recognize and show concern for other human beings, to engage in various forms of social interaction; being able to imagine the situation of another and to have compassion for that situation; having the capability for both justice and friendship.
- Being able to be treated as a dignified being whose worth is equal to that of others.
- Being able to live with concern for and in relation to animals, plants, and the world of nature.
- Being able to laugh, to play, to enjoy recreational activities.
- Possessing control over one's environment.

Nussbaum's ideas have important relevance for the engineering profession in our view. It calls into question any engineering design whose main goal is to destroy or inflict pain and suffering. It brings the notions of compassion and genuine friendship into our considerations as it does justice. It challenges us to engage in a critical reflection of our work.

III. Engineering and Chaos

Over the course of the last two centuries, science is undergoing a major reshuffling. The work of Einstein and others has shown that Newtonian science adequately describes a limited number of idealized problems at best.¹⁶ A new science, the science of chaos, is seen by many as potentially supplanting the classical mechanics of Newton. Chaos is a science of disorder, probabilities and non-linearities.¹⁷ Most interestingly, it appears to be a more

accurate description of Nature, for Nature's essence is chaos.¹⁸ The winds of the atmosphere, the streams of the oceans, the sliding of the surface platelets all are chaotic. Chaos also describes the deposition of river silt along the Mississippi Delta, the flow of water through the giant oak trees, and the flow of blood in the arteries and veins of human beings. The nonlinear interaction of one human-being with another is also chaotic.

In *Sand County Almanac*,¹⁹ Leopold wrote: "All ethics so far evolved rest upon a single premise: that the individual is a member of a community of interdependent parts. Ecology simply enlarges the boundaries to include soils, waters, plants, and animals, or collectively the land. In short a land ethic changes the role of *Homo Sapiens* from conqueror of the land community to plain member and citizen of it. It implies respect for his fellow members and also respect for the community as such."

Leopold went on to formulate "The Land Ethic": *A thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community. It is wrong when it tends otherwise.*"

According to Leopold, acting ethically is a matter of concern both for us and for others with whom we are in some sort of community. The notion of a community deserves some discussion. We perhaps are most comfortable with community referring to a body of people having common rights, privileges, or interests, or living in the same place under the same laws and regulations; as, a community of Franciscan monks. In biology or ecology, community refers to an interacting group of various species in a common location. For example, a forest of trees and undergrowth plants, inhabited by animals and rooted in soil containing bacteria and fungi, constitutes an integral community.²⁰ Extending the notion of community in this way is consistent with the pattern evidenced in human society over the centuries. We have progressively enlarged the boundaries of our understanding of community and recognized the membership of slaves, foreigners, etc., those for whom membership was not extended at earlier times in history. Leopold's land ethic then "simply enlarges the boundaries of the community to include soils, waters, plants, and animals, or collectively: the land."

Leopold's view of the natural world is apparent when he asserts that the *stability* of Nature is disrupted by the interference of humankind. He believed that Nature left to its own design will "naturally" opt for the stable or equilibrium position and that it is Man who disrupts this stability, challenges its integrity, and causes a natural world with diminished beauty. This view is a clear precursor of the thought of Thomas Berry, who compared the beauty of the Hudson River before its occupation by the Western world to its present condition and found its grandeur diminished. There is clearly one danger in Leopold's ethic which seemingly set forth a dualism of humans and the natural world, that is, we live our lives with the natural backdrop much like a stage backdrop for a theatrical production. This, in the view of the authors, false dualism would be subsequently addressed by Berry.²¹

The failure of the mechanical model of the natural world can be demonstrated through various examples. Sometimes more than simply being folly, the Newtonian view of Nature led to ecological disasters. The case of Tsavo Park in Africa is illustrative of the dangers of

the mechanical view.²² Briefly stated, elephants' numbers grew from near extinction to over-population in a number of years. The resultant devastation of the local eco-system by the larger herd numbers resulted in mass die-offs of the elephants, and very nearly extinction.

If we shift our model of the natural world from its historic deterministic base to one which embraces chaos, a new environmental ethic developed by the authors can be suggested: *A thing is right when it tends to allow the natural world and all the entities thereof, to thrive in richness and diversity, and to experience change. It is wrong when it tends otherwise.*²³

Note that there are three elements to this new ethic.

- Richness here refers to the richness of experience of the various entities that make up the natural world
- Diversity refers to wide variety in plant and animal species. An action which would result in the enhancement of the variety of species that would exist in a given ecosystem would be in accord with the new environmental ethic.
- Change as the restraint of change is a violation of the processes that model the natural world.

Consider the implications for the engineering profession particularly in our sense of responsibility towards the health of the natural world. Rather than seeing Nature as a system which has an equilibrium state if only we (i.e. humankind) would not interfere, Nature now is seen as a dynamic system in which change is allowed and the emphasis is shifted to nurturing diversity.

IV. Engineering and a Morally Deep World

Johnson discusses how non-sentient land can count morally and focuses upon the concept of a living being. For Johnson, a living being is best thought of not as a thing of some sort but as a living system, an ongoing life-process. A life-process has a character significantly different from those of other processes such as thermodynamics processes for example. Our character, as living beings, is the fundamental determinant of our interests. Johnson adds further that: "The interests of a being lie in whatever contributes to its coherent effective functioning as an on-going life-process. That which tends to the contrary is against its interests....moral consideration must be given to the interests of all living beings, in proportion to the interest. Some living systems other than individual organisms are living entities with morally considerable interests. ...All interests must be taken into account."

The concept of a morally deep world was developed within the framework of environmental ethics. Perhaps it may be useful to explore the morally deep world argument as it applies to a specific and presently quite contentious issue in wildlife management today, the reintroduction of the Mexican wolf into regions of the Southwestern United States.²⁴ For the purposes of illustration, let us focus on the land near the White Sands Missile Range near Las Cruces, New Mexico. Johnson would

challenge us to first identify all the members of the community. For this example a listing would include the following:

- Wolves
- Prey animals including domestic sheep and cattle as well as deer, rabbits, coyotes, and others
- Desert lands
- Ranchers and sheep farmers
- Hunters
- US Fish and Wildlife Service and other state and local government agencies
- US Department of Defense
- Residents of White Sands and nearby towns and settlements
- Residents of New Mexico and the entire United States
- Native American residents.

Often in such cases, two very different perspectives dominate the deliberations. On one side of the debate is atomism, a view that moral assessment applies only to individuals. The individual would be individual wolves, prey, ranchers, etc. On the other side is holism, a view that collectives or whole are subject to moral appraisal. In a morally deep world, the view is shortsighted morally if one adopts either a holistic or atomistic. No one (holistic or atomistic) interest has priority over the other. There is an inevitable tension between atomistic and holistic ethics. Sometime the interests of the biotic community will outweigh the interests of the individual, while at other times it is the interests of the individual, which are paramount. Let us next identify the extent of the community or living being in this case. Recall that a living being is characterized as having an ongoing life process with interests in whatever contributes to its coherent effective functioning. Clearly wolves, their prey, the desert lands, ranchers, sheep farmers, hunters and people who live in or near White Sands have considerable interests. Other identified elements could be argued to have less interest in the coherent effective functioning of the community. That is not to suggest that, for example, the residents in New York would have no interest in the restoration but their impact on the coherent effective functioning of the ongoing process would be less.

An interesting example of the tension between atomism and holism can be identified in the following scenario. Suppose wolves are restored to the White Sands Missile range desert and suppose that, as has been the case in Yellowstone National Park, wolves adapt well and quickly grow in numbers.²⁵ In Yellowstone, some wolves are routinely killed as part of wolf or game management practices. From a holistic perspective this may be morally acceptable but it would be difficult to justify the killing from an atomistic perspective. A morally deep world point of view would argue that both interests need to be considered carefully, including the interests of the entire park community and those of the “surplus” wolf.

One criticism often offered of a morally deep world perspective is that it prevents any action that will affect a community. On the contrary, though a morally deep perspective does assert actions that violate vital interests of the community or erosion of its self-identity should be avoided, it requires active participation in the protection of the

essential functions and the maintenance of the viability of life processes. Rather than calling for inaction, a morally deep world perspective suggests contemplation followed by direct and specific responses.

Given a shift to a morally deep world paradigm, a new engineering code of conduct is outlined. The majority of existing codes are structured in similar if not identical ways with fundamental principles supported by fundamental canons. That same structure will be incorporated into the present work. For a morally deep world, the first fundamental canon and rule of practice is specified as: *Engineers, in the fulfillment of their professional duties, shall hold paramount the safety, health and welfare of the identified integral community.*

The fundamental difference between an ethical code based on a morally deep world versus the present codes is the replacement of the “public” by the “identified integral community.”

V. Engineering and Globalism

There is little doubt that the world is becoming more and more globalized. The current form of globalization which is based upon neo-liberalism, free trade and open markets has sparked much debate throughout the world. Some critics would argue that the interests of powerful nations and corporations are shaping the terms of world trade. Proponents would argue that globalization has led to massive increases in the world's wealth while critics would suggest that while a few people are becoming increasingly wealthy, a greater percentage of the world's population is become poorer.

There are four distinct dimensions of globalism: economic, military, environmental and social:

- Economic globalism involves long-distance flows of goods, services and capital and the information and perceptions that accompany market exchange. E
- Environmental globalism refers to the long-distance transport of materials in the atmosphere or oceans or of biological substances such as pathogens or genetic materials that affect human health and well-being. E
- Military globalism refers to long-distance networks in which force, and the threat or promise of force, are deployed. M
- The fourth dimension is social and cultural globalism. It involves movements of ideas, information, images and of people, who carry ideas and information with them. T

Discussion on globalism primarily focuses on economic globalism. This phenomenon seems particularly important in the practice of engineering and we shall explore the implications of this form and suggest an ethical framework for making decisions in light of its existence.

With respect to economic globalism, the number of people living in absolute poverty has increased from a billion five years ago to 1.2 billion today according to a collaborative report prepared by the World Bank, the International Monetary Fund, the Organization for Economic Cooperation and Development and the United Nations.²⁶ For more than 30 of the poorest national economies, real per capita incomes have been falling for the past 35 years. Asia is the only region in which poverty rates decreased during the past five years. Economic progress in Latin America was made ineffective by the increase in inequality among the various classes of society. People in the industrial countries now are 74 times richer than those in the poorest. The wealth of the three richest men in the world is greater than the combined GNP of all of the least developed countries - 600 million people. This impoverishment has occurred at a time when globalization was supposed to have launched the poor into sustained economic growth.

On 4 September 1993, for the first time in the history of religion, delegates to the Parliament of the World's Religions in Chicago adopted a "Declaration toward a Global Ethic." On September 1, 1997, again for the first time, the InterAction Council of former heads of state or government called for a global ethic and submitted to the United Nations a proposed "Universal Declaration of Human Responsibilities", designed to underpin, reinforce and supplement human rights from an ethical angle.²⁷ In addition, the third Parliament of the World's Religions, held in Cape Town in December 1999 issued "A Call to Our Guiding Institutions", based on the Chicago Declaration.

What is in fact meant by a *global ethic*²⁸? A global ethic describes the core of common values, standards and basic attitudes or alternatively a minimal basic consensus relating to binding values, irrevocable standards and moral attitudes, which can be affirmed by all religions despite their differences and can also be supported by non-believers. In many ways, it is a call for a change of consciousness. In its widest sense it includes all our sensations, thoughts, feelings, and volitions--in fact the sum total of our mental life.

VI. Engineering and Love

Countless sages, scholars, poets, philosophers, theologians and others have tried to define love throughout the ages. We would like to use the following description of three aspects of love which may impact the manner in which we reach decisions.²⁹

- *Agape*: love that promotes overall well-being when confronted by that which generates ill-feeling (i.e., returning good for ill)
- *Eros*: love that promotes overall well-being by affirming the valuable or beautiful
- *Philia*: love that promotes overall well-being when cooperating with others.

Putting the three ideas together, we have the basic framework for reaching ethical decisions. Our work then must promote the overall well-being of all, including our perceptions of friends, and foes. It challenges us to reflect on the words found in nearly all universal wisdom traditions. It calls for moving beyond that false dualism, false as who is to say what actually is good and what is ill? Can we ever really know with certainty? Making decisions, using a sports metaphor, ought not to be equivalent to cheering for one side over another whether it is American football or that variety of football they play in every other corner of the world.

Secondly, how can we affirm the beautiful and the valuable? Perhaps the first step is to examine that which we view as beautiful and that which we view as valuable. The subjective experience of "beauty" often involves the interpretation of some entity as being in balance and harmony with nature which may lead to feelings of attraction and emotional well-being. In its most profound sense, beauty may engender a significant or important experience of positive reflection about the meaning of one's own existence. An "object of beauty" is anything that reveals or resonates with personal meaning. Inner beauty is a concept used to describe the positive aspects of something that is not physically observable. Qualities including kindness, sensitivity, tenderness or compassion, creativity and intelligence have been said to be desirable since antiquity.

The last category of love, *philia*, challenges us to see the world in a different way, in the words of Thomas Berry³⁰ as a *collection of subjects*. Berry's most famous quotation is:

The Universe and thus the Earth is a communion of subjects, not a collection of objects.

By communion, Berry was referring to intimacy or a feeling of emotional closeness, a connection, especially one in which something is communicated or shared. The shift from object to subject is also profound. An object is something visible or tangible; something that can be seen or touched, a focus of somebody's attention or emotion; or a goal or purpose. By subject, the reference is to the essential nature or substance of something as distinguished from its attributes. In other words, borrowing from Buddhism, the essential nature, the Buddha nature, is taught to be a truly real, but internally hidden, eternal potency or immortal element within the purest depths of the mind, present in all sentient beings.

VII. A Case Study: A Ticket Tearing Device for a Disabled Person

Consider the case of David S., a young man who suffers from a variety of physical and mental disabilities. David was employed at a movie theater in his local community near Philadelphia. His primary responsibility was to welcome patrons as they went into the theater hall, taking their admission tickets, tearing them in half and placing the torn tickets into a receiving basket. As David had very limited strength in his hands, the lines of people seeking admittance would soon back up. It was determined by both his employer and social worker a newly designed device that would help David's pace would be a great aid. A team of senior engineering capstone design students selected this project

and dedicated two semesters to the design, fabrication, testing evaluation and delivery of the final device.

During the two terms, David made several visits to the campus and he and the students became quite close. Delivery day became a highly publicized event with local officials, university officials, family and friends all in attendance along with local and national press. David thoroughly enjoyed the festivities and was immensely pleased by his device. At that time, the project seemed an incredibly successful effort for everyone. Subsequent to the celebration, David continued his work for a while as an attendant at the theater but soon things began to change. He became much more withdrawn than he had ever been and soon quit his job. The seeming depression became worse and worse notwithstanding the heroic efforts of his social worker. David now is completely withdrawn and in fact institutionalized.

An objective judging of this case would clearly point to the fact that notwithstanding all the noblest of intentions, David is now worse off than ever before. An engineering team though they followed all appropriate engineering dictums of safety, durability, etc., delivered a device that ultimately may have contributed to the suffering of a young man. What if instead of the engineering codes of conduct and ethics in place today, other engineering ethics paradigms were employed? What would the consequences of such approaches be in this particularly poignant case study?

We would suggest that such an approach would force a much broader consideration of all the factors at play in David's case. There would be consideration given to the impact of not only the device but also the associated attention that the project garnered, an integration of many more professional perspectives, a consideration of not only short term benefits but also those of a much longer time scale. A consideration of David's family and friends and their support for him would be factored into the design. Summaries of the reflective questions that each perspective may elicit are listed in Table 1. The lists are certainly not meant to be exhaustive but rather simply suggest the shifts that may occur if we consider different ethical approaches.

Table 1. New Frameworks for Engineering Ethics: Models and Reflective Questions

Ethical Model	Possible Reflective Questions
Freedom	<p>Are we aware of the responsibilities we have towards not only David but all of humankind?</p> <p>Are we working towards increasing David's freedom?</p> <p>Are we aware of the rich, contextual relationships that exist between David and</p>

other members of his family, his place of employment and his friends?

Are we aware of the obligations we have to David and others involved for the future? How far into the future should we be concerned?

Have we taken into consideration the uniqueness of David' situation?

Chaos Are we considering the integrity of David's life?

Are we enriching the potentialities of David's life?

Are we respecting the stability present in David's life?

Are we aware of the rich tapestry of David's life relationships?

Morally For whom are we designing the device? Whose interests does it serve?

**Deep
World**

Who is included in the integral community?

Have we used our vast array of critical and creative thinking skills in total?

Have we considered the possible negative consequences involved in the device for David? His employer? His family? His friends?

Have the pain and suffering in the world increased, decreased or remained the same?

Globalism Are we promoting a more equitable order?

Have we tried in many ways to fully understand the implication of the device?

Are we treating all those whose lives are being affected by the device in the same way w wish to be treated?

Is there a chance that more will benefit as a result of the device?

Have we considered the *global ethic* in our design?

Love Does the design and device exhibit elements of kindness?

Is it sensitive to the needs of all involved?

Does the device provide a sense of security and/or protectiveness?

Have we as designers and engineers demonstrated compassion for all affected?

Have we been creative and willing to think 'outside-the-box'?

VIII. Final Thoughts

We are suggesting new paradigms for engineering ethical decision making which broaden our professional responsibilities far wider than has been considered previously in our profession. In many ways, the shift that we are calling for is remarkably similar to an impassioned call for a radical shift in consciousness in Western thought that occurred almost 500 years earlier in Spain. It is a debate that brought to the forefront many of the same issues we are dealing with now in the 21st century. The confrontation was known as the Valladolid debate and it concerned the treatment of natives of the New World³¹. Held in the city of Valladolid in Spain, the debate featured the two main attitudes taken in Spain towards the conquests of the New World. On one side, Dominican monk Bartolome de Las Casas argued that the natives were free men in the natural order and deserved the same treatment as others, according to Catholic theology. Las Casas was opposed by fellow Dominican monk, Sepulveda, who insisted the Indians were natural slaves, and therefore reducing them to slavery or serfdom was in accordance with Catholic theology and natural law. The debate focused on questions such as: What are just wars? When is violence justified? What are the responsibilities of the developed world towards the under-developed world? What does it mean to be a human being? What rights do all human beings possess by virtue of being human? What rights if any does the planet possess?

We may ask similar questions as engineers and engineering educators. What are our responsibilities towards humanity, and our planet? Do we recognize the potentialities that exist within each of us? Do we honor diversity and in fact nurture it? Do we allow change? Do we demonstrate kindness and compassion in our decisions, in the ways we practice our profession and in the classroom? Do we set up a false dualism of 'us' versus 'them'—the 'them' being our clients and/or the natural world? Do we promote the freedom of all or just a select few? These questions and many others are suggested by the new frameworks for engineering we have suggested in the present work.

Consciousness was raised in Spain 500 years ago. It was a beginning of a conversation, a conversation that continues to today. Our hope is that in some small way our work will result in the beginnings of conversations and a similar awakening of consciousness in the profession of engineering today as we move ever farther into the 21st century.

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