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Moral Foundations of the Engineering Profession

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Abstract

Moral Foundations Theory (MFT) proposes that moral judgements are based on six universal elements of morality: Care, Fairness, Liberty, Loyalty, Authority, and Sanctity. In this paper, we explore the importance of these different elements of morality in the engineering profession. Examining a number of engineering texts demonstrates an emphasis on concerns for Fairness, Authority, Care, and Loyalty, with comparatively less emphasis on Sanctity and Liberty. While sustainable development appears in Canon 1 of the ASCE code of ethics, it is framed as an issue of Fair allocation of resources to future generations. There are also a number of important professional ethical issues in engineering related to Liberty, including issues of national security, privacy and surveillance, and diversity/access to the engineering profession. Application of MFT provides insight into the moral foundations underpinning the engineering profession, insight useful in evaluating the position of engineering on a variety of professional and societal issues.

Keywords

Engineering ethics; moral foundations theory; values; profession.

Introduction

Engineers are challenged on a daily basis with ethical dilemmas, from recognizing conflicts of interest, to fulfilling duties to clients and the public, to protecting the environment. The ethical challenges faced by engineers, and more importantly our ethical failures, are often front page news as recently illustrated by the Flint Water Crisis.

The importance of engineering ethics in engineering education has been highlighted in a number of reports and policy statements by the National Academy of Engineering (NAE),[1] National Society of Professional Engineers (NSPE), American Society of Civil Engineers,[2] and others. Professional societies in engineering have developed Codes of Ethics that address many of the issues faced by practicing engineers.

As part of the accreditation process, ABET has established engineering ethics as a student outcome in both current and proposed criteria. As a result, engineering programs have incorporated formal instruction in ethics into the engineering curriculum. ABET student outcome *f* requires students develop "an understanding of professional and ethical responsibility." Many state licensing boards also include some type of formal instruction in engineering ethics as part of a requirement for continuing education. In the state of New York, for example, professional engineers are required to obtain 1 hour of continuing education credit related to engineering ethics every three years. Similar efforts have occurred in other professions, such as law and medicine.

Traditional approaches to the formal instruction of engineering ethics utilize a Rationalist model based essentially on Kohlberg's theory of moral development.[3] In the Rationalist model, ethical decisions are based on determining facts, clarifying concepts, identifying relevant ethical principles, and finally weighing evidence.[4] Decision making tools, such as "line drawing," have been developed to aid in this process. Case studies are used to practice ethical decision making for realistic and often complex situations in which ethical priorities may be in conflict. Professional Codes of Ethics are presented and often provide structured principles to guide discussions of particular cases.

Despite the prevalence of the Rationalist model, social and psychological research indicates this approach may not be consistent with how people actually make moral and ethical decisions. Evidence suggests instead that moral intuition plays a more direct role in moral judgement than previously thought (for a review, see Haidt[5]). Moral reasoning, or the process by which one weighs information to come to a moral judgement, then becomes a *post-hoc* process that serves to justify or rationalize one's gut reaction. This view is called the *Social Intuitionist* model of moral judgement. In the context of engineering education, this model suggests that teaching the Rationalist approach alone may not lead to better ethical decision making. In fact, the Rationalist approach may instead strengthen the *post-hoc* justification of an engineer's moral intuition on a particular ethical issue.

Given that the Rationalist model and an emphasis on moral reasoning may not suffice, it is important for engineers to understand their own moral intuition and how this intuition affects her or his decision making on professional ethical issues. Moral Foundations Theory (MFT) proposes that our moral intuitions are based on five universal elements: Care, Fairness, Loyalty, Authority, and Sanctity.[5] A sixth foundation based on the concept of Liberty has subsequently been added. Based on MFT, these foundational elements provide the building blocks by which different societies and cultures construct morality.[5] Some cultures may put greater emphasis on caring and fairness, while others may put a higher priority on loyalty or authority. Studies suggest, for example, that people that identify as Liberals place more emphasis on caring (and it's opposite, harm). Conservatives, on the other hand, place more equal weight on all six of the foundational elements.[6]

Understanding how moral intuition compares with professional Codes of Ethics and norms of professional behavior is important for ethical decision making. Similar to political cultures, the professional *culture of engineering* also emphasizes certain moral foundations over others. Ethical decisions in which personal moral intuition and professional ethics align are straightforward. Decisions in which intuition and professional ethics diverge, on the other hand, are more challenging. Understanding and clarifying these distinctions will, however, support more informed ethical decision making.

In this paper, we apply MFT to elucidate the moral foundations of the engineering profession. In particular, we examine a number of texts that are representative of the culture of engineering, including Codes of Ethics, the Engineers' Creed, engineering ethics case studies, and other texts. These texts are analyzed to determine the relative emphasis placed on the different moral elements of Care, Fairness, Loyalty, Authority, and Sanctity, and Liberty.

Moral Foundations Theory

As introduced above, Moral Foundations Theory proposes that our moral intuitions are based on six universal elements: Care, Fairness, Loyalty, Authority, and Sanctity, and Liberty. The origins of the universal elements are related to both evolution and social structures.[5] A brief description of each foundational element is given below[5]:

> *Care*. The foundation of *Care* describes feelings of concern for others and feelings related with protection, safety, security, and preservation. The opposite of *Care* is *Harm*.
>
> *Fairness*. This foundation is related to proportionality and the just treatment of others. It invokes feelings of honesty, reciprocity, and tolerance. The opposite of *Fairness* is *Cheating*.
>
> *Loyalty*. The foundation of *Loyalty* is related to feelings of allegiance and a commitment to others. It is related to feelings of family, community, unity, fellowship, and patriotism. The opposite of *Loyalty* is *Betrayal*.
>
> *Authority*. The foundation of Authority describes feelings of obedience and deference to institutions. It is related to feelings of respect for traditions, hierarchy, and duty. The opposite of *Authority* is *Subversion*.
>
> *Sanctity*. The foundation of *Sanctity* is related to feelings of purity. It is related to feelings of sacredness, wholesomeness, austerity, innocence, and pristineness. The opposite of *Sanctity* is *Degradation* and feelings of contamination.
>
> *Liberty*. The foundation of *Liberty* describes feelings of freedom and is related to feelings of independence, self-determination, and autonomy. The opposite of *Liberty* is *Oppression*.

Engineers Creed

The Engineers' Creed, adopted by NSPE in 1954, states,

> *As a Professional Engineer, I dedicate my professional knowledge and skill to the advancement and betterment of human welfare. I pledge: To give the utmost of performance; To participate in none but honest enterprise; To live and work according to the laws of man and the highest standards of professional conduct; To place service before profit, the honor and standing of the profession before personal advantage, and the public welfare above all other considerations. In humility and with need for Divine Guidance, I make this pledge.*

A creed is "a set of beliefs or aims that guide someone's actions,"[7] and as such, the Engineers' Creed is illustrative of the moral or ethical imperatives of the engineering profession. The first sentence of the creed focuses on the overarching

duty of the engineer to contribute positively to human welfare, and therefore, illustrates an emphasis on the moral element of *Care* and the prevention of harm.

The pledge provides specific actions or behaviors the engineer should undertake in order to improve human welfare. "To give the utmost of performance" demonstrates commitment, and therefore in a sense, *Loyalty* to the public, employers and clients. "To participate in none but honest enterprise" and "to live and work according to the laws of man and the highest standards of professional conduct" emphasize honesty and reciprocity and so invoke the moral element of *Fairness*. "To place service before profit, the honor and standing of the profession before personal advantage, and the public welfare above all other considerations," illustrates the expected *Loyalty* of the engineer to the public and profession over personal self-interest.

Thus, in the Engineers' Creed, the moral element of *Care* is emphasized over all others. Elements of *Loyalty* and *Fairness* are invoked to support caring and efforts to advance human welfare.

Engineering Codes of Ethics

Engineering societies have developed "Codes of Ethics" to provide guidance on proper professional conduct. Most engineering codes of ethics include a number of fundamental "canons" that address public welfare and the environment, issues of competence, honesty and integrity, and issues related to serving clients. In addition to overarching canons, most codes of ethics also include more specific "rules of practice." As a case-study, the fundamental canons of the NSPE Code of Ethics and codes from other engineering professions are examined.

Engineers shall hold paramount the safety, health and welfare of the public

The first fundamental canon of the NSPE Code of Ethics is "engineers shall hold paramount the safety, health and welfare of the public." It is also similar to the first canon of the Codes of Ethics for ASCE, the American Society of Mechanical Engineers (ASME), The American Institute of Chemical Engineers (AIChE), the Institute for Electrical and Electronics Engineers (IEEE), and others. The phrase "safety, health and welfare of the public" quite clearly invokes feelings of caring and prevention of harm. The phrase to "hold paramount" establishes the safety, health and welfare of the public as the engineer's highest obligation, and therefore, a high emphasis is placed on the moral element of *Care*.

The "Rules of Practice" in the NSPE Code of Ethics further define situational considerations related to this canon and other canons. Many of the Rules of Practice related to this first canon focus on competency and the lawful practice of engineering. Engineers, for example, "shall approve only those engineering documents that are in conformity with applicable standards" and engineers shall not be associated with dishonest business ventures or fraudulent practice of engineering. The ASCE Code of Ethics elaborates within this canon that "engineers shall approve or seal only those design

documents, reviewed or prepared by them, which are determined to be safe for public health and welfare in conformity with accepted engineering standards." Thus, the competent and honest practice of engineering is an act of *Care* in that it ensures the safety, health and welfare of the public. The emphasis on honest practice also invokes the moral element of *Fairness*.

One Rule of Practice in the NSPE Code of Ethics under this canon is that "if engineer's judgment is overruled under circumstances that endanger life or property, they shall notify their employer or client and such other authority as may be appropriate." This rule of practice highlights that while an engineer's highest obligation is to the public, the engineer still has a duty to act within the hierarchical structure of the firm. This introduces an emphasis on *Authority*, i.e., an engineer must hold paramount the welfare of the public, but should do so while respecting the contractual *Authority* of public and/or private institutions.

Sustainable Development

The first canon of the ASCE Code of Ethics also includes a statement related to sustainable development, namely, "Engineers … shall strive to comply with the principles of sustainable development in the performance of their professional duties." The ASCE Code of Ethics adopts the following definition of sustainable development: "Sustainable development is the process of applying natural, human, and economic resources to enhance the safety, welfare, and quality of life for all of the society while maintaining the availability of the remaining natural resources." The NSPE Code of Ethics adopted a similar definition ("'Sustainable development' is the challenge of meeting human needs for natural resources, industrial products, energy, food, transportation, shelter, and effective waste management while conserving and protecting environmental quality and the natural resource base essential for future development"). As written, the engineers' obligation to comply with the principles of sustainable development is primarily an act of *Care* for current and future generations. However, inherent in the NSPE definition is the *Fair* allocation of resources to future generations.

Interestingly, preserving the *Sanctity* of the environment is not part of the ASCE definition and is mentioned weakly in the NSPE version. The first canon of the AIChE Code of Ethics, however, highlights the engineers' responsibility to "protect the environment." Presumably, the duty to protect the environment is based on not only the fair allocation of resources to future generations but also the inherent value of the nature and the environment.

Perform services only in their area of competence

The second fundamental canon of the NSPE Code of Ethics is the engineer's duty to "perform services only in their area of competence." This duty also serves as the second canon of the ASCE Code of Ethics. More specific Rules of Practice in the NSPE and ASCE Code of Ethics related to this canon deal largely with issues of education, experience and the direct supervision of engineering work. For example, the NSPE Code of Ethics specifies that "engineers shall not affix their signatures to any plans or

documents dealing with subject matter in which they lack competence, nor to any plan or document not prepared under their direction and control." In Case 94-8[8] the NSPE Board of Ethical Review (BER) concluded that it was unethical for a Chemical Engineer, with no obvious training or experience, to design a structural foundation because the engineer "does not possess the competence to perform the required task." As mentioned above, this duty is grounded in the foundational element of *Care* in that competency ensures the safety, health and welfare of the public.

Engineers shall issue public statements only in an objective and truthful manner

The obligation to "issue public statements only in an objective and truthful manner" appears in both the NSPE and ASCE Code of Ethics, and similar statements appear in other codes. Further, "engineers shall issue no statements, criticisms, or arguments on technical matters that are inspired or paid for by interested parties, unless they have prefaced their comments by explicitly identifying the interested parties … and by revealing the existence of any interest the engineers may have."

A relevant case study is BER 88-7[9] which examines whether an engineer's public criticism regarding the safety of a bridge was ethical. In this case,

> *Engineer A, a renowned structural engineer, is hired for a nominal sum by a large city newspaper to visit the site of a state bridge construction project, which has had a troubled history of construction delays, cost increases, and litigation primarily as a result of several well-publicized, on-site accidents. Her report identifies, in very general terms, potential problems and proposes additional testing and other possible engineering solutions. Thereafter, in a series of feature articles based upon information gleaned from Engineer A's report, the newspaper alleges that the bridge has major safety problems that jeopardize its successful completion date. Allegations of misconduct and incompetence are made against the project engineers and the contractors as well as the state highway department. During an investigation by the state, Engineer A states that her report was intended merely to identify what she viewed were potential problems with the safety of the bridge and was not intended to be conclusive as to the safety of the bridge.*

In the discussion of this case, the Board of Ethical Review noted the "technical expertise that engineers can offer in the discussion of public issues is vital to the interests of the public" and "the NSPE Code of Ethics makes clear that engineers should 'seek opportunities to be of constructive service in civic affairs and work for the advancement of the safety, health and well-being of their community.'" This demonstrates that a core foundational element of this canon, and this case in particular, is *Care* and ensuring the health, safety and welfare of the public.

This case also touches on issues of honesty and transparency. The BER, for example, also noted that the engineer has an obligation to insist the newspaper state that the engineer was paid by the newspaper to carry out her investigation. This conclusion by the BER is

grounded in the foundation of *Fairness* and proportionality and just treatment of others. Withholding information about the contractual arrangement between the engineer and the newspaper is a form of dishonesty by omission in that it does not allow the reader of the article to fully understand the context and motivation of the engineer in performing the inspection.

Engineers shall act for each employer or client as faithful agents or trustees

This Rule of Practice emphasizes the moral elements of *Loyalty* and *Fairness*. The use of the term "faithful," for example, highlights the duty of the engineer to demonstrate support and loyalty to the employer or client. Contractually, the engineer also has an obligation to respect the *Authority* of the employer or client. As a result, elucidating conflicts of interest is a major consideration associated with this Rule of Practice. In the NSPE Code of Ethics, for example, "engineers shall disclose all known or potential conflicts of interest that could influence or appear to influence their judgement or the quality of their services." In essence, not disclosing a conflict of interest is an act of disloyalty to the employer or client. Not disclosing a conflict of interest is also potentially a deceptive act, and therefore, touches on the moral element of *Fairness*.

The NSPE Board of Ethical Review, Case 99-3[10] illustrates the importance of maintaining loyalty to a client. In this case, Engineer A provides continuing education for Company X. The continuing education programs are well received and Engineer A is approached by Company Y, a competitor to Company X, to develop a similar continuing education program for their company. Engineer A discloses to Company X that she is starting a company to develop and provide continuing education, but does not indicate she has a contract with a competitor to Company X. The Board of Ethical Review concluded that it was unethical for Engineer A to enter into this contract with Company Y since Company Y was not disclosed and Company Y is a competitor to Company X. By not disclosing fully the conflict of interest, Engineer A was dishonest and not loyal to Company X. The BER recognizes that conflicts of interest are often difficult to avoid, and therefore, recommends that an engineer must fully disclose any conflicts of interest so the affected parties can accurately judge how their interests may be compromised. Full disclosure of conflicts of interest therefore highlights the importance of *Loyalty* and Fairness in the relationship between the engineer and employer or client.

In the ASCE Code of Ethics, to act as faithful trustees "engineers shall not use confidential information coming to them in the course of their assignments as a means of making personal profit if such action is adverse to the interests of their client, employers or the public." This obligation also highlights the duty of the engineer to demonstrate *Loyalty* to a client, employer or public. This obligation also touches on *Fairness* as an engineer may have an unfair advantage if given certain confidential information.

Engineers shall avoid deceptive acts

This Rule of Practice emphasizes the moral element of *Fairness*. In the NSPE Code of Ethics, for example, "engineers shall not falsify their qualifications or permit misrepresentation of their or their associate's qualifications." This type of dishonesty

creates an un-level playing field, and therefore, disadvantages honest firms that truthfully state their qualifications. This Rule of Practice also touches on the obligation not to offer gifts in order to "influence the award of a contract." Again, giving of gifts to sway a decision is not fair to other firms when the decision should be based solely on qualifications. In the ASCE Code of Ethics, a similar canon also includes that "engineers … shall not compete unfairly with others" through giving of gifts, political contributions, etc.

Corruption and the Engineering Profession

Corruption in the construction industry is a particularly important ethical issue in the practice of engineering. According to Transparency International, it is estimated that nearly 10% of all funding for infrastructure globally is lost to corruption.[11] Forms of corruption include bribery, extortion, "grease payments," etc. To help combat this problem, the ASCE has adopted "ASCE Policy Statement 510 – Combating Corruption," which outlines the professions position on global corruption in the construction industry. As stated, "fighting corruption can facilitate reallocation of assets thus mitigating poverty, disease, and famine and assisting in building a fair and civil society." This statement again emphasizes the moral element of *Care* and the engineers highest obligation to "hold paramount the health, safety and welfare of the public." It also highlights a goal to build a "fair and civil society." The moral element of *Fairness* is explicitly stated. The concept of a *civil society* invokes the ideal of citizenship and the formation of communities around shared interests. Supporting civil society thus is related to supporting independence, self-determination and autonomy, and the concept of *Liberty*.

Discussion

Analysis of texts that represent the engineering profession, such as the Engineers' Creed and Engineering Codes of Ethics, suggests an emphasis on the moral elements of *Care*, *Fairness*, *Loyalty*, and *Authority*. The overarching emphasis on *Care* is consistent with the concept of a profession. As Freidson[12] points out, a key element of a profession is a professed transcendent value. For engineering, the moral element of *Care* and the duty to "hold paramount the safety, health, and welfare of the public" serves this purpose and is supported in the Engineers' Creed, Codes of Ethics, ethical case studies, and other texts that represent the culture of engineering. Elements of *Fairness*, *Loyalty*, and *Authority* are invoked to establish the proper conduct of engineering work and to assist in understanding duties to different stakeholders, such as the public, the firm, and the client.

Professional issues related to *Liberty* and *Sanctity* are less represented in these texts. While issues of Liberty arise in some policy statements (e.g., ASCE Policy Statement 510), the concept is less emphasized in issues represented in the engineering Codes of Ethics and the Engineers' Creed. There are, however, a number of important professional issues in engineering related to *Liberty*, including issues of national security, privacy and surveillance, and diversity/access to the engineering profession. The increasingly digital nature of our world, for example, puts privacy and security in conflict. On the one hand, privacy is often considered a pre-condition to freedom and autonomy. Therefore,

protecting privacy is protecting *Liberty* and freedom. On the other hand, threats to national security have led to programs such as the National Security Administration's collection of phone records without a warrant. The collection of phone records therefore frames this issue as an act to ensure the safety and security of the country and so is an expression of *Care* at the cost of privacy and autonomy.

ASCE Policy Statement 417 – Promoting Diversity and Inclusion[13] "supports and encourages the equitable opportunity for participation of all people within the civil engineering profession without regard to race, ethnicity, religion, age, gender, sexual orientation, nationality, or physical challenges." As written, this statement emphasizes the concept of *Fairness* and equal opportunity. The rationale for this policy emphasizes how failing to develop a diverse workforce will hinder efforts of the profession to contribute to "the well-being of our global society" and "meet the challenges of our changing world," which represent issues of *Care*. Promoting a diverse workforce, however, also entails ensuring all people have the power of self-determination, which touches on the issue of *Liberty*, which is less emphasized in the policy statement.

The moral element of *Sanctity* is less prominent in engineering texts. Sanctity touches upon wholeness, purity and avoiding degradation. One aspect of this element relates to the engineer and the environment. While some Codes of Ethics and other texts argue for preservation of the environment, most focus on the concept of "sustainable development." The concept of sustainable development is prevalent, but it is framed largely as an issue of the *Fair* allocation of resources for current and future generations instead of preserving the sanctity of the environment. The AIChE Code of Ethics is a notable exception.

Conclusion

In this paper, we explore the importance of different foundations of morality in the engineering profession. Examining a number of engineering texts, including Codes of Ethics, policy statements, ethical case studies, and the Engineers Creed, demonstrates an emphasis on concerns related to *Care, Fairness, Authority,* and *Loyalty*, with comparatively less emphasis on *Sanctity* and *Liberty*. This paper shows that the application of MFT provides insight into the moral foundations underpinning the engineering profession, insight useful in evaluating the position of engineering on a variety of professional and societal issues. This analysis also improves understanding of how moral intuition compares with norms of professional behavior, an important consideration for ethical decision making.

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