KLM Technology Group **P. O. Box 281** **Bandar Johor Bahru,** **80000 Johor Bahru,** **Johor, West Malaysia**	**Kolmetz Handbook of Process Equipment Design** **ENGINEERING ETHICS FUNDAMENTALS** **(ENGINEERING DESIGN GUIDELINES)**	**Co Author:** **Rev 01 - Yulis Sutianingsih** **Editor / Author** **Karl Kolmetz**

TABLE OF CONTENT

LIST OF TABLE

LIST OF FIGURE

INTRODUCTION

Scope

This training module covers aspects of engineering ethics to improve engineering professionalism. This module discusses the origins of ethics, the background and purpose of ethics, and how to managing the ethics for every stakeholder. Ethics involve high-impact decisions, not just to the company where the engineer works but also to the community and the environment.

It is clear that the choices must be taken in design can increase the possibility of maintaining the moral ethics. Every decision that made by an engineer should obey the standard code of ethics either for general purposes (as an Engineer) or specifically as a representation of the company where they work.

At the end of the training module, there are cases for consideration to think, stimulate thinking and discuss about the possiblitiy of common actions which could improve the moral conduct.

General Design Considerations

Origins of Ethics

One branch of ethics may be based from the ancient Greeks philosophy and has been developed through subsequent centuries by many philosophers. Interestingly on the other hand, Eastern cultures have independently developed similar ethical principles.

Many ethicial principles are rooted in religious beliefs, there are also many ethical people who are not religious, and there are numerous examples of people who appear to be religious but who are not ethical.

Engineering could be descibed as the strategy for creating the best choice in a poorly understood or uncertain situation within available resources. The realm of ethics and professionalism entails very real, poorly understood problems that are as challenging as any technical problems an engineer will face.

Ethics is an essential value for engineers to properly lead their actions. The actions such as developing products, designing a process for manufacture a product, the equipment to support the process, and operating process conditions. Additional actions include communication with other engineers and non technical personnel, interacting with many people such as clients, the goverment, and the public, through marketing and selling of products.

Thus, the engineers must apply their own moral standards, mindful of the legal requirements, to make a proper decision. There are several types of reasons for ethical behaviours that could help engineers develop a personal code of ethics that will provide a framework for making any decisions involving :

- Moral
- Legal
- Ethical

Typically, engineers have a core principles based on of what they are believe such as faith, science, and also personal experiences. The basic framework by which one decides is what is right and what is wrong usally are developed well before the time one reads an engineering text.

The practice of engineering is governed by many laws on the international, federal, state and also local-rules. Although many laws are purely of a practical, rather than philosophical, many of these laws are from core from ethical principles. There is also a distinction between what is legal and what is ethical. Many things could be considered as unethical actions but they are legal to do. Designing a process that releases a chemical toxic substance that is unregulated could be one of the examples.

The engineers should always follow the requirements of the applicable laws. Nonetheless, from engineering ethics perspective, the engineers must go beyond the dictates of the law. The interesting area of this topic relies on the conflicts obtained where there is a zero legal guidance on how to resolve them.

Background & Purposes

Several events that occurred with a great deal of media attention in the past has led engineers to increasing knowledge of their professional responsibilities. The cases also help the engineers gain an awareness of the importance of ethics within the engineering profession as they realize how their technical decisions has far-reaching impacts on society. The work of engineers generally effect public health and safety and can influence business practices also, even in the political arena.

The goal of engineering ethics is core to the importance of ethical issues and frequently is summed up using the term 'moral autonomy'. Moral autonomy is the ability to think critically and independently about moral issues and to imply this moral thinking to situations that arise in the course of professional engineering practice.

Therefore, the ethical problems encountered in engineering practice are very complex and involve conflicting ethical principles. The engineers that worked on the Ford Pinto are a clear example, where the trade-offs were made so that the Pinto could be successfully marketed at a reasonable price. One of the trade-offs involved the placement of the gas tank, which led to the Indiana accident. The question became following is: "Where does an engineering team strike the balance between safety and affordability, and simultaneously between the ability of the company to make a profit?"

Managing Ethics and Stakeholder

One source of the ethical issues that is encountered in the course of engineering practice is uncertain or unknown knowledge. This is by no means an unusual condition in engineering. The engineers often encounter a situation where they don't have the information that they need but on the other hand, must react immediately to prevent a severe violation either to the physical asset or non-physical asset such as condition of the employee.

Nonetheless, engineering design is about creating new devices and products. It will lead to the conclusion on a larger view that an engineer's job is quite simple yet complicated such as the attempt to manage the unknown.

It is important to make a distinction between personal ethics and professional, or business ethics, although the boundary is not clear between them. These principles are could apply to the ethical conditions in business and engineering. Professional ethics often involves choices on organizational level rather than a personal level. These types of relationship pose problems that are not encountered in personal ethics.

Ethics and Engineering Design

The conception of ethical issues is used independently of what engineers think are ethical issues. The Engineers could or could not share the concept of ethical issues. There are ethical issues which also became a legal issues, such as safety issues. There are many standards, codes, legislation, and regulations pertaining to safety and design. This makes decisions regarding safety no less ethically relevant, it only provides engineers with rules they must obey from a legal point of view when making decisions. In these cases the way engineers deal with these issues might be evaluated both from an ethical and a legal point of view.

Thus, the decision about the safety of a product might then be morally right or wrong and legal or illegal. A question that often raised in such instances is whether a design that is safe enough according to legislation is also ethically acceptable and vice versa. Legislation, codes and standards regarding safety can also be evaluated ethically.

It is not that difficult to point out the ethical relevance of what seems to be a very trivial choice, such an example of the ethical impact of design decisions is the following. A person may decide not to drive too fast as this is usually dangerous and not environment friendly. The government of a country might decide to regulate the speed of cars by imposing speed limits. If there are speed limits imposed drivers can still drive as fast they wish, and is possible in their car, but they will run the risk of being fined when exceeding the limits. Car engineers could decide to design a car in which it is impossible to exceed the speed limits.

DEFINITIONS

Accidents – Effect of an action which crossed against safety rules.

Act utilitarianism – A kind of utilitarianism which focuses on individual actions rather than rules.

Active Responsibility–Responsibility of being for something or some task.

Characteristics – Element of trust which derived from membership of community.

Codes of ethics–Formal obligations that persons accept when they join organizations or when they are allowed to enter a profession.

Communication – Action to deliver thought, could be used on many ways like drawings, computer drafts, and description notes.

Confucianism – One of the anchinet chinese ethics principles roots which emphasize the imporance of balancing individual rights with the needs of the larger community.

Cost-Benefit Analysis – A tools usually used for engineering analysis and determine whether the project is benefit or not.

Duty – A task, A Point of moral concept that focused on action which should be performed whether it is lead to good or bad decision.

Egocentric Tendecies – A common feature of human experience is that tends to interpret situations from very limited perspectives.

Ethical Dilemmas–The problem which provide 'no perfect solution' that will lead to the condition.

Engineering–The strategy for causing the best change in a poorly understood or uncertain situation within available resources.

Environment – A place outside the system.

Evaluation – A check-and-balance action where the decision made as to whetner the possible solution meets the requirements.

Generation – First phase where a process design engineer needs to understand the design problem and generated concept.

Group Think – Situations where the groups come to agreement at the expense of critical thinking.

IACPE – International Association of Certified Practicing Engineers.

Ignorance – Lack of awareness of vital information.

Illegal – An action or properties which goes against the law.

Institutions – Element of trust which derived from rules, code of ethics or professional standards.

Legal – An action or properties which goes the obedience of law.

Moral Autonomy–The ability to make one's own ethical decisions.

Moral theory – A theory which defines terms of ethical principles in uniform and consistent ways.

Normative framework – A point of moral which exists and governs all ethically decisions in technology development.

Passive Responsibility–Responsibility that implied after some has happened, usually being accountable.

Probability – A chance to cause whether severe injury or fairly minor injury.

Problem – Factual target which could not reach set point.

Process – Element of trust which derived from the developing relationship between people.

Professional Autonomy – Condition that achieved when engineering codes of ethics emphasize the importance of ovejctive judgment.

Professional Ethics–The moral disposition professional brings to the strcuture in which engineer operates.

Proper Engineering Design (PED)–A decision that should be made from engineering people or at least by professional engineering standards.

Proper Management Design (PMD)–A decision that should be made by managers or at least governed by management.

Qur'an – The Holy Book for Muslims, one of the sources of ethical principles for muslims behavior.

Religion (beliefs) – One of the sources or rooted for ethical principles.

Risk – Danger, the possibility of suffering harm or loss.

Rule utilitarianism – A type of utilitarianism which focuses on rules rather than individual actions.

Safety – A freedom condition from damage, severe, injury, or risk.

Self-Deception – An intentional avoidance of truths.

Self-Interest – One of impediments which partially block the engineers mind from seeing and understanding their professional responsibilities.

Standards – One of the principal mechanisms for managing complexity of any sort, including technological complexity.

Utilitarianism – A balance between good and bad consequences.

Virtue – Positive moral distinction and goodness.

Virtue ethics – A point of moral concept which focuses on the type of person that the engineer must strive for.

Whistleblowing–A decision that further disclosure is warranted and then making that disclosure.

THEORY

A. Moral Theory

The approach for ethical problem solving could be similar to problem-solving strategies in other engineering classes which required some knowledge of ethical theory to provide a framework for understanding and reaching solutions.

The moral and ethical theories that will be apply in engineering ethics are derived from a Western cultural tradition. In other words, the ideas itself originated from Middle East and Europe. Western moral thought has not come down to people from just a single source.

Ethical ideas were continually redefined during the course of history. Many thinkers have turned their attention to ethics and morals and have tried to provide insight into the issues. Locke, Kant, and Mill are the example of philosophers who wrote about moral and ethical issues.

Regarding to develop workable ethical problem-solving techniques, engineer should look at several theories of ethics first in order to have a framework for decision making. Thus, the ethical problem solving is not as cut and dried as problem solving in engineering classes. The relatively large number of theories do not indicate a weakness in theoretical understanding of ethics or a ‘fuzziness’ of ethical thinking. Rather, it reflects the complexity of ethical problems and the diversity of approaches to ethical problem solving that have been developed over the centuries.

Moral theory defines terms in uniform ways and links ideas and problems together in consistent ways. This definition is also apply for scientific theories usage in other engineering classes function. So, in moral theory, the engineers will organize ideas, define terms, and facilitate problem solving.

There are at least four ethical theories that will be considered to study. Each differing according to what is held to be most important moral concept including:

1. Utilitarianism.
   Utilitarianism is looking to produce the most utility, defined as a balance between good and bad consequences of an action, taking into account the consequences for everyone affected.

2. Duty ethics.
   Duty ethics contends that there are duties that must be performed regardless of whether these acts lead to the most good. Treat others fairly is one of the examples of duty ethics.

3. Right ethics.
   Meanwhile, right ethics emphasizes that all of the people have moral rights, and any action that violates these right is ethically unacceptable. The ultimate overall good of the actions is not taken into account.

4. Virtue ethics.
   Virtue ethics regards actions as bad that display bad character traits. The theory is focuses on the type of person we should strive to be.

Utilitarianism

Utilitarianism description could be whatever the action will lead to its consequences, such as good actions serve to maximize human welfare. But, the emphasis in utilitarianism is not on maximizing the well-being of the individual, but rather on maximizing the well-being of society as a whole and as such it is somewhat of a collectivist approach.

Utilitarianism is fundamental to many types of engineering analysis, including risk-benefit analysis and cost-benefit analysis. However, as good as the utilitarian principle sounds, there are also some problems.

An objection to utilitarianism is that its implementation depends on knowing what will lead to the most good. Frequently, it is impossible to know exactly what the consequences of an action. It is often impossible to do a complete set of experiments to determine all of the potential outcomes. Then maximizing the benefit to society involves guesswork and the risk

that the best guess might be wrong. Despite the objections, utilitarianism is a valuable tool for ethical problem solving.
It should be noted that there are many flavors of the basic tenets of utilitarianism, as follows:

- Act utilitarianism.
  Act utilitarianism focuses on individual actions rather than rules.

- Rule utilitarianism.
  Rule utilitarianism differs from act utilitarianism in holding that moral rules are most important. The rules include 'do not harm others' and 'do not steal'. Rule utilitarians hold that although adhering to these rules might not always maximize good in a particular situation. Overall, adhering to moral rules will ultimately lead to the most good.

Although these two different types of utilitarianism can lead to slightly different results when applied in specific situations.

Cost-Benefit Analysis

Cost-Benefit Analysis one of the tools that is frequently used in engineering analysis, especially when trying to determine whether a project makes sense. Fundamentally, this type of analysis is just an application of utilitarianism. By this theory, the costs of a project are assessed as are the benefits. Only those projects with the highest ratio of benefits to costs will be implemented. This principle is similar to the utilitarian goal of maximizing the overall good.

Similar to utilitarianism, there are pitfalls by using cost-benefit analysis method. While it is often easy to predict the costs for most projects, the benefits that are derived from them are often harder to predict and to assign a dollar value to. Once dollar amounts for the costs and the benefits are determined, calculating a mathematical ratio could looks very objective and therefore may appear to be the best way to make a decision.

It should be noted that although cost-benefit analysis shares many similarities with utilitarianism, cost-benefit analysis is not really an ethical analysis tool. The goal of an ethical analysis is to determine what is the ethical path. The goal of a cost-benefit analysis is to determine the feasibility of a project based on costs. Whenever the engineer facing an ethical problem, first step must be to determine what the right course of action and then factor in the financial costs in choosing between ethical alternatives.

Duty Ethics and Rights Ethics

There are the two other ethical theories which are similar to each other and frequently occurred together. These theories hold that those actions are good that respect the rights of the individual. Here, good consequences for society as a whole are not the only moral consideration.

Duty ethics and rights ethics are really just two different sides of the same coin. Both of these theories achieve the same end: Individual persons must be respected, and actions are ethical that maintain this respect for the individual. In duty ethics, people have duties, an important one of which is to protect the rights of others. While in right ethics, people have fundamental rights that others have duties to protect.

There are also problem between the duty and rights ethics theories that must be considered as follows:

- First the basic rights of one person (or group) could be conflicted with the basic rights of another group.

- Second, the problem with duty and rights ethics is that these theories don't always account for the overall good of society very well. Since the emphasis is on the individual, the good of a single individual can be paramount compared to what is good for society as a whole.

Already it is clear why the engineer should be considering more than one ethical theory in engineering cases. Thus, any complete analysis of ethical problem must incorporate multiple theories if valid conclusions are to be drawn.

Virtue Ethics

Virtue ethics is usually described as positive moral distinction and goodness. Virtue ethics is interested in determining the kind of person you should becpme. In virtue ethics, actions are considered right if they support good character traits (virtues) and wrong if they support bad character traits (vices).

Virtue ethics focuses on words such as responsibility, honesty, competence, fairness, respect, trustworthiness and loyalty which are virtues. Incompetence, disloyalty, and irresponsibility are vices.
The theory is not only about personal ethics but could also applicable to engineering or professional ethics. Therefore, virtue ethics could be applied to business and engineering situations by answering several questions such as:

- Is this action honest?
- Will this action demonstrate loyalty to my community and/or my employer?
- Have I acted in a responsible fashion?

To use virtue ethics in an analysis of an ethical problem, the engineer should first identify the virtues or vices that are applicable to the situation. Then, determine what course of action each of these suggests. As with any ethical theory, it is important to be careful in applying virtue ethics. Problems can arise with words that on the face seem to be virtues, but can actually lead to vices.

Non-Western Ethical Thinking

As explained before, since the rest of the world has different foundations for ethical systems. Hence, ethics is not geographic or cultural. Indeed, ethical consideration and standards which have been developed similarly around the world, and it is not dependent on a Western cultural or religious tradition.

A detailed understanding of ethical considerations from cultures around the world is well beyond the scope of the module. Despite the diversity of origins of ethical philosophy, the engineer must see the ethical concepts governing engineering practice are similar regardless of where engineers practice. Nonetheless, personal ethics are not determined by geography. Personal and business behavior must be the same regardless of where an engineer happens to be on a given day. Several examples non-western ethical consideration are further explain following:

- Chinese Ethics.

  Confucian ethics emphasizes the importance of balancing individual rights with the needs of the larger community. In trying to balance individual and group rights, Confucianism emphasizes the fact that this is not an neither/or proposition: neither individual rights are paramount or the rights of society as a whole paramount.

  By acknowledging the interdependence, Confucianism mirrors the tension inherent in trying to balance the Western concepts of utilitarianism and rights or duty ethics. Confucian ethics could informed the engineer at decision-making moment by emphasize on virtues and the importance of leading a virtuous life speaks very directly to the engineering profession especially in terms of honesty, integrity, and other core values of engineers.

- Indian Ethics.

  Indian philosophy and ethics was focused less on the theoretical and intellectual aspects of philosophy, and more on the practical and the spritiual. Nothing could be more practical than the ethical concerns about human social behavior.

  Indian ethical philosophy has much in commmon with virtue ethics discussed in Western ethical traditions. Nevertheless, the Indian philosophical and ethical traditions speaks to modern engineering practice by emphasis on the practical everyday nature of philosophy directly speaking to modern engineers and engineering practice. In addition, the emphasis on reinforcing virtues and avoiding vices directly mirrors the language used in modern engineering codes of ethics.

- Muslim Ethics.

  Muslim ethics could be considered as a cousin to many Western ethical traditions. Broadly speaking, the Muslims ethics have much in common with what Western philosophers refer to virtue ethics. For muslim philosophers, ethics is derived from principles set forth in the Qur'an.

  Specific virtues mentioned in the Qur'an are humility, honesty, kindness, giving the poor, and trustworthiness. It is clear that honesty and trustworthiness are an essential virtues for those practicing a profession such as engineering. In many areas Islamic world is different compared to the Western world, but the way Islam impacts engineering professional practice is similar as Western ethics.

- Buddhists Ethics.

  Like other formulations of ethical consideration in non-Western societies, Buddhist ethics could appeared to be similar to the Western concept of virtue ethics. Buddhist's speak of five major vices: Destruction of life, taking what is not given, licentiousness, lying, and consuming intoxicants. Buddhism speaks of virtues such as spiritual development, mastery of skills, friendship, diligence, patience and a sense of proportions of limits.

  The engineer must examine the role that the Buddhist virtues of learning, mastery of skills, and diligence have in relation to engineering practice. The engineering codes of ethics often discuss the importance of continous development of an engineer's skills, and supporting others in developing their skills.Thus, the ideas regarding protecting the environment and sustainable development that appear in the most recent versions of the codes of ethics of professional engineering societies are similar to ideas found in Buddhist teachings.

Although ethical consideration throughout the world has originated in various ways and has diverse language and terminlogy, the results are similar across cultures. It also seems that the concept of a formal code of ethics is a Western creation designed to serve the needs of professional communities.

B.Code of Ethics (Standards of Engineering)

Codes of ethics are formal obligations that persons accept when they join organizations or when they are allowed to enter a profession. Especially for engineers, there were at least three main types of codes of ethics: Employer, Technical society and also Government (National Bureaucracy).The employer-based codes of ethics are usually incorporated into the codes of business conduct that one agrees to upon employment with a particular firm.

For engineering societies like IACPE, the code will identify to whom the code applies and purpose of the code (such as upholding and advancing the honor, integrity, and dignity of the engineering profession).

Generally, the purposes are based on the concept that each member of a group who has a high responsibility to maintain the good image of all other members of the group through professional behaviors that tend to increase the trust that society has in the profession.

This concept is a strong one due to high-impact of acknowledging the unethical behavior of any member of the group that could cause the trustissues between internal members of the group and externally relationships. Therefore, all members should have share the same interest level of the ethical behavior of all members.

The second part of codes for engineering socities is the list which identify the duties that engineers must have (being honest, impartial, loyal), to whom (employers, clients, the public, the profession), and why (enhancing of human welfare). Also, it represents that practicing engineering ethically involves improving the profession (striving to upgrade their competency). This section provides two important purposes:

- The engineers should acknowledge the core responsibility to the society that may not be apparent in day-to-day work. The decision that their made could save many lives by admitting fertilizer to grow much needed food, it might be turned to the other way and kill scores of people by catastrophic event.

- Second purpose as the list of goals points out quite clearly that not all goals can be met simultaneously all of the time. As a matter of fact, one frequently encounters ethical dilemmas, in which no choice is a perfect choice, completely satisfying all of our moral, legal, and ethical responsibilities.

The third part of the code of ethics will be focused on specific responsibilities that engineers have. During reiterating and clarifying the responsibilities of engineers for safety and health of the society at large, the engineers speak to the responsibilities to clients, employees, and the profession itself.

An engineering code of ethics generally insist that engineers conform to standards of competence. Regulatory standards and standards of competence are intended to provide some assurance of quality, safety, and efficiency in engineering.

It is also important that engineers have a responsibility to use their specialized knowledge and skills in ways that will give benefit to the clients and also to the public (environment) with no violation of trust placed for them.

An early code is called the 'Engineer's Creed' which illustrated as a pledge:

"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, 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."

Design Standards

As explained previously, most engineering codes of ethics insist that, in designing products, engineers are expected to hold considerations of public safety paramount. Further question then is: "What if there is more than one way to satisfy safety standards, how are designers to proceed?.".

Principally, there will always be more than one way to satisfy the standards, but this does not mean that professional standards have no effect on practice. As Stuart Shapiro noted;

"Standards are one of the principal mechanisms for managing complexity of any sort, including technological complexity. Standardized terminology, physical properties, and procedures all play a role in constraining the size of the universe in which the practitioner must take decisions."

Thus, for a professional, the establishment of standards of practice is typically regarded as contributing to professionalism, thereby enhancing the profession in the eyes of those who receive its services. At the same moment, standards of practice may contribute to both the quality and the safety of products in industry. Nonetheless, standards of practice have to be applied in particular contexts that are not themselves specified in the standards.

Some standards of practice are only localized in their scope. Vivian Weil argued that there is a good reason to believe that professional standards of engineering practice could cross the national boundaries. Weil also cited that two fundamental principles of engineering that could be practically implemented consist of:

- Gathering all of the reliable information about the specific condition.
- Sight view of engineering plans and projects in context, the needs of workers, transportation, communication, economic feasibility, and also impacts to both of the users or any other parties such as environment.

It must be noted that the code of ethics of engineering societies typically endorse principles that seem intended to apply to engineers in general rather than only to members of those particular societies. Morality value was recommended as providing the ground for basic provisions of the exact codes had been mentioned. Nonetheless, whether engineers who does not join the professional engineering societies actually do, either explicitly or implicitly, accept the principles articulated in a particular society's code of ethics is yet another matter.

Other Resources

There are many resources for an engineering ethics. The following are a few of the most helpful. Engineering Ethics Center at the National Academy of Engineering has many engineering ethics resources, as follows:

- Cases and Experiences of Ethics.

  There are more than 100 engineering ethics examples based on cases and experiences had been published by the group which consist of engineers, univerisities and others. The publication paper usually covered famous accidents with significant engineering ethics issues. Bhopal case in India is one example.

- Moral Examples

  Accounts of engineers and scientist showing leadership in very difficult and important ethical situations.

- Guidelines to Professional Employment for Engineers and Scientists.

  Issues that specifically related to employment, recruitment, professional development, transfer process and termination. They also identify responsibilities for the employees.

- Educational Resources.

  Represents a general assignments, syllabi, and strategies for exploring professional ethics and assessment procedures.

Problems

At the start for an Engineer-in-practice or Engineer student, they could find that the types of problems and discussions that take place in an engineering ethics topics are ambigious. Generally, the problems are more open ended and are not as susceptible to formulaic answers as are problems typically in other engineering classes. Thus, problems for engineering ethics are difficult to find a satisfication answer from every single-perspective and probably have no ‘the-right answer’. However, the types of problem-solving techniques that engineer often use could result a striking resembalnce to the most fundamental engineering activity – engineering design.

The main substance of engineering practice is the design of products, structures, and processes. The design problem is cited in terms of specifications : A device must be designed that meets criteria for performance, aesthetics value, and also consumer pricing. Hence, within the limits of the specification, there are a lot of solutions that could be applied. There are several problem-solving that could achieved as a solutions that are better than others in terms of higher performance or lower cost, yet perform identically.

Althought there will be no unique correct solution for most of the problems, there will be a range of appropriate action that possibly could be done by the engineer and became a solution which actually clearly right, some of them would be better than the others. Yet, there are also be a range solutions that are clearly wrong. Basically, the engineering ethics and engineering design have similiarities for both of them such as : (1) Apply in a large body of knwoledge to the solution of a problem, and (2) Involve to use the analytical skills.

C. Moral Frameworks

The engineers do not share a single set of moral principles by which to make ethical decisions, it is fully expected that different readers will make different decisions. In a complex condition what is the proper decision to take under a short periode of time. The goal is not to unify all decisions by all engineers, but give some autonomy to each engineer to make the right decision. By this context, the ‘right’ decision can be identified by the use of a heuristic method.

As for the right decision is one that following a'consistency of values' such as :

- General codes of engineering conduct.
- Moral principles for Engineers.
- Any obligations that previously accepted.
- Laws.

Nonetheless, the right decision is the one that the engineer can live with. Thus, there is always a chance of possiblity for people to make an unacceptable decision.

Moral autonomy is the ability to make one's own ethical decisions. In order of that term, moral autonomy does not require that you able to look back and alwas be confident that the choice made was the best of all possible choices. This is a 'moving-target', since it is very dynamic. In conclusion, whenever the decision choice based on a reasonable analysis of the potential consequences consistent with moral values, legal, faith, ethical beliefs, duties, right, laws, and also obligations, it was actually exercising the moral autonomy of engineers.

On the other hand, if there are no understanding of moral principles, strategy to go along with for ethically analyzing a situation properly, and defer the engineers resonsibility to others, it will lead to to the lowering competency of engineer.

The idea of normal design might be related to 'business-as-usual' technology development there is no need for engineers to reflect ethically. There are some situations which an engineer must ethically reflect the development of technology.

There is a normative framework that exists which governs all ethically relevant decisions in technology development. The engineers should obey the rules from the normative framework without further ethical reflection.

The normative framework must meets one of the following requirements:

- Pragmatics.
  This requirement has to comprehend properly the decision to be made and must leave out no important aspects from consideration.

- Unambiguous.
  Beyond the normative framework, there has to be a sufficient common understanding among the actors in the decision under discussion.

- Consistent at local stage.
  This term has to be also ‘sufficient’ degree of freedom from contradiction among the various elements of the normative framework.

- Observation.
  The normative framework has to be in fact observed.

- Acceptation.
  The normative framework has to be accepted as the basis for the decision by the decision maker and also those who concerned about engineering ethics.

Regarding to the acceptance of the normative framework, it cited that the acceptance requires neither to be universal nor should it be restricted to the very narrow sphere of engineering. Thus, the normative framework could be composed from all obligations given by political regulation and all obligations resulting from other societal regulation like technical codes and standards and codes of ethics. In conclusion, the normative framework comprises the same elements as the regulative framework.

Reflection of Action

After an engineering event has achieved in which ethical decisions were made, one party or a group of people should sit down and reviews the case, analyzing the facts, the missing information, the constraints, the unnecessary perceived constraints, the options considered, the options not considered, and the strategy used to arrive at the decision. Frequent postmortem analysis is one of the key characteristics of successful professionals in a variety of fields. Reflection in action at any cost will be focus on two things:

- The force for the one that must be analyze the strengths and weaknesses of their strategy.
- Provides continual opportunities and encouragement for rehearsal.

There are several step that should follow consider of doing a reflection of action including:

- Definition of the problem.
- Exploration of an alternative ways.
- Planning the details of action.
- Do the action with eagerness to accomplish it well.
- Review all of the action from beginning to the end.

At the end of any reflection, person or party in-charge must develop a list of heuristics to use in future ethical problem solving. The following heuristics could be identified as:

- Traditional problem – solving strategy usage for solving ethical problems.
- Consider the possibility that inexperienced people can be right.
- Debrief people fully before assuming facts about their decisions.
- Consideration of the consequences.
- Honesty.
- Concern about the welfare of the company.
- Be aware about the welfare from the employees.
- Independency.

As the technology growth, so does for the additional ethics heuristics approachment. Many heuristics for the solution of ethical problems have been explained. Thus, a great heuristics methods is always try to develop a new heuristics. Such as in example points below:

- Obtain all of information about the exact situation. The problem may be more serious than it first appears, or it could be lead to the opposite matter, in which no real problem exist.
- Always open minded and honest.
- Acknowledge the concerns of others frequently.

D. Responsibilities and Rights

Basic concept of responsibility is relies as a notion of accountability, it could be applied to individual engineers, a team which consists of engineers, division or units within the organization, or more over, it could be organization themselves. Respnsibility should be focus mainly on legal liabilities, jobdescription roles, and moral accountability. Engineers as a professinals are expected to commit themselves to high standards of conduct and follow them.

William F. May concludes, what is important to professional ethics is the moral disposition that the professional brings to the structure in which engineer operates. At one end of the spectrum is the minimalist approach of doing as little as one can and still stay out of trouble. On the other hand, the spectrum are attitudes and dispositions that may take one “above and beyond the call of duty”. The professional’s attitude could be as one dedication to an extraordinary high level of performance.

Most engineers, cited by May, typically fall somewhere in between the two ends of spectrum most of the time. We usually require some expectation of an attitude value like integrity, honesty, civic-mindedness, and willingness to make some self-sacrifice. The values involved will make an engineer as a ‘highly-responsible’ engineer.

Thus, the ‘highly-responsible’ engineer also should displaying the basic engineering competence including:

- Imaginative and Perseverance.
- Able to communicate clearly and informatively.
- Objective.
- Open-minded and correcting mistakes.
- Work well with the others.
- Quality oriented.
- Must be able to see the ‘big-picture’ as well as its details.

Duties

The engineers must have a certain duties involved by virtue of their positions, and other obligations. Joining a professional organization beyond their family is one of kind an example. To solve an ethical problem that could be achieved by this action, one needs to remind oneself of all of the duties and obligations to which one has agreed. Ones’ duties and obligations form the basis for some additional important heuristics in ethical problem solving for the engineers, including :

- Always remind theirself of relevant duties and obligations that you have accepted and have not accepted.
- Make a lists, and rank the responsibilities of the relevant duties and obligation that have been accepted.
- For a decision that could cause violation of obligations, the decision must be discussed with whom was made and determine the consequences.

Impediments to Responsible Action

What attitudes and frames of mind may influence to do less than fully responsible actions, it could be intentional, reckless, or even merely negligent? There are some impediments to responsible action involving :

- Self-Interest.

  Concern for self-interest could be partially block our mind from seeing and understanding our professional responsibilities. Engineers are not simply as we think engineers they are, they are still human, just like everybody else. An extreme form of self-interest is egoism, could be defined as an exclusive concern to satisfy one's own interest, even at the possible expense of others.

- Self-Deception.

  Honestly, and always conduct a check-balance program is one of a way to resist the temptations of self-interest. We should truly aware what we are contemplating doing. Rationalizaion often gets in the way of this recognition. Self-deception is described as an intentional avoidance of truths we would find it paintful to confort self consciously. Selfdeception is naturally difficult to discover by one point of view, they always need an 'outisde view' to check them.

- Fear.

  There are a lot of kind of fear, fear of acknowledging out mistakes, or some sort of punishment or other bad consequences. Fears will make it difficult to act responsibly.

- Ignorance.

  Ignorance of vital information is an obvious barrier to responsible action. If the engineer does not realize when a design poses a safety problem, then they can not be in a position to do anything about it. Lack of awareness such as turning away from information in order to avoid having to deal with the challenges it may pose may also become a willful avoidance. It will lead to the lack of imagination from not looking in the right places for necessary information like a failure to persist, or the pressure of deadlines. Therefore, there are limitation of what engineers could be expected to know. At the end, ignorance is not always a good excuse.

- Egocentric Tendencies.

  Egocenttricity in a psychological term means as a common feature of human experience is that tends to interpret situations from very limited perspectives and it takes special effort to acquire a more objective view-point. It is not just self-interest that interferes with out ability to understand things from other perspectives. The engineers may have a good intention of others but could also failed to realize that their perspective are always different from the others.

- Microscopic Vision.

  Microscopic vision embaces a limited perspective. Microscopic vision may be strongly accurate and precise but fails due to lack of understanding of others perspective. Since microscopic vision has to take a look closer it will lead to see something that could not be seen before. It gains a detailed knowlegde but ceases to see things at the more ordinary level.

  Engineers should spend time to raise their eyes from their world of scientific and technical expertise and try to look around them in order to understand the larger implications of what they are doing. Many organization also tend to foster microscopic thinking whereas each person has their own specialized task and are not responsible for the work of others.

- Uncritical Acceptance of Authority.

  Professional autonomy is achieved when engineering codes of ethics emphasize the importance of engineers exercising independent, objective judgement in performing their functions. The codes of ethics also insist that engineers have a duty of fidelity to their employers and clients. Therefore, there is a difference between independent consulting and the vast majority of engineers. Independent consulting engineers usually have an easier time management to professional autonomy better than the engineers who work in large and hierarical organization. Many engineers in large organization are expected to defer to authority in their organizations.

- Group Think.

  Irving Janis defines groupthink as situations where the groups come to agreement at the expense of critical thinking. Janis identifies eight symptoms in groupthink, concentrating on groups that are characterized by cohesiveness, loyalty, and solidarity as follows :

  a. An illusion of invurnability of the group to failure.
  b. Encouraging shared stereotypes of others caused by a strong feelings that bound each member of groups.
  c. Rasionalization, this value will lead agreement for shifting responsibility to others.
  d. Illusion of morality which assumes the inherent morality of group.
  e. Self-cencorship.
  f. Illusion of unanimity which construing silence of a group member as consent.
  g. Application of direct pressure.
  h. Mindguarding, means as protect the group from dissenting views.

E. Social Experimentation

When engineers learn a new skill, they should practice and do a rehearsal. For example, when engineer wants to learn to apply the ideal gas law in process calculations, one does end-of-chapter problems in thermodynamics. Therefore, understanding the theory behind the ideal gas law is no guarantee that engineer will be able to solve applied problems.

The goal of rehearsal action in the early stages of skills training and education is to work through a scenario that mightcommonly occur in the future and to develop the best response of the engineers.

Some ethical problems may be solved smoothly. The problem which provide ‘no perfect solution’ will lead to the condition that usually called an ‘Ethical Dilemmas’.

Does a whistle-blowing action satisfy one ethical obligation, but at the same time violating the others. Whenever the engineers deal with an ethical dilemma, one must necessarily rank one's ethical obligations. This might be the important heuristic in solving ethical dilemmas, but there are many others such as:

- Rank order the ethical obligations again after brainstorming for solutions.
- Admit that you may not be able to satisfy all the obligations.
- Unify the individual actions identified in the brainstorming into action plans. Always check the entire plan for its risk, consequences, and effectiveness.
- For some point in the decision-making process, involve those who are most affected by the consequences but who are not active members in the solution.

Whistle-Blowing

Many Socity codes state that - engineers shall issue statements or present information only in an objective and truthful manner. It was clear that one has the responsibility to tell those who engage one's professional services when there is a problem or potential problem. Also, it was clear that one should be honest and truthful about the fact. What is not so clear is what the engineers should do, after such disclosure, the situation still persists.

Assuming the decision that further disclosure is warranted and then making that disclosure is called 'whistle-blowing'. Most instances of whistle-blowing share the characteristics as follows :

- A whistle-blowing action rarely results in correction of the specific situation. Nonetheless, it some changes a prevailing the strategy for decision making and decrease the chance of further consequences.
- A whistle-blowing usually brings a personal-violation and also professional trouble for the one who did it and is often called a 'whistle-blower'.

Many protections have been made to prevent a whistle-blowers at specific circumstances. There is a specific conduit for an employee, former employee, or applicant for federal employment to make a whistle-blowing disclosure, with the identity of the whistle-blower protected to some extent.Even though the professional engineer's code of ethics requires whistle-blowing in some states, protection of the whistle-blower is not ensured.

An employee in the private sector are protected by other laws, rule and regulations, many which are summarized on the web. Many whistle-blower laws regulations exist in other countries and at state and local levels. For each case, there is a limitation period for filing a complaint of retaliation. Nonetheless, before deciding to do a whistle-blowing action, there are several questions that needs to examine first, involving:

- What Should One Do to Solve the Problem without Whistle-Blowing?
- Is Whistle-Blowing Likely will to solve the Problem?
- What Whistle-Blowing Actions Should One Take?
- What Are the Potential Consequences to One's Personal and Professional Career?

Such an important distinction is between internal and external whistleblowing, also for open and anonymous whistleblowing.

- Internal Whistleblowing
  The alarm about wrongdoing stays within the organization, although the whistleblower may by pass his immediate superiors, especially if they are involved in the wrongdoing.

- External Whistleblowing
  The whistleblower goes outside the organization, alerting a regulatory organization or the press.

- Open Whistleblowing
  The whistleblower has to reveal their identity.

- Anonymous Whistleblowing
  The whistleblower attempts to keep his identity secret.

There are some practical advice on whistleblowing that is strongly recommended to apply such as:

1. Taking any advantage of any formal or informal processes the organization may have for making a protests. Many managers have an ‘open door’ policy, and there may be other informal procedures for expressing to a superior a different assessment of a situation.

2. Determining whether it is better to keep the protests as confidential or to involve others in the process. Sometimes, the most effective way to work within an organization is to work confidentially and in a nonconfrontational way with superiors and colleagues.

3. Focusing on issues, not personalities. People usually get defensive and hostile when they are being attacked, whether these people are superiors or peers.

4. Keeping all of the process records written down. This is important if court proceedings are eventually involved.

5. Always present positive suggestions in association with the objection. This approach will keeps the protest suggested as a positive solution for the identified problem.

Social Process in Design

In general, a design of a process usually made by more than one engineer and it should a comprehensive review from many engineers from different knowledge backgrounds. Hence, by this example, designing is could also involve of social process. The choices and the decision are made by groups of people.

During this activity communication, negotiation, debate, trust and mistrust are the elements that often influence the design. These activities could lead to the consequences for design research as the design process must be conceptualized as a social process. Therefore, the different engineers, with their different educational backgrounds and experiences, will all conceive the design task differently.

The engineers have responsibilities towards the customers and also society as a whole. The codes of ethics formulated by engineering societies which stated that every engineers must exhibit an integrity and honesty values while doing their job.

The development of fresh (and controversial sometimes) technologies are questioned by different people in society. For this case, a bureaucracy power in example local government has to describe a certain limits and gaining people trust also.

Trust, might be built from several main-elements involving:

- Characteristics.
  This elements are derive from membership of community.

- Institutions.
  This elements are derive from rules, code of ethics but could be from the professional standards.

- Process.
  This elements are derive from the developing relationship between people.

Hence, a regulative framework (government) can produce institutionsbased trust. The public will tend to trust engineers to make good designs because the engineers adhere to the rules and standards of the regulative frameworks and act in a trustworthy manner. The public expects engineers to design products that will, in normal circumstances and use, not lead to severe incidents.

Trust in engineers could be wrong if the regulative framework is not proper. If these casesthat happen, engineers must be given the regulation that they should follow and lead to the protection of what people value. The requirements that a regulative framework should be complete, unambiguous and consistent to ensure that the rules could be used in design processes. Nonetheless, trust in engineers making designs is warranted if:

- Engineers must behave and provide a good manner.
- Engineers are high-competence.
- The regulative framework is adequate.

F. Safety and Engineering Design

Safety and Risk

The main duty of engineers is to protect the safety and well-being of the public. Indeed, the codes of ethics of the professional engineering societies make it clear that safety is paramount importance to the engineer. The engineering codes of ethics will show that engineers should have a responsibility to society to produce products, structures, and processes that are safe. There is an implied warranty that products are safe to use. Engineers are required to make their designs as safe as reasonably possible. Thus, safety must be an integral part of any engineering design.

What is safety? As in general, safety is a vague term, safety is a value judgment. Some literature cited that safety as a freedom condition from damage, severe, injury, or risk. Hence, it is impossible to discuss safety without including a discussion about risk. Risk could described as a danger, the possibility of suffering harm or loss. There is a strong relationship on both of the terms. Risk could be engaged by doing something that is unsafe, meanwhile something is unsafe if it involves substantial risk.

Although these definitions are on point. Essentially, safety and risk are subjective and they are depend on many factors as follow:

- Background of Risk.

  Risk could achieved either from intentional action or unintentional action. Many engineers believes something will safer if they knowingly take on the risk, but would find it unsafe if forced to do so. Such an example, if the property values are low, some people will be tempted to buy house near a plant that emits low levels of a toxic waste into the air. However, if a person already living near a plant finds that toxic fumes are emitted by the plant and he wasn't informed, the risk could gained to be larger, since it was not voluntarily assumed.

- Time period of consequences.

  From humanity perspective, something that might cause a temporarily illness or disability looks safer than something that will result permanent destruction. On this term, the engineers should consider how to manage the safety, risk, and time period of consequences for not only the people who run the action, but also a larger units such as community and environment.

- Probability.

  There is always a chance to cause a severe injury and also fairly minor injury. It might be about 50:50 or another ratios. It is depend on how to the risk occurred, is it merely from the substance? In addition, any unsafe action could also lead to the higher chance of severe injury consequences.

- Reversible effects.

  Something will seem less risky if the bad effects are could be reversible. At this point, the concept reversibility have a similar base of time period term.

- Degrees / Levels of Risk.

  The probability of being an automobile accident is the same regardless of how often people drive, on the other hand, studies shown that low levels of nuclear radiation is actually have beneficial effects on human health, whilst only at higher levels of exposure are there severe health problems or death. This kind of example prove that something is risky for only at fairly high exposures, and it will seem safer than something with a uniform exposure (such as habit) to risk.

- Delayed and Immediate Risk.

  An activity whose harm is delayed for many years will seem much less risky than something with an immediate effect. Such an example is that since an accident will cause immediate injury or death, people might find an activity such as skydiving unacceptably risky.

Something is unsafe or risky often depends on who is asked, nonetheless. At one condition, one person could be feel safe while the rest is not. Thus, line drawing and flow charting can be used in making a decision. Therefore, the engineer and company management has to use their professional judgment to determine whether a project can be safely implemented.

Safety Design and Analysis

Safety is such an essential aspect for engineer's duties. There are at least four classification that should be match to make sure a proper safe design, including:

1. The design should comply with the applicable laws. The requirement should be easy to meet, since legal standards for product safety are generally well known, published and easily accessible also.
2. The design should match with the standard of "accepted engineering practice."
3. Alternative designs which have future potential should be explored further. Since it requires a fair amount of creativity to seek an alternative solutions, this point is kind of difficult to accomplish.
4. The engineer must attempt to foresee potential misuses of the product by the consumer and must design to avoid them. Also, this action requires a fair amount of creativity and research. In example of placing a warning label on a product is not sufficient and is not a substitute and is not a substitute for doing the extra engineering work required to produce a safe design.
5. After the product designed, it must be tested using prototypes and finished devices. The goals is to check whether the product meets the specifications that had been set.

Safety could also incorporate into engineering process by including some variation on a basic multistep procedure for effectively executing engineering design. Wilcox (1990) summarized following:

- Describe the problem. This step includes determining the needs and requirements and often involves determining the constraints.
- Generate several solutions. Multiple alternative designs are created.
- Analyze each solution to determine the pros and cons of each. This step involves determining the consequences of each design solution and determining whether it solves the problem.
- Test the solutions.
- Choose the best solution.
- Apply the chosen solution.

At step 1, it is appropriate to include issues of safety in the product definition and specification. During steps 2 through 5, engineers typically consider issues of how well the solution will meets the specifications, how easy it will be to build, and how much the cost should be paid off.

Safety and risk must be a criterion for consideration during every step. Especially, in step 5 which the engineer attempts to assess all of the trade-offs required to obtain a successful final design. In assessing the trade-offs, it is important to remember that safety considerations should be paramount and should have relatively higher priority than any other issues.

There are many things that make minimizing risk is a difficult task for the engineer, since the engineers almost always in touch with the uncertainties. The risks could be only be expressed as probabilities and often no more than educated guesses. Risk is also rise by the rapid pace at which engineering designs must be carried out.

Minimizing risks and designing for safety is not always be an expensive alternative. Looking at the possible consequences of not minimizing the risk could become such more long-term review. Thus, the prudent and ethical thing to do is to spend as much as possible to engineer the design correctly so as to minimize future risk of injury and subsequent criminal or civil cases against the engineers.

One method that engineers sometimes use to help analyzing the risk and to determine whether a project often proceed as a ‘risk-benefit analysis’. The method is same to cost-benefit analysis. By risk-benefit analysis, the risks and benefits of a project are assigned dollar amounts and the most favorable ratio between risks and benefit is sought. Meanwhile, the cost-benefit analysis is a tricky technique due to its difficulties to assign realistic dollar amounts to alternatives. Especially, in risk-benefit analysis, the method become such a difficult one since the risks are much harder to calculate and more difficult to put realistic price tag on. Nonetheless, the method could be useful technique if used as a part of broader analysis with an objectively sight view.

Accidents

There are many ways accidents could be classified and studied. Most common method is to group an accidents into three major classes, they are:

- Procedural.
  Procedural accidents become the most common and are the result of someone making bad decision by not following the proper procedures.

- Engineered.
  Engineered accidents are caused by flaws in the design. These kind of failures could come from materials, devices that are not working adequately, or do not performing as expected under all circumstances encountered. Engineered failures normally could be anticipated in the designing phase and should be caught and corrected during testing.

  However, it isn't always possible to anticipate every condition that will be encountered, and sometimes testing doesn't occur over the entire range of possible operating conditions.

- Systemic.
  This kind of types are harder to understand and harder to control. They are characteristic of very complex technologies and the complex organizations that are required to operate them. Because it is difficult to take systemic accidents into account during design, especially since there are so many small and seemingly insignificant factors that come into play, it may seem that the engineer bears no responsibility for this type of accident.

  It is important for the engineer to understand the complexity of the systems that he is working on and to attempt to be creative in determining how things can be designed to avert as many mistakes by people using the technology as possible.

Ethics and Engineering Design

Engineering ethics is the field of study that focuses on the ethical aspects of the actions and decisions of engineers, both collectively and also individually. A rather broad range of ethical issues are discussed in engineering ethics including :

- Codes of conduct.
- Whistle-blowing.
- Safety and Risks.
- Liability.
- Conflict of Interests..
- Mutlinational corporations.
- Privacy.

Engineering ethics should not focus on more than individual problem scope. Ethical poblems that engineers encounter are partly due to the context where they work. Some of ethical problems can not be solved by individual engineers or the profession.

On the other hand, engineering design is an interesting topic research from the point of view of engineering ethics because design is one of the core activities of engineers. Thus, in many design processes, ethical problems are indeed difficult to recognize and less specific than some of the example given in the literature.

Some values such as efficiency are not more a values than necessarily an ethical issue. Decisions regarding efficiency can be ethically relevant if they are related do making a more energy efficient product is ethically relevant due to the part for desigining a more sustainable product.

There are several actions for the design process that may be ethically related, including:

- The formulation of goals, design criteria and requirements and their usage.
- The choice of alternatives to be investigated during a design process and the selection among those alternatives at a later stage in the process.
- The assessment of trade-offs between design criteria and decisions about the acceptability of particular trade-offs.
- The assessment of risks and the domino effects, also the decisions about the acceptability of these.
- The assessment of scripts and political-social visions that are inherently in a design and decisions about the desirability of these scripts.

Formulating requirements can be ethically relevant, such an example if safety requirements are formulated. The requirements need to be easy to operate and ethically relevant also. Different alternatives that score differently with respect to different requirements and different operationalization of requirement s could have to be assessed.

The beginning of a design process is usually stated or perceived customer's needs. Hence, design process is generally limited by an economic purposes and also time restrictions. The design should be finished in a certain costs and date and also must not exceed from the constrained that had been set.

In general, model of the design process consists of three phases as follows:

- Generation.
  First phase of the design process which a concept is generated. A designer needs to understand the design problem and to find possible solutions for it.

- Evaluation.
  At this phase, the concepts that had been generated will evaluated. The decision is made as to whether the possible solution meets the requirements. These concepts are also adapted to an iterative process that could lead to problems in other parts of the design.

- Communication.
  Last phase is communication, where the design is communicated to the people who are responsible for production. The communication could be used on many ways such as by drawings, computer drafts, and also description notes.

The design process could be also divided into four activities such as:

- Analysis of the problem.
  This activities should lead to a clear statement of the problem. The requirements and constrains are formulated in this phase.

- Conceptual design.
  The design engineer is looking for various possible solutions and makes schemes of them in the conceptual design phase.

- Embodiment of schemes.

The choice is made between each of the scheme at this phase.

- Details explanation.
  At this phase, the scheme will be explained further through its details.

Nonetheless, the design process basically core as an iterative process. It could always be important to go back one or more steps and then move forward again to seek the satisfy design process.

When a design problems are problems in which the requirements alone determine the solution then engineers could be ‘free’ as they are not responsible for ethical issues due to the requirements which determine everything and the customers describe the requirements.

The formulation of requirements and goals as in general is ethically related but must not be done by the engineers. The requirements should be formulated by another stakeholder such as managers, customers, and also politicians. In this particular line of thinking, the task of engineers is to discover the technology that suit best for give a solution of certain requirements. Ethical questions may achieved in order at the user phase when technologies are used for certain questions concerning use are also outside the scope of the engineers and must be solved by the user as represents in Figure 1.

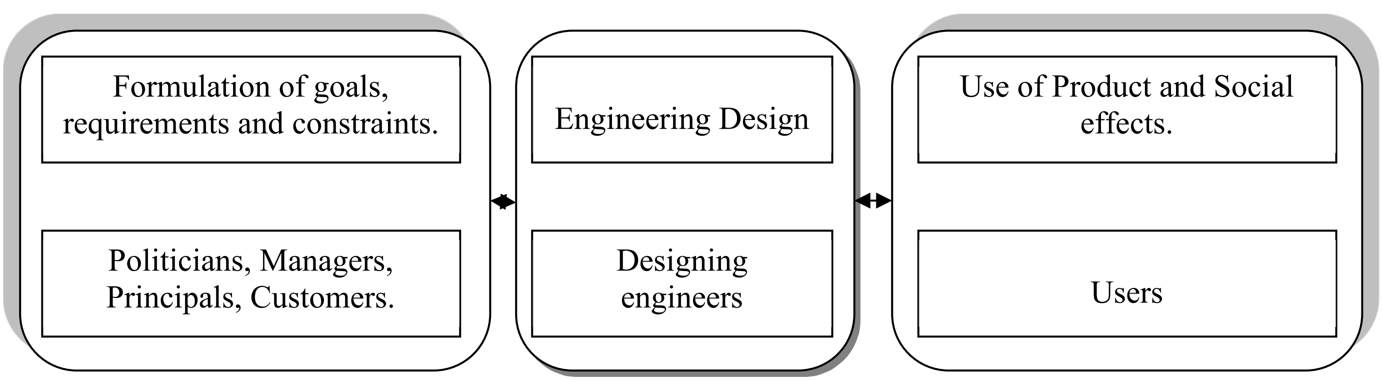

Figure 1. Formulation of requirements and goals.

By this model, the sole responsibility of engineers is to carry out a task formulated by others in a competent way. However, design problems are usually not problems where a clear set of problems are more or less ill-structured problems. The main characteristics of an ill-structured problem are that the solution space was not described well and that there is no specification to test different solutions and decide which is best.

The following characteristics of ill-structured problem including:

- Problems may have an infinite formulation.
- Any problem or formulation could cause inconsistencies.
- Formulations of the problem are solution – dependent.
- Proposing solutions is a means to understanding the problem.
- There is no definitive solution to the problem.

Some design methods required an engineer to formulate the requirements and solutions separately and independently, on the other hand, this is an impossible mission if design problems are ill-structured.

By redesigning an existing design, it could lead to the formulation of the requirements to independently make a solution that the engineers believed which is best. The solution space itself could be limited due to the certain features of the product will remain the same. Other design problems aiming at designing a completely new product are very ill-structured and only some vague requirements might be formulated at the start of the design process. Thus, design problems could be more or less ill-structured.

By the case when a design problem is ill-structured problem, there may be more than one solution to accomplish with. Each of the requirement solution could be valid. Thus, the engineers must make a choice that will lead to only one decision to imply. At the beginning of design process phase, there may not even be a clear and unambiguous set of requirements. During the designing, it might be proved that there is no solution to the ill-structured problem.

At some case, it is important to adjust and drop some requirements due to the null solution which can be apply. It conclude that a design problem could be under, or over, determined by the requirements. Either way, the engineers must to make choices during the design process for example regarding which requirements can be dropped or which of the possible solutions to the design problem is the best.

G. Organizations and Regulations

Organizations

Take the example of designing a car, which may be divided into the design of the drive shaft, the engine, the seats, the electronic systems, the suspensions and the styling of the car. This kind of partitioning the design team into smaller groups responsible for a part of the design is, from ethical point of view, noteworthy because it could lead to the problem of too many hands. This type of problem achieves itself regarding to:

- The active responsibility.
  Active responsibility refers to being for something or some task. Regarding this, the problem of too many hands can be seen when no one feels or thinks that they are responsible for certain issues. When the issues are not specifically part of someone's task description, everyone could avoided for taking the responsibility for them. Nonetheless, these issues may be neglected in the design process.

- The passive responsibility.
  Passive responsibility is responsibility that implied after some has happened, usually being accountable. By this term, the problem of too many hands is the following. It could be seem to be clear who is responsible (officially) for what as this depends on formal job in organizations. Practically, it is very hard to point out who is the 'person-in-charge' (PIC) for the acts of organization that caused accident.

Organization Culture

Why the organization culture is important? In order to be morally responsible in an organization without suffering the fate of the employees, the engineers should have learned where they are working. The knowledge helps engineers to understand several essential point such as:

- How the engineers and their managers tend to frame issues under the influence of the organization.
- How one can act in the organization effectively, safely, and in a morally responsible way.

Organization culture extract the qualities of the organization. It is usually agreed that organizational culture could be set at the top of an organization. If the organization placed a success and productivity over integrity and ethical principles, these values will become powerfully influence the decisions of each member of the organization.Some literature cited organization culture as the term ‘organizational scripts’, ‘organizational schemas’, or ‘organization scenario’ to refer to the seeing some things and not seeing others.

There are several types of Organizational Culture including:

- Engineer-Oriented.
  This company have a general agreement that quality takes priority over any other considerations, except safety. Engineers often described their relationship to managers in these type of company as one in which negotiation or arriving at consensus was prominent. Also, engineers often said that managers would rarely overrule them when there was a significant engineering issue.

- Customer-Oriented.

  There are significant differences between customer-oriented company and engineer-oriented during decision making.

  First, the managers think of engineers as advocates of a point of view different from their own. While managers should focus on such business factors as timing and cost, engineers must focus on safety and quality product.

  Communication between engineers and managers may be somewhat more difficult than in engineer-oriented company. Managers are usually more concerned about engineers’ withholding information, even though consensus is highly valued.

- Finance-Oriented.
  At these kind of company, they are more centralized structure and purposes which will also produce an important consequences.

Thus, acting in an ethical manner and with little harm to oneself usually easier in engineer-oriented and customer-oriented companies than in the finance-oriented type. At engineer and customer oriented company, they are more respect to the types of values with which engineers are typically concerned (especially safety and quality). Communication is better and more emphasis on arriving at decisions by consensus rather than by the authority of the managers. Through all of them, it will makes much easier for the engineers to act professionally and ethically manner.

Nonetheless, there are several recommendation to act ethically easier and also less harmful at the same for the employee of the company, following:

1. The engineers and employees must be encourage to report not only the ‘good-news’, but also the ‘bad-news’. For several company, this action could be discover from their ‘ombudsmen’ or ‘ethics-engineers’ who cannot just only promote ethical behavior as well as serve as a conduit of complaints.
2. The engineers, employees, and also companies must adopt a position critical loyalty rather than uncritical or blind loyalty. Critical loyalty is giving by the interests of the employer but only insofar as this is possible within the constraints of the employee’s personal and professional ethics. On the contrary, uncritical loyalty is giving to the employer who placing the interests of the employer, as the employer describe those interests, above each other consideration.
3. The engineers must be focused on the issues rather personalities during critical timing such as making criticisms and suggestions. This action will helps to avoid excessive emotional release and personal-clashes.
4. All complaints should be records either by written or any other media. This is one of an important thing to do if court proceedings are eventually involved.
5. Complaints should be treat as confidential things to protect both of complainer and the receiver.
6. Explicit provision for protection from retaliation should be made, with mechanisms for complaint if an employee believes they have experienced retaliation.
7. The provisions should be made for neutral participants from outside the organization when the dispute requires it. Sometimes, employees within the organization are too emotionally involved in the dispute or have too many personal ties to make a dispassionate evaluation of the issues.
8. The process for handling organizational disobedience should proceed as quickly as possible. Delaying resolution of some issues could be a technique to punishing dissent.

Regulations

There are more external constraints in normal design as opposed to making a radical design. Normal design is a form, of standard design practice guided by existing formal and informal rules. A system of regulations and formal rules are concern at a product exists in normal design.

A regulative framework for a certain product is made up of all relevant regulation, national and international legislation, technical codes, and standard rules for controlling and certifying products. A regulative framework is socially sanctioned. The interpretation of legislation and technical codes are also part of regulative framework. Thus, interpretations of codes and legislation can be provided by the controlling and certifying organizations and also by engineering societies. Meanwhile, the engineering societies could also formulate a code of ethics that become a part of the regulative framework.

Note that the regulative framework does not include company specific norms and standards. When company specific norms and standards were to be involved, then the regulative framework would differ in different companies. Companies are forbidden to formulate company specific norms and standards due to the intersection of the rules and regulations from regulative framework. Company specific norms and standards can therefore only impose stricter requirements than the regulative framework.

Managing Decision

The primary function of engineers within an organization is to use their technical knowledge and training to create structures, products, and processes that are of value to the organization and also company's customers. Hence, engineer should be professionals, and they must uphold the standards that their profession has decided must guide the use of their technical knowledge. Therefore, the engineers hold a dual loyalty, first to their organization, and the second to their profession. Their professional loyalties go beyond their immediate employer.

The function and consequent perspective of managers is different. The managers function is to direct the activities of the organization, including the activities of engineers. Manager's perspective is differs from that of engineers. Rather than thinking in terms of professional practices and standards, managers tend to enumerate all of the relevant considerations and balancing them to against one another to achieve the final decision.

Whereas the managers feel strong pressure to keep costs down, the engineers usually tend to assign a serial ordering to the various considerations relevant to design so that minimal standards of safety and quality must be match before any other considerations are relevant. The engineers are more likely to believe that they have a special obligation to uphold safety and quality standards in negotiations with managers. Although, the engineers could also be willing to balance safety and quality against other factors to some extent.

These kind of considerations recommend a distinction between a ‘proper engineering decision’ (PED) and ‘proper management decision’ (PMD).

- Proper Engineering Decision (PED).
  A Decision that should be made from engineering people or at least governed by professional engineering standards due to the several reasons such as:
  1. Involving a technical matters that require engineering expertise.
  2. Lies within the ethical standards embodied in engineering codes, especially those that require engineers to protect the safety and health of public.

- Proper Management Decision (PMD).
  A Decision that should be made by managers or at least governed by management consideration due to:
  1. Involving factors that related to the well-being of organization, such as marketing, cost production, scheduling raw material and products, and also welfare.
  2. The decision does not force engineers or any other professionals to make unacceptable compromises with their own technical or ethical standards.

Based on these characterizations of engineering and management decisions, it concluded to the three preliminary remarks such as:

- The distinction between engineering and management decisions is made in terms of the standards and practices that should predominate in the decision-making process. Therefore, the PMD should not override the engineering standards when the two are in substantial conflict, especially with regard to safety and perhaps even quality.
- The PMD specifies that a legitimate management decision not only should not force engineers to violate their professional practices and standards but also must not force other professionals to do so either. A complete characterization of a legitimate management decision should also include prohibitions against violating the rights of nonprofessional employees.

- Engineers may often be expected to give advice, even in decisions adequately made by managers. Management decisions can often benefit from the advice of engineers.

Even if there are no fundamental problems with safety, engineers may have important contributions with respect to such issues as improvements in design, alternative designs, and ways to make a product more attractive.

The engineer refer to the relatively uncontroversial examples of PEDs and PMDs as paradigmatic. Hence, the characterizations of PED and PMD provided are intended to describe such paradigms. These two paradigms can be thought of as marking the two ends in spectrum of cases. Table 1and 2 show the paradigmatic PED and PMD characterization instead.

Table 1. A paradigmatic PED

Feature	PMD	Test	PED
Technical expertise	Not needed	____________X	Needed
Safety	Not important	____________X	Important
Cost	Important	____________X	Not Important
Scheduling	Important	____________X	Not Important
Marketing	Important	____________X	Not Important

The engineering consideration must be involved to the engineers during the decision-making prcess in order to:

- The decision includes issues related to accepted technical standards.
- The decision relates in important ways to safety to the public and therefore to the ethical standards of engineers.

Table 2. A Paradigmatic PMD

Feature	PMD	Test	PED
Technical expertise	Not needed	X____________	Needed
Safety	Not important	X____________	Important
Cost	Important	X____________	Not Important
Scheduling	Important	X____________	Not Important
Marketing	Important	X____________	Not Important

Many cases will lie between two extremes of paradigmatic PEDs and paradigmatic PMDs. At some cases, it may lie so near the center of the imaginary spectrum of cases that might be characterized as either PED and PMD. Such consideration of reliability and safetu are engineer responsibility, while the consideration of cost, marketing, and scheduling are typical management considerations.

Table 3 provides a simple illustration of the non-paradigmatic case.

Table 3. A Nonparadigmatic Case

Feature	PMD	Test	PED
Technical expertise	Not needed	_________X___	Needed
Safety	Not important	_______X_____	Important
Cost	Important	__X__________	Not Important
Scheduling	Important	_____X_______	Not Important
Marketing	Important	_____X_______	Not Important

Rational people with good intention could produced a different perspective in their judgments. Because, it is important that as in all line-drawing cases, the importance or moral ‘weight’ of the feature should be considered. The one cannot simply count the number of features that could be lied under the PED and PMD side or where the “X” marks should be placed on the line also.The issues of pollution illustrate the problematic condition which could arise in the interface between proper engineering and proper management decisions.

Disobedience

Disobedience that could happened in one organization appropriate as a generic term to cover all types of action taken by an employee that are contrary to the wishes of employer. Such an engineer attempted to be either loyal employees and responsible professional and citizens encounter difficulties also. By the time engineers find theirself on the position of having to oppose their managers or organization could described as a ‘disobedience’. Sometimes, disobedience means as a protest, or refusal to follow an organization policy or action. Meanwhile, there are two points about organizational disobedience, consists of:

- The policy that a professional employee disobeys or protests migh be specific and general. It can be a specific directive of a superior or a general organizational policy, either a single act or a continuing series of action.
- The employer may not intend to do anything morally wrong.

There are also three distinct areas in which responsible engineers could involved in the organizational disobedience following:

1. Disobedience from contrary action.
   This type is engaging in activities contrary to the interests of the company, as perceived by management. Sometimes, the engineers may find their actions consider outside the workplace are objectionable to managers. The objections are usually between one of two areas:
   - First, the managers may believe that a particular action or perhaps the general lifestyle of an employee reflects unfavorably on the organization.
   - Second, the managers may believe that some activities of employees are contrary to the interests of the organization in a more direct way.

   Despite these objections, many managers usually act strenuously when they believe they or their organizations are threatened by actions of employees outside the workplace. Therefore, two observations may be appropriate, involving:
   - Actions by employees outside the workplace that could harm an organization more directly than others.
   - Major difference in the degree to which curtailment of an employee's activities outside the workplace encroaches on their freedom.

2. Disobedience from nonparticipation.

   On this term, disobedience means as refusing to carry out assignment because of moral or professional objections. Disobedience by nonparticipation could be based on professional ethics or personal ethics. Engineers who refuse to design a product that they believe is unsafe can base their objections their professional codes. Nonetheless, there are several things should be a consideration about disobedience by nonparticipation, including:
   - It is possible for an employee to abuse the appeal to conscience, using it as a way to avoid to projects that they find not challenging for them.
   - Sometimes it is hard for employers to honor a request to be removed from a work assignment.

3. Disobedience from protetsts.

   This kind of disobedience is such an actively and openly protesting a policy or action of an organization. Whistleblowing is one of the most common action for this kind of protests.

H. Environmental Ethics

Human life is possible because of the greenhouse effect, in which atmospheric gases such as water vapor and carbon dioxide block solar energy from escaping, after being reflected from the earth's surface.

Regarding to global warming, environmental challenges confront humans at every turn, including myriad forms of pollution, human-population growth, extinction of species, destruction of ecosystems, depletion of natural resources, and nuclear waste. The complexity of the issue divided scientific opinion, but an emerging consensus led to the 1997 Kyoto agreement, which signed by 150 governments, to decrease carbon emissions to 5.2% below 1990 levels by 2012.

Two powerful metaphors have dominated thinking about the environment:

1. The Invisible hand.
2. The tragedy of the commons.

Both of them are often used to highlight unintentional impacts of the marketplace on the environment, but one is optimistic and the other is cautionary about those impacts. Each delivers a large part of truth and require to be reconciled and balance also.

Despite its large element of truth, the invisible hand metaphor does not adequately take account of damage to the environment. Regarding to environment, most of cumulative impact such as expanding populations, unregulated capitalism, and market 'externalities' are became the negative externalities. While pollution, destruction of natural habitats, depletion of shared resources. This damages are the topic of the second metaphor.

Sustainable Development

As the matter of fact, engineers usually were not as responsible concerning the environment as they should have been, but in that respect they simply reflected attitudes predominant in society (public). Thus, there is no single canonical professional attitude or philosophical 'green' attitude. Individual engineers, like individuals in all professions, are differ considerable in their views, involving their broader holistic views about the environment.

The important thing to remember is that all engineers should reflect seriously on environmental values and how they could adequately make a clear explanation about solving the environmental problems. One of the way is that engineers must be able to work in an organizational context in which an eco-friendly approach is valued and supported with the tools, information, and incentives necessary to succeed, as cited by Sarah Kuhn.

Engineers are singularly well-placed to make environmental contributions. The engineers should encourage and nudge corporations in the direction of greater environmental concern, finding ways to make that concern economically feasible. Increasingly, engineering codes of ethics explicitly refer to environmental responsibilities under the heading of the terms 'sustainable development'.

The term of sustainable development developed in the 1970s, but became more popular at the 1980s and 1990s. Nonetheless, the term was invented to underscore how current patterns of economic activity and growth cannot be sustained as populations grow, technologies are extended to developing countries, and the environment is increasingly harmed. On the positive perspective, the term applies the crucial requirement of the new economic patters and products that are sustainable.

Some literature propose that sustainable development could be defined as:

"Development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

-Our Common Future,
Published by World Commission on Environment and Development.

The statement emphasize balancing the needs of living populations against those of future generations. On the other hand, the statement also covered a justice in overcoming poverty among living populations, for conserving natural resources, and for keeping populations at sustainable levels.

Hence, many people criticize that sustainable development is a ruse way that conceals business as usual under the guise of environmental commitment. In order to maintain the term of sustainable development growth, there are stakeholders who could influenced, such as:

- Corporations

  By now, good business for a corporation is to be perceived by the public as environmentally responsible, indeed as a leader in finding creative solutions. This is true of corporations of all sizes. In example from one of the biggest energy company in the world that had spent over $350 million for the wind-turbine. This large number of money used for intensifying it research and development in biofuels and other renewable energy resources.

- Government

  Government laws and regulations are becoming a lighting-rod in environmental controversies and issues. They usually questioning the requirement for the force of law in setting firm guidelines regarding the degradation of the ‘commons’, especially in limiting the excesses of self-seeking, while establishing fair ‘rules to play by’. Yet, how much law, of what sort, and to what ends are matters of continual disagreement.

- Communities & Social Activists

  Communities at many levels (local and state) have special responsibility to conserve natural resources and beauty for future generations, as well, for preventing events like: Floods, Fires, Hurricanes, Earthquakes and etc. There are four sets of measures communities can take to avert or mitigate disasters following:

  1) Consists of restrictions or requirements imposed on human habitat. Homes must not be built in floodplains is one of this application set.
  2) Consists of strengthening the lifelines for essentials utilities such as water such as water and electricity.
  3) Encompasses special-purposes defensive structures that would include dikes, avalanche barriers, dams, and etc.
  4) Assures safe exits in the form of roads and passages designed as escape routes, structures designated as emergency shelters and agreements with neighboring communities for sharing resources in emergencies.

  Meanwhile, social activism by concerned citizens has also played a key role in raising public awareness.

I. International Professionalism

Ethical Resources

The most obvious and the most useful resource for resolving boundary-crossing problems is a creative middle way solution. By using this kind of solution the two extremes are recommended to be avoided. One extreme is called ‘moral laxism’ and the other called ‘rigorism’.

Moral laxism holds that in some situations, the engineer could justified in applying them so loosely that moral constraints are almost completely abandoned. Meanwhile, moral rigorism holds that moral principles must be strictly applied in every situation.

Sometimes there may be such serious moral problems with one of the options than a creative middle way solution is not appropriate and even a person who is not a moral rigorist could not accept it. How to determine then when a creative middle way solution is cannot be accepted?

The standard could be helped solving the problem. Thus, the standard must employ and match with two criteria. First, it should be universal, and the second is they should have an immediate plausibility. The following standards could useful when implemented such as:

- The Golden Rule.
  The Golden Rule is embraced by most of the major religions, beliefs, and ethical philosophies.

- Universal Human Rights.
  Implied on ‘international right’ that is a right which every country in the world should grant to its citizens.

- Promoting Basic Human Well-Being.
  One of solution to a boundary-crossing problem is satisfactory is whether the solution promotes the well-being of host country citizens. The most important way in which engineering and business can promote is through economic development.

- Code of Engineering Societies.
  Many of the major engineering codes are clearly intended to apply to their members wherever they live, even if they practice engineering in host countries.

To be recognize as an engineer and to offer such services access to the public, the engineers should be registeredas an engineer. However, the licensed for them could be applied for only one local region. Some of local licensor (the one who gave a license or certification for the engineers) might established an international certificate to facilitate the engineers to become an ‘international-engineer’.

There are several importance of become a licensed engineer, following:

- The engineers who work for engineering design or engineering and construction firms require to be licensed early in their careers, this will lead them could rise above a certain technical level effectively. Either wise, the engineers could not be a consultant or an expert witness without a license.

- If the corporate exemption is rescinded, the status of engineers who are licensed will be enhanced, whereas other engineers will need to study for and pass the examinations and to document the appropriate years of engineering experience just to retain their status.

- Engineer registration will become indication to potential employers, as well as to general public, of one’s competence in the field.

Business Codes of Conduct

Most company and institution have formal codes of conduct that should be adhered to as a condition of employment. As with any contract, it is important to read and to understand all of the details and to fulfill all of the obligations undertaken. If an employee does not adhere to the code the engineers could be fired from the firms that they are worked at that time.

In consideration for employment, the engineer accepts what are called ‘fiduciary resposibilities’ which means that trust has been suited in the engineer to act faithfully for the good of the Company. Related to fiduciary responsibilities is the avoidance of conflicts of interest. The focus is to avoid circumstances where engineer have, appear to have, and contradicttory obligations.

In the business code of conduct or in a proprietary secrecy or patent agreement, the employee agrees that certain knowlegde gained and discoveries made through employment are the property of the company and could not be divulged to others. In a typical business code of conduct, one agrees to keep personnel information confidential and other hand, the one agrees not to release such information to anyone outside the company and to release it only to those within the company who have a clear need to know.

Before signing the contract, the engineers must read and fully understand the agreement between them and their company. Much of the value of a company resides in proprietary knowledge that is not shared with with others. Breaching a secrecy agreement could cost a very expensive consequences while the engineer might be in serious legal trouble.

If the company such an international brenchmark, the code of conduct that apply generally covers the conduct of employees representing the company abroad. It is important to achieve as complete knowledge as possible for the customs and also the laws of other country before the engineers are leaving the country on assignement.

Final aspect of business conduct that should considered is employee relations. A specific guidelines for hiring and firing of employees must be obeyed to avoid any legal diffulties. Whenever the engineer are in a position to hire or fire, they should be proactive to learn the appropriate company procedures. Most businees of conduct include requirements to avoid any personal discriminatory or harassing behaviour.

J. PROBLEMS & SOLVING TECHNIQUES

Analysis

The first step in solving any ethical problem is to completely understand all of the issues involved. Once these issues are determined, many solutions could achieved come to the surface. Thus, the issues involved in understanding ethical problems can be divide into three classes:

1. Moral.
2. Factual.
3. Conceptual.

Understanding the issues will help the engineers to put an ethical problem in the proper framework and often helps to point out the solution. Conceptual issues have to do with the meaning of applicability of an idea.

In engineering ethics, it defines as what constitutes bribe as opposed to an acceptable gift, or determining whether certain business information is proprietary. For the case of the bribe, the value of the gift is probably a well-known fact. Once the factual and conceptual issues have been resolved, at least to the extent possible, all that remains is to determine which moral principle is applicable to the situation. Resolution of moral issues is often more obvious. One the problem is defined, it is usually clear which moral concept applies and the correct decision become obvious.

Factual issues can often be resolved through research to establish the truth. It is not always possible to achieve a final determination of the 'truth' that everyone can agree on. In general, further research helps clarify the situation, can increase the areas of agreement, and sometimes also can achieve consensus of the facts.

Meanwhile, conceptual issues are resolved by agreeing on possible but as with factual issues, further analysis of the concepts at least clarifies some of the issues and helps to facilitate agreement.

Finally, moral issues could be resolved by agreement as to which moral principles are pertinent and how they should be implemented. Often, all that is required to solve a particular ethical problem is a deeper analysis of the issues involved according to the appropriate principles. Once the issues are analyzed and agreement is reached on the applicable moral principles, it is clear what the resolution should be.

Line Drawing

An appropriate metaphor for line-drawing is a surveyor deciding where to set the boundary between two pieces of property. Although definitions of concepts are open-ended, this does not mean that every application of a concept is problematic. In fact, it is usually quite easy to find clear-cut, unproblematic instances.

The advantage of listing major features of clear-cut applications of a concept such as bribery is that the features could help the engineers decide less clear-cut cases as well. The engineers also can easily identify features that contribute heavily in favor of this being a clear-cut instance of bribery. Such features include gift size (large), product cost (highest in market) and so. Table 4 will show further example of the features.

Table 4. Paradigm Case of Bribery

Features of bribery	Paradigm Instances of Features of Bribery
Gift Size	Large (>$10,000)
Timing	Before recommendation
Reason	Personal gain
Responsibility for decision	Sole
Product quality	Worst in industry
Product cost	Highest in market

Thus, line-drawing could be applied to the analysis of concepts. It can be helpful both in clarifying the basic meanings of concepts and in their applications in particular circumstances. Cases that are uncontroversially wrong called the ‘negative paradigm’ cases. Reversely, the cases that are uncontroversially acceptable are called the ‘positive paradigm’.

Although line-drawing techniques are often useful, the engineer shall not underestimate the complexities that could be occurred. Several general points are still require to be made, as follows:

- When involving ambiguous case, the more ambiguous the more engineer should know about the particular circumstances regarding to determine whether it is morally acceptable or morally wrong.
- Impose a line of demarcation between some of the cases in a series involves an element arbitrariness. The precise line between night and day may be arbitrary, but this does not mean there is no difference between night and day. Nevertheless, sometimes arbitrary conventions to separate acceptable from wrong actions are in order.
- It is essential to maintain that concentrating on only one feature will usually be insufficient to determine where on identification of analogies and disanalogies between various example in a series of cases whenever the engineer using the method of line-drawing.
- The method of line-drawing resembles a kind of such a ‘common-law ethics’ in which, as in law, what one decides in one case serves as a precedent for similar cases.

Flow Charting

For engineering people, a flow chart is very common. Flow charting probably is the most often used in developing computer programs. In engineering ethics, flow charting help analyzing a variety of cases, especially for the cases which there is a sequence of events to be considered, or a series of consequences that could flew from each division of one company.

The benefit of using a flow chart to analyze ethical problems is that gives a visual picture of a situation and allows the engineers see the consequences that flow from each decision had been made.

Different flow charts could be used to emphasize different aspects of the same problem. As with line drawing, it will be essential to be as objective as possible and to approach flow charting honestly. Otherwise, it will be possible to draw any conclusion the engineer want, even it is clearly wrong. Figure 2 describe the decision-making process that might have been gone on at Union Carbide as the plant extent in Bhopal. On the other hand, Figure 3 deals with the decision that required during the maintenance of the flare tower at the Bhopal plant, an essential safety system.

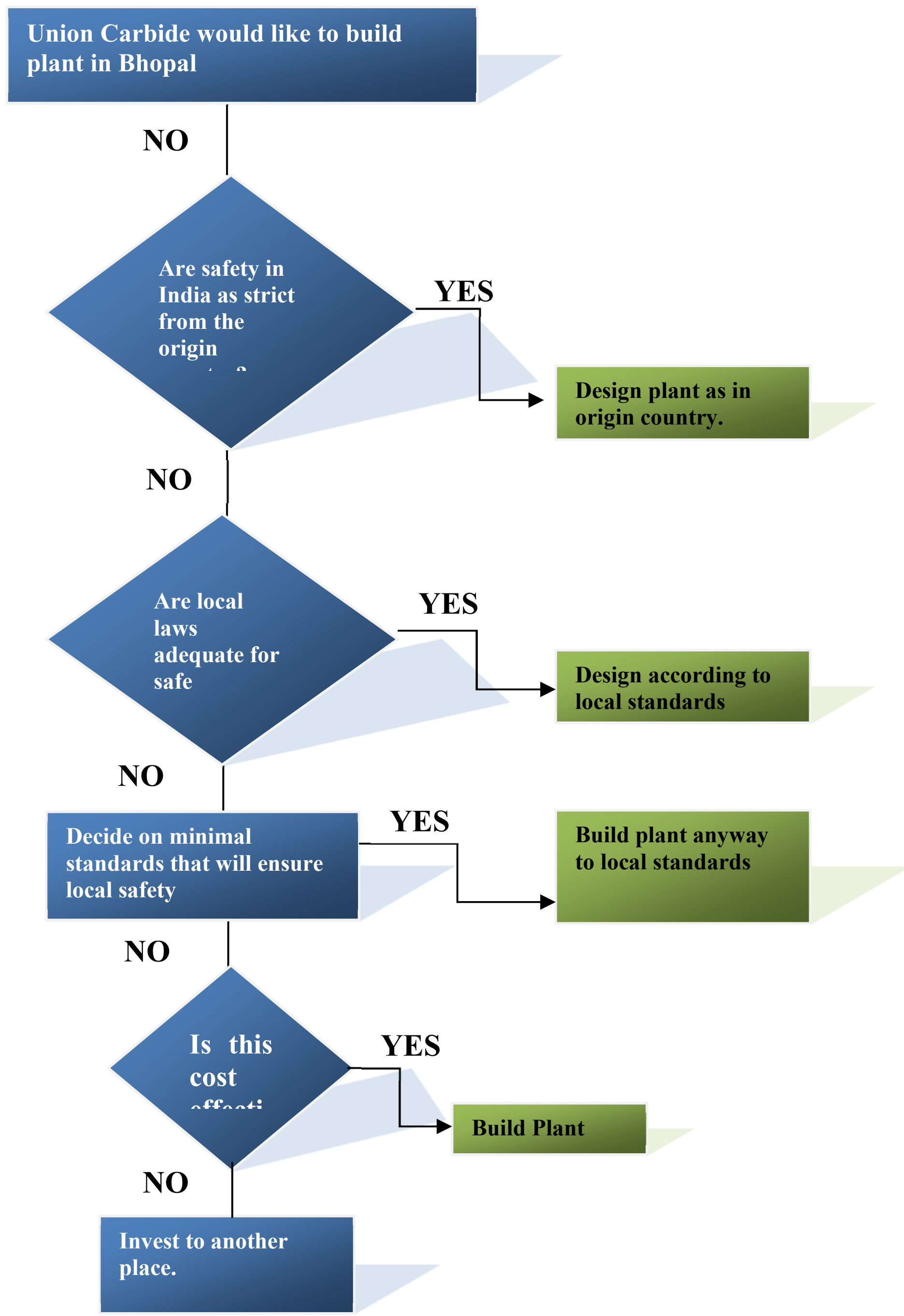
Union Carbide would like to build plant in Bhopal
NO
Are safety in India as strict from the origin
YES
Design plant as in origin country.
NO
Are local laws adequate for safe
YES
Design according to local standards
NO
Decide on minimal standards that will ensure local safety
YES
Build plant anyway to local standards
NO
Is this cost
YES
Build Plant
NO
Invest to another place.

Figure 2. Simple flow chart.

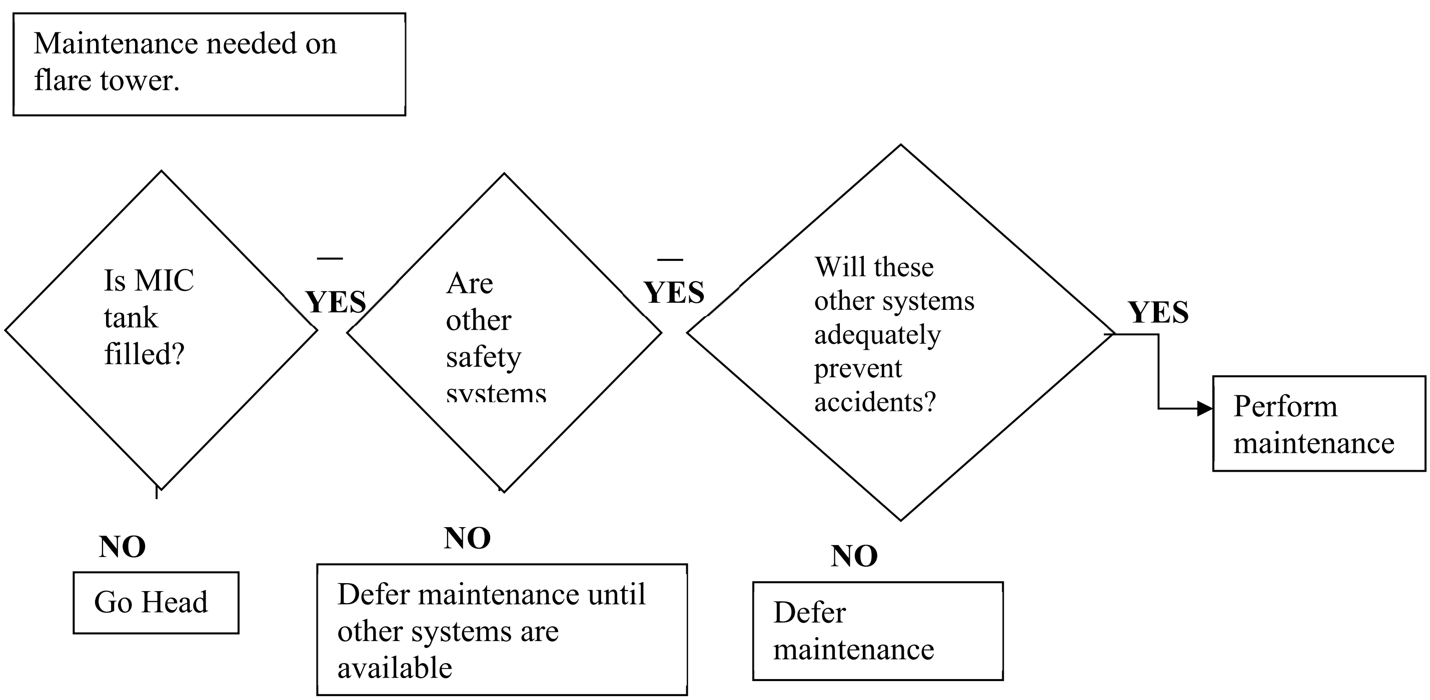

Figure 3. An alternate flow chart.

The key of effective use of flow charts for solving ethical problems is to be creative in determining possible outcomes and scenarios and also to not be shy about getting a negative answer and deciding to stop the project.

APPLICATION CASE

ACCEPTANCE OF GIFTS (BRIBERY)

Bribery could be describe as something such as money, property, or favor, offered or given to someone in a position of trust in order to induce somebody to act dishonestly. Bribery is something offered or serving to influence or persuade. One of many gray areas of engineering ethics is the acceptance gifts from vendors or the offering gifts to customers to secure business.

Frequently, engineers find themselves in the position of either dealing with vendors who wish to sell them products for incorporation into the engineer's work or acting as vendors themselves and working on sales to other engineers or companies.

Most of countries in the world consider bribery as a criminal action. Bribery always take place 'under the plate' and is never legitimate business practice. At many cases, there is a fine line between bribery and simple gift. Sometimes, the distinction has to do with the value of the gift. It is important to ensure that no matter how innocent the gift, the appearance of improprietary is avoided nonetheneless.

On the other hand, sometimes the boundary between a legitimate gift and bribe is very subtle. The engineers could describe gifts as a things which has nominal value, such as ticket to holiday trip, a little souvenir like coffe mugs and calendar with a vendor's logo to become their advertising tool. Generally, there is no problem with accepting these items. When all of the gifts are no longer of low cost and the expense of these items is not shared equally, the probability of abuse becomes large.

Take a look at one of the example sequence below to ensure whether the engineer's gift becomes a bribe or not. The solution itself will be left to the engineer:

- During a sales visit, a sales representative offers an engineer a coffee mug with his company's name and logo on it. The value of mug say, 5 dollars. Can the engineer accept the item? Will the answer change if it's made from crystal that cost 350 dollars?

- An engineer meeting with a sales representative is running into the lunch hour. She invites the engineer to go out for lunch and she paid the engineer for the engineer's lunch. Is it appropriate?, Would it be achieving the same answer either the engineer spent his lunch on Fastfood or exclusive French restaurant?.

- One of company sales representative would like an engineer to attend in one-day sales seminar in nearby the city. The engineer's company will also pay for him, should he go? What if the seminar held on someplace fancier with the sales representative's would paid you?

Always remember that gifts accepted even after the purchase of something from a company might be a bribe directed at securing future sales from the engineer or might be aimed at engineers at other companies. So, clearly bribery is pernicious and even the appearance of bribery should be avoided.

A bribery can easily analyzed by looking at the factual, conceptual, and moral issues as described previously. Oftenwise, the facts will be obvious: who offered a gift, what its values was, and what its purpose was. Conceptual issues will be somewhat harder, since it should be determined whether the gift is of sufficient value to influence a decision or whether that influence is the intent of the gift. Once the conceptual issues have been worked out and it is clear whether or not the gift a bribe, the moral issue is often very clear.

Line drawing method could be very useful for the previous example. The subtle differences between the value of the gift, the timing of the gift, etc. Are easily visualized using line drawing, and often it will be very clear what the ethicalbchoice will be based on a well-drawn line. Hence, flow charting could be used to examine the cnsequences that will results from the acceptance or offer of a gift.

There are several steps to ensure that gift accepted from the vendor crosses the line into bribery, following to take a look back at the company policy. The large corporations many and smaller companies have very clear rules abour what is acceptable. Some companies have very strict policies. While other companies realize the importance of social interactions in businees transactions and allow their employees more discretion in determining what is proper.

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