# WIP: How Should We Decide? The Application of Ethical Reasoning to Decision Making in Difficult Cases

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## Abstract

This study is a Work in Progress in which first-year engineering students are introduced to four frameworks for ethical decision-making and then prompted to apply them to ethical dilemmas involving engineers. The chosen frameworks are Deontology, Virtue Ethics, Consequentialism and Utilitarianism. The participants were non-traditional-aged first-year engineering students who had recently transferred to our university from other two-year or four-year institutions. Each student identified and analyzed ethical issues in a societal problem by applying these four frameworks and comparing their conclusions as a homework assignment.

Our prior studies involving the application of different ethical frameworks with traditionally-aged first-year engineering students indicated that some students could apply each framework independently, logically and correctly, while others formed solutions based solely on what they believed to be "right", regardless of framework. These ungrounded responses were often devoid of a logical argument based on published evidence. Fortunately, the students in the current study population chose societal problems that tended to provoke less of an emotional response.

The study sample consisted of 12 essays in which solutions to a societal problem were recommended according to each of the four frameworks, which were chosen for their contrasting approaches to ethics, i.e, outcome-based or rules-based. Results indicated that a relatively small number of participants were able to differentiate clearly among the four frameworks in offering solutions. In addition, not all of their recommendations were necessarily viable or included any negative consequences. The reasons for these results could have due to lack of effort, lack of understanding, or simply a failure to adhere to the intent of the assignment.

## Study Problem and Purpose

The purpose of this study is to investigate how first-year engineering students apply each of four frameworks for ethical reasoning to the resolution of a chosen societal problem involving both technical and non-technical issues which are ethical in nature. The central problem lies in the fact that many first-year engineering students do not yet realize that that there may be more than one way to solve a problem, especially societal problems for which there is no one "correct" solution, but a number of possible solutions arising from conflicting conditions, interests, and beliefs. There are also multiple ways of determining the "best" solution, through the application of ethical frameworks. The field of engineering ethics has contributed virtual and actual case studies to encourage engineering students to consider what they would do when faced with an ethical dilemma, by applying these well-established theoretical frameworks for ethical decision making.

Relatively few studies have been identified, to date, dealing with the understanding of engineering ethics by first-year students, especially when philosophically-based ethical

frameworks are considered. This study will inform the engineering ethics community about how well different ethical frameworks are understood by first-year engineering students. In addition, the ability to analyze and resolve ill-structured problems is a common learning outcome that can be met, in part, through in-class exercises and homework assignments which help to build a sense of professional responsibility through the application of engineering ethics. Students often complete these courses without a sufficient understanding of the various ways in which ill-structured problems can be analyzed and resolved, because they lack guided practice in doing so. The fact that different solutions could be derived under different frameworks also adds a creative or novel element to an are often considered dry and lacking in interest or relevance to today's students.

The first-year multidisciplinary engineering design course at a research institution in the southeastern United States contains a unit in engineering ethics with an assignment to identify the ethical issues associated with a societal problem, and to suggest solutions to those issues using each of four ethical frameworks: Deontology, Virtue Ethics, Consequentialism and Utilitarianism. For this study, students wrote short essays in which they presented the issues, and then explained how they could be resolved by applying these frameworks. As a Work-in-Progress, this study was limited to non-traditional first-year engineering students, who were assumed to possess a greater understanding of the complexity of societal problems than traditional first-year engineering students, whether or not they would be interested in alternative forms of ethical analysis.

These four frameworks were chosen because their application could lead to several different decisions, whereby our students would realize that ethical decisions often involve conflicting views and interests. Previous attempts by students to apply ethics to case studies have contained responses with hastily made judgments based only on Deontology, in which they have interpreted an engineering code of ethics as a law that was broken in the case study. This gap in knowledge and lack of acceptance of uncertainty indicated a need to re-design our approach to the instruction and practice of engineering ethics at the first-year level to include the possibility that there could be more than one valid solution to an ethical dilemma, depending on the applied ethical framework.

On this basis, our research question is as follows:

- How do non-traditional transfer first-year engineering students apply different ethical frameworks to the resolution of issues associated with ill-structured societal problems?

Theoretical Frameworks

The four frameworks of ethical reasoning employed in this study include Deontology, Virtue Ethics, Consequentialism and Utilitarianism. These frameworks are described below.

Deontology is the adherence to specific directions, guidelines or rules for moral conduct, which may or may not be codified, which often specify what is required, permitted or forbidden [1]. Sometimes, though, one or more of these guidelines may conflict with others. For example, one of the provisions of the National Society of Professional Engineers' Code of Ethics emphasizes the primacy of the health, safety and welfare of the public in the conduct of engineering work,

while another admonishes engineers to serve their employers and clients with fidelity. What happens if the welfare of the public could be compromised by the directions of an employer or client?

Virtue Ethics directs actions that reflect on the character or moral virtue of the decision maker, as considered by others according to well-known historical attributes of virtue [2]. While people may decide to act based on "the right thing to do", often the "right thing" is related to a virtue that others would recognize and admire. Examples of commonly recognized virtues include honesty, selflessness, altruism, and compassion [2]. While the origin of deontology is attributed to Immanuel Kant in the late 18th century [1], virtue ethics has a much longer historical tradition, originating with Plato, Aristotle and Confucius [2]. Both Virtue Ethics and Deontology are based on written or cultural expectations for behavior which are independent of outcome. By contrast, an outcome-based system involves circumstances which determine the outcome.

By contrast, consequentialism is outcome-based, and is often described as a case where "the ends justify the means." Actions can be justified by the outcomes that they produce [1], [3]. People have used this framework to justify dishonesty, selfishness, and even crime, arguing that the positive outcome of their actions outweighs the fact that laws, moral principles, or individual rights were violated. Value is also assigned to Consequentialist outcomes as "good", where "good" may be an increase in happiness, wealth, advantage, pleasure, etc. [1].

Utilitarianism is favored by engineers as well as by many others, because it proposes the "greatest good for the greatest number", as a form of cost-benefit analysis [3], [4]. The earliest definitions of what is meant by "good" were later considered to be hedonistic, and therefore contemptible [3]. However, philosophers such as Jeremy Bentham and John Stuart Mill, while emphasizing hedonistic pleasure, also supported the "greatest good for the greatest number" approach. Even later views labeled good as "agent-neutral" in that one person's "good" is equal in importance to that of any other person [4], which ameliorated the stigma of hedonism to an extent, as well as to seek an optimal level of good for everyone involved. Like Consequentialism, Utilitarianism is outcome-based rather than rule-based, so that it would seem that context matters in decisions under this framework to a greater extent than it would under either Deontology or Virtue Ethics.

The application of multiple frameworks for ethical reasoning to an ongoing societal problem emphasizes the fact that knowledge, and therefore, judgment, is not static or absolutely certain, but change under the differing conditions contained in these types of reasoning. If someone realizes that decisions can change depending on the framework that is applied, this means that decision making is driven by conditions or constraints in the form of assumptions, and that more than one interpretation, point of view, opinion or position could be as valid as any other. The realization of the validity of multiple contexts and views was described by King and Kitchener [5] as reflective judgment, which is considered to be a higher form of intellectual development than the blind acceptance of one view or set of conditions as absolutely correct in all cases. This conclusion is based on the work of King and Kitchener with college students as well as adults, which expands it applicability to ethical reasoning by college students [5]. Reflective judgment involves the examination of views, whereby decisions are made to recognize, accept as valid, or even replace, one or more alternative views [5]–[7].

Another way to relate the ethical frameworks to reflective judgment is to liken Deontology and Virtue Ethics as being rule-based, with little regard for variations in context, and Consequentialism and Utilitarianism as being heavily dependent on context in the form of circumstances and outcomes. This does not mean that proponents of Deontology or Virtue Ethics are operating at lower levels of intellectual development, but that people who think in terms of authority-based knowledge and rules for living might be more easily attracted to these two frameworks.

Research Methods

This is a research study in which the participants produced written essays which were coded for constructs such as subject matter, solution for the ethical issue using each framework, and the extent of evidence in support of the problem and its possible solution. The study population was approximately 80% male and 20% female, although the essays were not classified by gender. The sampling method was both systematic and stratified, as described below and by Krathwohl [8]. Essays contained proposed solutions to ethical issues associated with a societal problem by applying each of four ethical frameworks: Deontology, Virtue Ethics, Consequentialism and Utilitarianism.

Study Context

The first-year engineering sequence was offered to transfer students as a one-semester course, with the same learning outcomes for technical skill development, professional awareness, and engineering design, for the same total number of credits and contact hours as the original sequence. After a briefing about the ethical frameworks, with definitions and examples, the students completed an in-class exercise in small groups, about ethical decision making using a case study with a variety of stakeholders whose interests and motives were described in detail. The stakeholders included employees in the problem's work setting as well as members of the general public who could be affected by any proposed solution.

Each stakeholder could be expected to recommend a solution according to their own interests, which might reveal a tendency toward Deontology, Virtue Ethics, Consequentialism or Utilitarianism. By combining an awareness of ethical frameworks with a variety of stakeholder views, students would realize that many factors could influence the solution to a societal problem containing both technical and non-technical ethical issues.

Following the in-class exercise, students completed an assignment about the ethical issues associated with a societal problem involving an engineering context, and applied each of the four ethical frameworks described above to the resolution of these issues. Students were prompted to analyze the problem through a technical lens, i.e., to suggest how engineers could contribute to a solution to the problem.

Each student wrote a 1-2 page essay to identify their problem, and explained how the ethical issues should be resolved under each of the four frameworks. Students were able to choose one of four societal problems included in the assignment, or choose another societal problem of interest. These four problems were suggested, but not specifically required:

- Gun violence
- Self-driving cars
- Internet privacy
- Automation

Additional problems of interest that were selected by a small number of students included wastewater pollution from mining operations, infant survival in minority populations, and the manufacture of weapons for warfare, among others.

Participants

The study population consisted of non-traditional first-year engineering students, i.e., transfer students who had completed one to two years of study at another institution of higher education. Most had a background at a fundamental level of a STEM-related field, and were required to complete the first-year engineering course prior to entering their chosen engineering degree programs at our institution. Two sections of approximately 50 students each completed the ethical reasoning assignment.

Data Collection

Ethical reasoning essays were collected from a block of 60 students, ordered consecutively by last name. These essays were screened for prior consent to participate in research studies involving data collected from first-year students, which resulted in 43 essays available for stratified sampling [8]. Student essays were collected and de-identified in accordance with Institutional Review Board (IRB) policy.

The essays were then separated into five groups: one for each of the prompted ill-structured problems, and a group containing participant-identified problems. Each group contained the following numbers of essays:

- Gun violence: 8 (18.6%)
- Self-driving cars: 14 (32.6%)
- Internet privacy: 9 (20.9%)
- Automation: 2 (4.7%)
- Miscellaneous: 13 (30.2%)

A stratified sample of essays was selected, where the number of essays in each topic was proportional to the percentages shown above. This sample consisted of 12 essays distributed as follows:

- Gun violence: 2
- Self-driving cars: 4
- Internet privacy: 2
- Automation: 1
- Miscellaneous: 3

A stratified sample was taken because of the wide variation in the number of essays in the abovementioned topics, with the intent that the sample would be more representative of the population than by just sampling randomly, as recommended by Krathwohl [8] . The sample size was limited by the scope of this qualitative Work-in-Progress study, in order to test the research methods with a smaller sample before applying them to a larger one.

## Data Analysis

The essays were first a priori coded, as recommended by Saldana [9] to identify the subject matter of the essay and the recommended solution under each ethical framework. Variation among solutions would be expected, given the variations in focus among the ethical frameworks. The compatibility of each solution with its designated framework, or lack thereof, would clearly indicate whether the participants in the study sample understood each framework and were able to apply it accurately. Additional criteria for evaluating the quality of student work were used for grading purposes, but were not included in this study.

## Overall Quality and Limitations of this Study

Qualitative research studies can be evaluated for validity and reliability, although Creswell labels all quality-related methods as "validation." [10]. We can demonstrate validation using these methods from Creswell and others:

- Disclosure of researcher bias to demonstrate reflexivity [10], [11], and
- Peer reviews of the study and its results to demonstrate effective communication for understanding and acceptance [10].

While students should respond truthfully, response bias is possible [12]. Response bias could arise from lack of understanding or lack of an appropriate level of engagement with the assignment.

This study is limited by its time frame, institutional space, courses that the participants in the study sample are currently taking, and their frame of mind when they completed the assignment. There is little doubt that one lesson and one homework assignment are not sufficient to develop a commitment to both understand and practice professional ethics, but the assignment provides an introduction to this field, to be continued elsewhere in an engineering curriculum. In addition, at the end of the course, there is no available evidence as to whether students had changed their own ethical decision making process, or what their disposition was with respect to the stakeholders' perspectives in the in-class exercise.

## Ethical Considerations

The data from consenting participants will have been de-identified prior to analysis, in accordance with IRB regulations [13]. We will also assume that the data accurately reflect participants' responses to the assignment prompts [14]. Finally, the data will be maintained in accordance with IRB policy.

<u>Results and Discussion</u>

The data are summarized in Tables 1-5, which are attached. The first three solutions for the self-driving car issue, shown in Table 1, used the NSPE Code of Ethics' primacy of public welfare as the basis for recommending that loss of life be minimized, although the fourth solution contained indications of Virtue Ethics in both the Deontology and Virtue Ethics responses, showing an incomplete understanding of Deontology. While there was a clear distinction between Consequentialist and Utilitarian solutions among all four participants, the first participant's solutions showed a Consequentialist solution that was closer to a Utilitarian view, and conversely.

Regarding the samples dealing with Internet privacy in Table 2, the first participant offered a progression of remedies from extreme, i.e., company must disclose types of data collected, to moderate, whether by action of the company or the user. However, the first participant also showed a lack of understanding of Virtue Ethics, as their proposed solution more closely resembled a Consequentialist solution. The second participant also offered several means by which personal data could be protected, and their solutions adhered to each ethical framework accurately.

Solutions to issues involving gun violence, as shown in Table 3, varied from mandatory buybacks of outlawed guns, a popular solution that reflected both Consequentialism and Utilitarianism, to increased police presence and revision of the Second Amendment, neither of which appeared to adhere to the respective frameworks of Deontology or Virtue Ethics. In addition, the evidence for any of the gun violence-related solutions was not nearly as sound as the evidence offered for either self-driving cars or Internet privacy. It is possible that these participants were acting from more of an emotional than a framework-based viewpoint.

Empathy for displaced workers was a common theme among the participants who offered solutions to ethical issues with automation, as listed in Table 4. While empathy could influence the process of forming a solution under any of the frameworks, it does not necessarily drive a particular solution. Empathy could, however, exert a strong influence under the ethics of care framework, which could be offered in a new study with a problem containing a prompt toward a deeper consideration of stakeholders' motives and interests.

The relatively small number of essays containing this problem caused a study sample of only one.  This participant recommended that companies had a responsibility to their workers who would be displaced by automation, no matter which ethical framework was being considered. An alternative solution, in which the company's profits were more important than the displaced worker's employment with that company, was not considered, nor the necessity of the company to remain profitable as displaced workers were retained.

Finally, in Table 5, the participant who analyzed wastewater pollution due to mining operations offered solutions under certain frameworks that belong to other ones, which was another misunderstanding of a Consequentialist view as Utilitarian. Similarly, the participant writing about weapons for warfare proposed a solution to only allow countries with major global influence to develop these weapons as a Consequentialist solution, without mentioning the

negative consequences of doing so. The participant writing about infant survival showed the best overall compatibility between the solution proposed under each framework, and the meaning of that framework.

Conclusions and Recommendations

The results indicate that the participants in this study sample exhibited an understanding of the ethical frameworks that was incomplete across all of their proposed solutions, although misunderstandings seemed to be greatest in the differences between the Consequentialist and Utilitarian solutions. Certain participants also seemed to have difficulty in correctly applying Virtue Ethics to their chosen problem's ethical issues, regardless of the problem itself. The lack of compatibility of the solutions with the definitions of the ethical frameworks indicates where additional guidance is needed in the classroom exercise, perhaps by limiting the homework assignment to two frameworks instead of four, such a rule-based framework, such as Deontology, with an outcome-based framework, such as Utilitarianism.

Overall, the solutions offered under the Deontology framework were more consistently compatible with the definition of this framework than those offered under other frameworks. This could be attributed to the ease of understanding externally-prescribed rules compared with the apparent ambiguity that students experience when applying the other frameworks.

Recommendations for improvement in students' understanding of ethical issues and how solutions may vary under these, or other, ethical frameworks should involve greater exploration of alternative technical and non-technical solutions to societal problems, and how these solutions would reflect the moral traditions represented by these frameworks. In addition, the ethical frameworks assignment should include greater encouragement to explore issues of the student's choosing, accompanied by additional in-class exercises in building a case with evidence, identifying areas of uncertainty and how to resolve them, and further consideration of stakeholder views.

The process of developing alternative solutions to ethical issues, whether or not a student agrees with any of them personally, enables first-year engineering students to learn how to analyze all problems critically, check their own assumptions, and accept the fact that the societal and sociotechnical problems that they will face may be amenable to several different solutions, none of which would be found in a textbook. This realization is part of becoming a more successful engineer who can more easily handle and help to resolve complex and ill-structured societal problems as well as technical ones.

# References

[1]  L. Alexander and M. Moore, "Deontological Ethics," *Stanford Encyclopedia of Philosophy*. Stanford Center for the Study of Language and Information, Stanford, CA, p. 11, 17-Oct-2016.

[2]  R. Hursthouse and G. Pettigrove, "Virtue ethics," *Stanford Encyclopedia of Philosophy*. Stanford Center for the Study of Language and Information, Stanford, CA, p. 12, 08-Dec-2016.

[3]  W. Sinnott-Armstrong, "Consequentialism," *Stanford Encyclopedia of Philosophy*. Stanford Center for the Study of Language and Information, Stanford, CA, p. 12, 03-Jun-2019.

[4]  McCombs School of Business, "Ethics unwrapped: Utilitarianism," *Ethics Unwrapped, McCombs School of Business, University of Texas at Austin*, 2020. [Online]. Available: https://ethicsunwrapped.utexas.edu/glossary/utilitarianism. [Accessed: 02-Feb-2020].

[5]  P. M. King and K. S. Kitchener, *Developing reflective judgement*. San Francisco, CA: Jossey-Bass, 1994.

[6]  J. Moon, "Resources for Reflective Learning," in *A Handbook of Reflective and Experiential Learning*, London: Routedge Falmer, 2004.

[7]  D. Kember, J. McKay, K. Sinclair, and F. K. Y. Wong, "A four-category scheme for coding and assessing the level of reflection in written work," *Assess. Eval. High. Educ.*, vol. 33, no. 4, pp. 369–379, Aug. 2008, doi: 10.1080/02602930701293355.

[8]  D. R. Krathwohl, "Chapter 8: sampling, representation and external generality," in *Methods of educational and social science research- the logic of methods*, 3rd ed., Long Grove, IL: Waveland Press, 2009, pp. 159–186.

[9]  J. Saldana, *The coding manual for qualitative researchers*. Thousand Oaks, CA: Sage Publications, 2016.

[10] J. W. Creswell and C. N. Poth, "Chapter 10: Standards of validation and evaluation," in *Qualitative inquiry & research design: choosing among five traditions*, Washington, DC: Sage Publications, 2018, pp. 253–286.

[11] E. G. Guba and Y. S. Lincoln, "Chapter 6: Competing paradigms in qualitative research," in *Handbook of Qualitative Research*, 2nd ed., Thousand Oaks, CA: Sage Publications, 1994, pp. 105–117.

[12] R. A. Singleton and B. C. Straits, "Chapter 9: survey research," in *Approaches to social research*, 5th ed., New York, NY: Oxford University Press, 2010, pp. 263–351.

[13] American Educational Research Association, "AERA code of ethics: American Educational Research Association, approved by the AERA Council, February 2011," *Educ. Res.*, vol. 40, no. 3, pp. 145–156, 2011.

[14] American Educational Research Association, "Standards for reporting on empirical social science research in American Educational Research Association (AERA) publications," *Educ. Res.*, vol. 35, no. 6, pp. 33–40, Sep. 2006.

**Table 1: Data Summary for Ethical Frameworks Analysis of Self-Driving Cars**

| Sample No. | How to prevent self-driving car-related deaths using: | | | |
|---|---|---|---|---|
| | **Deontology** | **Virtue Ethics** | **Consequentialism** | **Utilitarianism** |
| C-1 | Have an NSPE Code expert provide oversight to make sure that all follow rules | Choose random individuals as test subjects without their knowledge [no consent = not ethical. Missed meaning of virtue] | Continue with current practices or change based on possible outcomes[more like U than C] | Justify continuing current practices because many lives are improved despite one life being lost [more like C than U] |
| C-2 | Apply NSPE Code means that casualties must be minimized if the public welfare is paramount. | Give the decision to legislators, who are more sensitive to the variations in public values. | Needs of the public are more important than the needs of the car owner. | Minimize casualties, even if it means not prioritizing owner safety. |
| C-3 | It is the vehicle's duty to be programmed to minimize the loss of life. | In the company's interests, prevent users from providing input to the car's operation | Prevent users from providing input to the car's operation. If loss of life occurs, so be it. | If the technology was able to lower the current levels of car deaths due to human error, allow the car to operate without user input. |
| C-4 | The car owner should not put those at risk who are not affected by the purchase. | Pedestrians should not have to be afraid of this car, so that only the owner should be at risk. | Minimize the number of lives lost by whatever means are necessary. | Minimize the number of lives lost by whatever means are necessary. |
| | | | | |

**Table 2: Data Summary for Ethical Frameworks Analysis of Internet Privacy**

| Sample No. | How to preserve Internet privacy using: | | | |
|---|---|---|---|---|
| | **Deontology** | **Virtue Ethics** | **Consequentialism** | **Utilitarianism** |
| I-1 | Company is required disclose what personal data is being collected and stored. | User has the option to withhold their personal data or remove it from the internet. [more of a Consequentialist-type solution] | Users have the option to encrypt their data, so that only the user has access to it. This results in ineffective service. | Company collects and uses data from only a sufficient number of users, with or without their consent, to keep the service viable |
| I-2 | Reinforce laws about contracts between companies and users. Contract should contain detailed information about privacy and how it would be preserved. | Companies should enforce a policy to require its workers to handle all data confidentially, including non-disclosure provisions in employee contracts. This would lead to higher worker integrity. | Implement a system whereby users' identity is hidden. One possible consequence is that it would be more difficult to capture criminals who commit fraud or sell stolen data on the internet. | Users would hide their identity on most sites, except those directly involved with banking or security. Authorities could not profile or track individuals for exercising freedom of speech. |

**Table 3: Data Summary for Ethical Frameworks Analysis of Gun Violence**

| Sample No. | How to reduce gun violence using: | | | |
|---|---|---|---|---|
| | **Deontology** | **Virtue Ethics** | **Consequentialism** | **Utilitarianism** |
| G-1 | Second Amendment allows people to own guns for lawful purposes. Laws can be written and enforced to outlaw assault weapons. | A political leader endorses gun restriction laws, but is opposed by the NRA, which influences the election against them. | Mandatory buybacks of outlawed guns, which might conflict with Second Amendment rights. | Mandatory buybacks of outlawed guns, where the safety of the public outweighs the interests of the gun owners. |
| G-2 | Under the Second Amendment, do not restrict the ownership of guns, but increase police presence in sensitive areas such as schools. | Ban assault rifles because the public views them as totally harmful, due to media coverages of violent acts involving assault rifles. | Outlaw the use of all guns, but this might lead to an increase in other types of crime. | Restrict the use of guns by law to save lives without infringing on the rights to own a gun, such as regulating gun sales and enforcing more comprehensive background checks. |
| G-3 | Pass laws that don't infringe on peoples' rights, but protect lives. | Amend the Second Amendment to be more relevant for today's world. | Outlaw all guns. | Outlaw all guns. |

**Table 4: Data Summary for Ethical Frameworks Analysis of Automation**

| Sample No. | How to resolve ethical issues with automation using: | | | |
|---|---|---|---|---|
| | **Deontology** | **Virtue Ethics** | **Consequentialism** | **Utilitarianism** |
| A-1 | Per NSPE Code, enact rules for companies to provide training for workers to avoid displacing their jobs by automation. | Give all workers a universal basic income, so that no one who loses their job would lose their income. | Prevent companies from laying off workers due to automation, in order to prevent the negative consequences of unemployment. | Provide training for workers to prevent them from losing their jobs due to automation, by proactively putting worker welfare first. [similar to solution under Deontology] |

**Table 5: Data Summary for Ethical Frameworks Analysis of Miscellaneous Subjects**

| Subject | How to resolve ethical issues using: | | | |
|---|---|---|---|---|
| | **Deontology** | **Virtue Ethics** | **Consequentialism** | **Utilitarianism** |
| M-1: Water Pollution from Mining Operations | Companies have a duty, per NSPE Code, to place the public's interest above that of stakeholders by managing waste to prevent or minimize pollution. | Need company officials who want to "do the right thing" and clean up polluted sites first, before beginning any new operations that could cause pollution. Place respect for human health above profit motive. | Determine optimal level of negative outcomes, since these outcomes cannot be entirely eliminated, only minimized. Balance the need for profit with concern for environment, as human economic welfare is coequal with concern for human health. [sounds more like Utilitarianist view] | Place high priority on economic prosperity, above environmental health. [sounds more like Consequentialist view – is the participant biased based on level of industry knowledge exhibited?] |
| Weapons for Warfare | Per NSPE Code, discontinue the development of weapons for warfare [sounds like a Consequentialist view] | Develop weapons for defensive purposes only, until the need for any weapons can be totally eliminated. | Only countries with major global influence and power should be allowed to develop weapons for warfare. The current level of conflict is due to countries with less influence becoming involved with developing weapons for warfare. | Larger and more influential governments should form alliances with smaller governments to help people in the smaller countries become more prosperous. |
| Infant Survival | Per NSPE Code, engineers have a responsibility for health and welfare of the public; therefore, should provide better means to improve resources and infrastructure toward maternal and infant health. | Promote improvements in infrastructure, nutrition and medical technology, although funding may not be readily available. | Increase taxes to pay for improvements toward maternal and infant health among minority and disadvantaged populations. | Benefits to minority and disadvantaged populations do not outweigh consequences to those who are assessed the necessary taxes. Therefore, this is not an optimal solution. |