1

Explaining Ethics

1.1 Introduction

Scientific and engineering disciplines are considered to be highly ethical professions in which scientists and engineers exhibit behavior of the highest ethical and moral standards.

Ethics is "the normative science of conduct, and conduct is a collective name for voluntary actions" (Lillie, 2001, page 3). In this regard, voluntary actions are those actions that could have been done differently, where such actions may be good or bad, right or wrong, or moral or immoral. Ethics focuses not on what people think but what they ought to think or do. An ethical science is an in-depth, systematic study of the standards for judging right and wrong, good and bad principles, guiding means, and how far we will or should go (Lillie, 2001; Howard and Korver, 2008).

Generally, ethics (morality) is a core branch of philosophy that attempts to define right and wrong; what a scientist or engineer *ought* to do is as distinct from what they may do. In philosophical studies, ethics is usually divided into three sub-fields: (1) meta-ethics, (2) normative ethics, and (3) applied ethics.

Meta-ethics includes investigation of whether or not ethical claims are capable of being true or false, or if they are expressions of emotion. *Normative ethics* attempts to arrive at practical moral standards that would tell, for example, the scientist or engineer what is right or what is wrong. *Applied ethics* is the application of theories of right and wrong and theories of value to specific issues such as honesty and lying.

Whatever the definition, ethics is one of the pillars of scientific research, teaching and community service requirements of higher education. It is definitely one of the criteria for evaluating the quality of higher education in these aforementioned areas. Despite the variables that contribute to ethical or unethical behavior, the central determinants are the personal thoughts and behavior of the scientist and engineer which determines the meaning that an individual assigns to their position regarding ethics.

Personal thoughts and behavior can override the influence of any other factor, including the Codes of Ethics of professional bodies. The ability to manage emotions during the processes of scientific and engineering research orients many individuals to act on feelings and engage in unethical practices. This is reflected in the increasing frequency of reports of misconduct in the scientific and engineering disciplines (Chapter 8).

The realm of ethics is concerned with standards and requirements for socially acceptable behavior, in addition to following proper procedures for getting things done at any level of interaction – individual, group, organizational, community, governmental or regional. Ethics has several strands that are applicable to the scientist and engineer: (1) *descriptive ethics,* which the actual behavior of people and the ethical requirements of their behavior, (2) *normative ethics*, which is the application of the values that are good enough to guide interaction, and (3) *applied ethics*, which is the application of normative rights to specific issues, disciplines and settings (Kitchener and Kitchener, 2009, page 5–6).

Furthermore, the ethical aspects of scientific and engineering research revolve around the proper method to collect, analyze and report all aspects of a study, and the responses to researcher-respondent interactions, which are especially true in the social sciences where surveys of human actions are accumulated (Kitchener and Kitchener, 2009, page 6).

The requirements, in this regard, are stipulated in various Codes of Ethics documents of scientific and engineering organizations such as: The American Chemical Society (ACS), The Royal Society of Chemistry (RSC), The American Institute for Chemical Engineers (AIChE), The Society of Petroleum Engineers (SPE), The American Psychological Association (APA), the American Sociological Association (ASA), American Anthropological Association (AAA) and various other disciplinary bodies across the world.

However, such codes (Chapter 6) do not resolve the issue which, in the final analysis, depends on personal decision-making, and freedom from bias, prejudice and personal values (Kitchener and Kitchener, 2009, page 32). Furthermore, these codes cannot, and must not, be ignored by using claims of academic freedom. Generally, they are intended to legally reinforce the need for respect for all other human beings independent of what anybody thinks about location, upbringing, gender, ethnicity, religious affiliation, age, culture, level of education and other characteristics.

In fact, academic integrity is critical to higher education, especially where research and learning manifest. However, the incidence of academic dishonesty in university settings leaves much to be desired with occurrences of dishonesty among 40% to 70% of the students (Davis et al., Kibler, 1998; Marcoux, 2002). However, faculty consensus is limited on what forms of behavior constitute dishonesty. Traditional forms of academic dishonesty, where there is consensus, such as looking on another student's paper during a test or handing in work done by a classmate, have changed with technological advances (Marcoux, 2002). Modern computer programs and applications, Internet access to diverse and instant information, distance learning classes, and hand-held computing devices which can transmit information in moments change the need for an increasing awareness by faculty, in terms of addressing academic dishonesty.

Indeed, ethical issues have come and will remain at the fore because of the prioritization of differences by scientists and engineers as they seek to attain a more privileged position in their organization and the world of academia. This behavior has been compounded further by the emergence of procedural inconsistencies in several major research projects (Kitchener and Kitchener, 2009, page 8) (see also Chapter 8).

In addition, there seems to be much truth in the post-modern view of research ethics that every research activity, question and decision has ethical underpinnings. In such cases, a number of pertinent and revealing questions should follow with the corresponding ethical issues identified.

Moreover, honesty has to be practiced at all times and must be evaluated on the basis of intentions and not outcomes, like some occupations. However, "intentions will stop being regarded as good if they repeatedly produce bad results or no results at all" (Lillie, 2001, page 13). In addition, the correctness of an action depends on the action as a whole, not on past actions.

Whether a scientist or engineer's conduct is good or bad may be: (1) instinctive and discernible through one's actions, (2) intentional, which may be direct and motivating, or (3) indirect, rooted in desire, which is a consciousness to act in a particular manner, or (4) a matter of calculated choice (Lillie, 2001, page 24–33).

Furthermore, explanations of theories of ethical behavior have been described as: (1) absolute, which assumes that changes in circumstances make no difference in the rightness or wrongness of guidelines for action, (2) relative, which indicates that ethical conduct can vary from person to person, (3) naturalistic, which is due to the variation of ethical standards with a person's attitude, in which case it is subjective, or, if ethical standards vary with a person's attitude changes, it is objective, (4) deontological, which is when correctness depends on the action itself and, (5) teleological, which focuses on correctness of actions in terms of levels of the benefits that result (Lillie, 2001, page 98–101).

Indeed, the actions of one person can impact on the actions of others and, as such, the general nature and direction of actions in a society may affect the choices of others and their level of consideration for moral standards. Such actions impact concerns for the common good, levels of egoism and altruism, and the eventual emergence of rights, duties and entitlements.

Ethical disagreements on rights, duties and entitlements are also possible and may take the form of disagreement in belief. This is when an individual believes in one aspect of a theory or argument, and another individual believes in a different aspect of the theory or argument such that one individual persistently challenges the other. Ethical disagreements may also take the form of disagreement in attitude. This is when an individual has a favorable, or unfavorable, attitude towards one side of the theory, and another individual has the opposite attitude towards one side of the theory (Stevenson, 2006). Such disagreements are typical of the types of disagreements which occur between scientist and engineers. But what really matters is the means by which a scientist or engineer reaches their conclusion, how the data were handled, and any ensuing interpretation of the data.

The extent and frequency of agreements and disagreements vary with the extent to which there exists an ethical environment, defined as "the climate of values in which people live and in which young people grow up" (Haydon 2006, page 2). Schools, like all other organizations, share an ethical environment. All societies have norms of conduct – norms are synonymous for morals which signify how people should treat each other. *Norm conformity* is recognized as an obligation or duty, in the absence of norms being identified, where people can be guided by the consequences of their actions.

Values, laws and religious teachings are part of the ethical environment (Haydon, 2006, page 35 and 37). As such, values and laws must be considered to evaluate the ethical environment, which may have to be changed, if necessary. This can happen through individual action, legal changes, or education. Implicit in the creation and maintenance of an ethical environment is the emergence of regimes of reason and unreason, which are comprised of conscious and unconscious, opposing and accepted values that often clash with each other in a society (Leitch, 1992, page 1–3).

The assessment of rights, duties, and entitlements is also a moral issue. Moral capacities and judgments would have been shaped by personality, socialization, situational demographic (age, gender, ethnicity etc.) and broader societal factors. Generally, scientists and engineers act because they want to achieve a goal by which they satisfy an interest or desire (Furrow, 2005, 10). These factors do not act independently of each other, rather in combination. Indeed, morally appropriate behavior is driven by thoughts and feelings that were cultivated and reinforced across time and space.

Moral autonomy is not achievable when personal desires, emotions and inclinations persistently influence a person's judgment. However, moral autonomy has to be exercised within certain societal boundaries even if it conflicts with individual's needs. In this regard, it is necessary to evaluate desires and goals (Furrow 2005, page 25).

It follows that reasoning is instrumental in helping scientists and engineers pursue and attain certain goals. However, caution is warranted because reasoning may be either rational or emotionally loaded. In fact, the reality of cultural differences – individual, group, and organizational has universally generated a diversity of moral codes where people do not subscribe to a single moral code. This has resulted in "relative morality," which does not mean that there is no true objective moral code. Relative morality has been justified on the basis of physical and cultural differences, and the constant promotion of tolerance for different views (Rachels, 2000, page 12). In the context of social changes, communication and interactions with other countries, there has been significant cross-fertilization of ideas influencing people to make judgments on levels of morality (Furrow 2005, page 38).

It is generally known that once a promise or commitment is made there is an obligation to keep it. Some scientists and engineers may not keep their obligations because they are not quite comfortable with themselves, or because of others giving them differing advice. The result is diminished will-power, or intention, to fulfill their obligation. Intentions are the outcomes of deliberating with self to decide what to do (Williams, 2006, page 18).

While beliefs are not always under voluntary control, it is true that there is a choice of what to believe, and, as a result, choice is controlled. In this regard, the scientist and engineer must remain open-minded and always be ready to evaluate arguments and findings from different perspectives.

Consequently, it must be recognized that the end does not justify the means, a rational basis must be established for dealing with uncertainty in any type of research, some types of research may not be ethically justifiable, and, while researchers prefer to minimize errors, there are those who prefer false positives over false negatives (Shrader-Frechette, 1994).

If the act that the individual scientist or engineer performs is in their power not to perform, then they are responsible for that act and must face the consequences (Chisholm, 2008, page 418). This would establish the morality of the action. It must be noted, however, that the orientation to autonomous or independent individual-level action is shaped and reshaped by a changing society. As a result, the central influencing factor is the quality of individual-level socialization despite the changing nature of the context. It is further reinforced by law enforcement, cultural influences, accountability arrangements, and monitoring and evaluation standards. In addition to these, the promotion of equity initiatives (Kezar et al., 2008, page 154–56) would serve to reduce ethical lapses in universities and other settings.

1.2 The Impact of Science and Engineering

Scientific and engineering are the driving forces for the majority of changes witnessed in the 20th century. They require a critical mind that is free of prejudice and open to new ways of thinking, with the capability to apply honest principles by investigators. The rapid development of modern science and engineering since the Renaissance is due mainly to the postulate that scientific theories should be independent of theological or religious beliefs. In the 17th and 18th century, knowledge was mainly exchanged through scientific academies which disseminated new theories and thus accelerated scientific progress. At the beginning of the 19th century, there was a remarkable rise in academic research at universities (*pure research* and *basic research*) and many university-based scientists were not interested in the technological applications of the results of their endeavors.

On the other hand, even though the research methods in industry (*industrial research* and *applied research*) differed and emanated from basic research, each method had completely different aims and rules. The focus was to acquire new knowledge *and* to adapt this knowledge to produce a profitable product for sale. The results were not the property of the investigating scientists and engineers, but the property of the industry for which they worked.

Generally, discussions concerning ethical problems were more or less absent from both realms. In academia, scientists and engineers were indifferent to the possible consequences of their work, and in industry, employers did not consider it appropriate for scientists and engineers to worry about ethical problems. In fact, this atmosphere may still exist in many scientific and engineering laboratories.

At the beginning of the 21st Century, changes in the interactions between scientist and engineers from different universities are taking place and scientists and engineers in academia and industry are increasingly collaborating. Furthermore, the results of industrial research are often published in peer-reviewed journals. As a result, it has become pertinent and necessary to evaluate, from an ethical point of view, not only the use of scientific and engineering knowledge, but also its production (Iaccarino, 2001).

As a result of the knowledge explosion, the impact of science and engineering is reflected in several ways. For example, the focus on science and engineering recognizes that new fundamental knowledge and technology will lead to the creation of new industries with associated high technology. In addition, a clean energy future, through expanded investment in research, development, demonstration, and deployment of clean energy technologies, can help reduce dependence on domestic and imported oil. It also can create green jobs, and limit the impact of climate change. The development of better science and technology is improving the prediction and prevention of, and the reaction to, destabilizing or paralyzing natural and man-made threats; improving capabilities for bio-defense; and monitoring nuclear nonproliferation compliance and preventing the surreptitious entry of weapons of mass destruction (NSB, 2010).

In addition, public attitudes about emerging areas of scientific and engineering research and new technologies will have an impact on innovation. The climate of opinion concerning new research areas could influence levels of public and private investment in related technological innovations and, eventually, the adoption of new technologies and the growth of industries based on these technologies. Furthermore, public opinion is swayed by the occurrence of cheating and misconduct in science and engineering.

On the issue of cheating and misconduct, students use a variety of methods to cheat on class examinations (Bernardi et al., 2008). In order to preserve the integrity of science and engineering, teachers and professors must: (1) acknowledge that cheating occurs, (2) examine the level of cheating, and (3) determine the reasons for cheating. Then actions such as having multiple versions of the examination and scrambling the questions on these versions would be a start to deter cheating. In addition, punishment of these actions through expulsion from the program or another equally drastic measure will force the students to recognize that there is no tolerance for cheating and misconduct. Such actions are necessary for science and engineering to remain honorable disciplines. This will preserve the beneficial impacts of the scientific and engineering disciplines.

Furthermore, there are other critical issues relating to the assessment of impact of the work of scientific and engineering professionals: (1) the impact of any new technology or modified technology takes time, and (2) the measure of the impact is not achieved by the use of a so-called standard citation index, which is used to indicate the importance of journals and the papers contained therein.

There is always the distinct possibility that the number of citations is directly related to those who are critics of the work and may consider it nothing short of ludicrous (Did the reviewers concentrate on grammatical errors rather than on scientific content?). Not all papers in high quality publications are of great significance, and high quality papers can appear in lower quality publication media. Therefore, the academic form of evaluation can be severely underwhelming and even incorrect!

On the other hand, the young professional's supervisor may fail to recognize the impact of the work, especially if the name of the young professional name is not included as a co-author. The rationale for such an omission is not easy to explain and must often remain in the dark recesses of the mind of the supervisor.

If the scientist or engineer request an evaluation of their work and its effects, evaluators should be selected from academic or company colleagues, and even users – if the concept has been reduced to practice.

Some academic institutions and companies prohibit such methods of evaluation from writers not having an academic affiliation or a company affiliation, respectively. This can be a serious blow to the morale of scientists and engineers because some of the field's best researchers work at other institutions.

Unless such an assessment of the work can be performed, the young professional may fail because the significance of their work may be ignored. It is probable that the young professional believes the impact of his work is not recognized, therefore, bypassing new ideas and techniques. The world is visibly marked by science and engineering.

The scientific and engineering disciplines continue to move towards new and important discoveries which continue to have crucial consequences for society. As a result, scientists, engineers, and the public in general, should be concerned about the consequences of the correct or incorrect data that drive these discoveries.

As a whole, this scientific revolution generates a new system of values and creates conditions which must involve an *ethical approach*. In managing new discoveries, scientists and engineers are faced with economic competition, which is combined with ideology and serves as a basis for scientific effort. This highlights the responsibility of scientists and engineers and calls for them to reaffirm a generation of older values and then create a set of new ethical values.

There is a current challenge to develop workable frameworks by which ethics and ethical behavior can be defined and the concepts followed. It is hoped that by doing so, the cheating and misconduct (which seems to propagate as the years pass) can be diminished with science and engineering, affording a positive influence on the future.

1.3 The Framework of Ethics

Ethics is based on feelings and instinct, which provides information that allows ethical choices to be made. In addition, ethics does not necessarily involve following cultural law. Some cultures may be ethical while other cultures are corrupt or ignore ethical concerns – following the old adage, *when in Rome, do as the Romans do,* is not a satisfactory ethical standard. On the other hand, ethics provides many reasons for how scientist and engineers ought to act (Markkula, 2010).

One of the hurdles of applying ethics to science and engineering is to find the correct place to start. For example, one of the most vital areas of modern philosophical debate concerns the hands-on practice of science and engineering and the treatment of the data. If a scientist or engineer begins with the premise that their actions are always moral, this reflects their attitude to helping humanity in general. They may conclude that their actions were correct and what was written on paper was infallible, and therefore, the reason for the ten additional experiments used to produce a possible answer to the problem.

Such attitudes are, in fact, the starting point of much of the traditional moral philosophy, as applied to, science and engineering. It is at the heart of the distinction between what is right and what is wrong with many scientists and engineers. The scientist and engineer had burned the late candle in bringing his model to a conclusion, but has forgotten that many of his assumptions are invalid. Similarly, the he has toiled in the laboratory to complete the additional experiments that were invariably designed to prove his theory without even acknowledging that the theory could be irrational.

Part of the difficulty with applied ethics is exemplified by the very real issue of the relationship between facts and values in the matter of under study.

It is clear, from further and more detailed consideration of the issues above (The model cannot be wrong or the experiments were designed impartially.) that:

1. scientific and engineering ethics (morality) require a *human agent* (the scientist or engineer) to carry out the actions and often, but not always, also a human as the recipient of the action,
2. the moral action requires the capacity within the scientist or engineer to reason with the actions, and then understand whether such actions are ethical or unethical (moral or immoral), and
3. the scientist or engineer must be responsible for his actions and have the freedom – in some cases it is designated as *academic freedom* (Chapter 5) – to act otherwise.

In addition, the role of reasoning, care, personality attributes, interactions, and the motivations of the individual have been variously emphasized. The scientist or engineer can act contrary to his or her embodied nature and according to a rational principle that transcends that nature (McLaren 2006, page 143). In fact, prospects for the theoretical synthesis of the contemporary perspectives of care ethics, cognitive developmentalism and character education are both good and bad insofar as: (1) the arguments of only two of these views converge, which is bad, and (2) morality has cognitive and emotional dimensions.

A much more empirically relevant position on ethics should consider human nature and standards of morality. However, in this era of social norm deterioration and moral confusion, individual beliefs and values cannot depend on social influences for a sense of direction and therein lies the tension to maintain certain ethical standards.

As a professional, if the moral reasoning of a scientist or engineer is inadequate, he should turn to The Codes of Ethics (Chapter 6) but these may not cover certain issues. The ultimate requirement of a professional is to benefit others, doing no harm, while being fair and faithful. (Welfel and Kitchener, 1999, page 134).

Research ethics however, seeks to ensure that scientific and engineering research is conducted within acceptable standards of morality, in order to preserve integrity, validity, and reliability of the study. While standards for conducting research focuses on the study itself, ethical issues emphasize people. Such issues include concerns about fraud, misconduct, harm to subjects, infringement of rights, manipulating the data directly or through the misuse of statistics, conflicts of interest, as well as misrepresentation of self and others. In fact, many professional bodies have stipulated codes of conduct to guide scientific practices.

Several theories of theories of ethics affirm that harm can emerge after a study is done and such harm is to be weighed. For example, *utilitarianism ethics* evaluates morality in terms of right and wrong while *deontological ethics* believes that some actions are inherently right or wrong despite consequences (Peach, 1995, page 15–17). While and focusing on the details of moral cases as well as providing procedures for resolution. *Virtue ethics* highlight human characteristics, habits, skills, traits, motivations, and intentions (Annas, 2006, page 516–517).

In the Protestant Ethic and the Spirit of Capitalism, a relationship between morality and work was established and a morality of aspiration focuses on rewards for outstanding performance rather than on punishment administered for failure.

In keeping with many non-scientists and non-engineers, some scientist and engineers (believe it or not) may not have a strong commitment to the process of rational thought, resulting in a focus on image (Kearney, 1999, page 12). Such occurrences render it possible for any mechanical expression of responsibility to be eroded when the new emerges. Socialization into responsibilities during childhood and teenage years is one of the prerequisites for ethical commitment in later years and also for the exercise of professionalism. One therefore has to be responsible first before one can become or act like a professional. The demonstration of responsibility cannot be talked into being. Where there are interactional bonds, there is a commitment to be responsible for the other and the resulting emergence of a sense of culture.

As responsibility develops, the stages involve inclinations to punish or obey, orientation to seek pleasure and avoid pain, the emergence of social awareness, and acceptance of the importance of ethics (Alcorn 2001, 86–88).

A framework has been proposed to analyze ethical issues in the behavioral sciences (Beauchamp et al., 1982, page 46) in which *harm* is defined as any situation where an individual's well-being is reduced, while a *benefit* occurs when well-being is enhanced. Harm, like benefit, can impact participants in scientific and engineering research as a result of the research or during the conduct of research. Such ethical issues are an invasion of privacy, loss of confidentiality, lack of informed consent or deception. These may take the form of stress or humiliation, affecting group interests and violating the norms of healthy interpersonal relationships (Beauchamp et al., 1982, page 104–109).

Thus there is a strong need for the scientist and engineer to clarify his perception of the moral issue, list alternative causes of action, make a choice from the options available, decide on the consequences while evaluating his values, and discuss with others in an attempt to gain further guidance in decision making (Smith, 1990, 146).

Ethics and morality are similar, but yet, different. Morality involves "sensitivity to the needs of others... and responsibility for taking care" (Walker, 2003, page 59). Furthermore, morality is reflected in the fair treatment of other people and the monitoring of relationships with others relative to the nature of the attachment. The particular context can frame and guide ongoing moral thinking and action, as well as making judgments and taking responsibility (Walker, 2003, page xii). Such contexts include but are not limited to classrooms, conferences, professional associations, order of author listing in publications, and graduate programs. Moreover thinking and theorizing about moral issues – valuing, judgment and responsibility – without paying attention to context is questionable, if not futile (Walker, 2003, page xiii).

Criticisms of theories on moral development (Gilligan, 1982) have led to the development of the more practical-oriented theories of caring and justice (to a lesser extent), which complement each other. Following from this, it is possible to derive ethical frames that foreground sharing, sensitivity to others, personal responsibility, and shared decision-making (Lincoln, 2009, page 157). In addition, *justice theories* emphasize legal procedures, natural rights, and individuality; whereas *care theories* can be criticized for ignoring the concerns of minorities and other marginalized groups (Lincoln, 2009, page 157).

Justice theories, like care theories, are applicable to community work in order to restore the balance of justice for issues of gender, social class, race, politics, history, poverty or oppression (Lincoln, 2009, page 157). The point of departure is the most significant contribution to our understanding of morality that links moral reasoning and behavior (Walker, 2004, page 2). This is involves focusing on the importance of moral values to one's identity, the sense of personal responsibility, which orients individuals to ensure that their actions are consistent with their moral judgments, and self-consistency, which emphasizes the need to maintain congruence between one's sense of morality and moral decision-making. (Walker, 2004, page 2–4).

On the other hand, it has been proposed that there are four dimensions of moral behavior: interpreting how the actions of others are affected by oneself, determining the ideal moral behavior for a situation, deciding which moral action to pursue, and acting on the decision (Bergman, 2004, page 25).

Identity theory postulates that individuals act on the basis of beliefs and values that collectively contribute to one's sense of self and moral identity (Moshman, 2004, 92). This is both discovery and creation as the individual scientist or engineer can decide what type of person they want to be (Moshman, 2004, 91). If there is not any judgment-action correspondence, then this is a false moral identity due to a weak moral commitment. Indeed, moral reflection is a capacity available in different forms at all points in development. People can be used to evaluate social or technical situations from a moral point of view (Nucci, 2004, page 127).

Feminism and racism have historically, and successfully, identified a major ethical void in the scientific and engineering disciplines by exposing practices that have denied access to women or other oppressed groups by ignoring or devaluing them (Brabeck and Brabeck, 2009, page 39 and page 41). To combat this prevailing attitude toward women and other races, it is necessary to raise awareness of depressing social conditions, promote key values of fairness, welfare, and justice, encourage rethinking of the social issues, and examine the historical aspects of domination, control, alienation and inequities (Thomas, 2009, page 54).

Another perspective that is applicable to ethical or unethical decision-making and actions is the *Theory of Planned Behavior*, which emphasizes that intentions influence volitional behavior by exerting a motivational effect on individuals (Kiriakidis, 2008, page 2211). In addition, the predictors of intentions are attitudes, subjective or personal norms, perceived behavioral control and hypothesized relationships; all of which have gained much empirical support (Kraft et al., 2005, page 480; Kiriakidis, 2008, page 2211).

Of significance are the methodological and empirical aspects of this issue since these interact and collectively influence the extent of the ethical commitments of a scientist or engineer in any context – academic or non-academic. As such it is not only an intellectual or purely rational exercise at the individual, group, organizational or societal levels – but it is a subjective exercise. Indeed, this is an issue where the natural emotionality of scientists and engineers provide a catalyst for the realization of ethical imperatives, requiring philosophical attention (Tangney et al., 2007, 345).

Then, the framework for ethical decision making lies in the following concepts (Markkula, 2010):

1. Recognize an Ethical Issue – is the decision or situation damaging to someone or to some group? Does the decision involve a choice between a good and bad alternative? Is the issue about more than what is legal or what is most efficient?

2. Investigate the Facts – what are the relevant facts of the issue? What individuals and groups have an important stake in the outcome? Have all the relevant persons and groups been consulted?
3. Evaluate Alternative Actions – especially the option which best respects the rights of all who have a stake and treats people equally or proportionately? Which option best addresses the situation?
4. Act and Reflect on the Outcome – how will the decision be implemented with attention to the concerns of all stakeholders? How will the decision turn out?

Whilst considering this framework, it is also worth considering the *The 4-Way Test* which is the *credo* or operating principle of Rotary International (Chapter 2).

1.4 Ethics in Professional Life

Scientists and engineers have become increasingly interested in questions of ethics. It might be diversity of the sub-disciplines or the fundamental questions from scientists and engineers which leads to this interest.

Some scientists and engineers are more enamored with such interests and discussions than others. However, the disciplines largely belie the common interpretation by non-scientists and non-engineers as more of a repository of descriptive facts about the world than some deeper intellectual perspective on their meaning.

To many scientists and engineers ethics is often misunderstood and believed to be, or seen as, an abstract and speculative area. An area that is as impractical as it is incomprehensible and is of interest only to scholars paid to think thoughts bearing little connection to reality outside the ivory tower.

However, it is vital that ethics not be treated as something remote to be studied only by scholars locked away in universities. Ethics deals with values, good and bad, and right and wrong. Scientists or engineers cannot avoid not being involved in ethics, for what they do and what they do not do is always subject to ethical evaluation.

Ethics, also known as moral philosophy, involves systematic intellectual reflection on morality in general – where morality is the realm of significant normative concerns, often described by thoughts of right or wrong, or specific moral concerns.

One realm of applied ethics that has received considerable attention in the scientific and engineering communities focuses on professional conduct. The moral questions asked by scientists and engineers, as well as those in, for instance, the fields of law, medicine or business, are legitimate components of ethical enquiry.

In addition to ethics involving both theoretical and applied concerns, another useful distinction can be drawn between descriptive ethics, normative ethics, and meta-ethics (though only the latter two are represented in philosophical literature). The aim of descriptive ethics is to characterize existing moral schemes; this has been an important feature of the science and engineering disciplines.

Normative ethics is devoted to constructing a suitable moral basis for informing human conduct, while meta-ethics, is more an examination of the characteristics of ethical reasoning, or systems of ethics.

Thus, in science and engineering, ethics typically involves reflection upon moral questions that arise in research, publication and other professional activities. From this several questions arise:

- Is it wrong to bend data to support one's conclusions?

- Is it wrong to publish data gathered under some assumption of confidentiality on the part of the research subject?
- Is it wrong to publish a work based substantially on the research of the graduate student(s) of a professor (mentor) as the professor's own?
- Is it wrong to enter the policy arena as a scientist or engineer, where objectivity and partiality could well clash?

The sheer number and complexity of these kinds of ethical issues, in the conduct of science, is amply evidenced in the older literature (Shrader-Frechette, 1994; Weeks and Kinser, 1994) and are addressed in this book (Chapter 8 and Chapter 9). However, this prevailing sense of ethics among scientists and engineers avoids, at least, as many difficult moral questions as are asked. Indeed, the kinds of moral issues entertained in much of scientific and engineering work tends to dodge (or ignore) the much larger moral question about the ethics of science and engineering. Also, whether the current research priorities and the amount of scarce resources that are currently allocated to scientific and engineering research are justifiable, and whether the typically elevated status of scientific and engineering pronouncements on reality is justified, in the light of the many stinging critiques of misconduct in science and engineering (Chapter 9).

One way to weave together both professional and substantive ethical behavior in science and engineering is to recall the heritage of both disciplines. The net result could be a greater affinity between professional and substantive concerns among scientist and engineers.

Professional ethics represents the context, or the process, out of which the content, or the result, of substantive ethics emerges. Joining these two areas will allow scientist and engineers to be properly reflexive in the moral statements they make about their work.

One of the most familiar areas of ethical enquiry in science and engineering involves research and analytical techniques. The act of research itself, and the consideration of the role of the researcher vis-à-vis the research subject(s), has also been a popular subject of enquiry. Another area of concern is related to the manner in which science and engineering are represented, and the direct social significance of the data. Indeed, ethical issues become more focused as one moves from a particular scientific or engineering concept to its technical implementation, and finally to its application.

There are so many questions which scientists and engineers could apply their intellectual efforts and organize these questions as presented below:

- What is the role of ethics in scientific and engineering and practice?
- What kinds of values have implicitly or explicitly accompanied the practice of science and engineering in recent history?
- Is it appropriate for only a subgroup of scientist and engineers to be intellectually concerned with ethics, or does ethics pertain to all scientists and engineers?
- How might scientists and engineers proceed to address ethical problems in their work?
- To what extent is ethical conduct desirable, definable and/or enforceable in the practice of science and engineering?

Finally, understanding ethics as an inextricable part of the work of scientists and engineers is the first step in their ability to answer these questions.

Going beyond much of the previous literature on ethics, the authors of this book attempt to show how ethical issues, despite its varied philosophical moorings, ultimately find fuel in and can be put in proper perspective on the basis of understanding human nature or – more correctly – the goals of scientists and engineers.

The goal now is to scientists and engineers more sensitive to the ethical implications of their work. This requires a start from the basics of the education system where cheating and misconduct occur frequently. Since cheating and misconduct occurs as early as the middle school years of a student, the most appropriate context to discuss ethical questions is in the primary and secondary schools, followed by the universities (Chapter 4). Finally, discussion of ethical implications should be at the annual meetings of scientific and engineering societies (Smaglik and MacIlwain, 2001) – if by then it is not too late!

Teachers and professors need to make themselves more aware of the unethical and immoral implications of cheating and misconduct. Then they need to be more prepared to inform their students about ethical and unethical issues. Subsequently, it will be possible to come to a more general conclusion at national and international levels. The ethics of science and engineering is not only a personal problem but also a collective problem that involves all scientists and all engineers.

The continuity of civilization depends on people (i.e., scientists and engineers) interacting in a genuinely ethical manner (Madison and Fairbairn, 1999, page 3). Indeed, the occurrence of unethical practices in academia and elsewhere brings to the front-stage, not only the issue of ethics, but also the need for recognition of the nature of ethics in the age of personal image being the top dog of the group, and the recipients of copious awards (Madison and Fairbairn, 1999, page 4).

Making good ethical decisions requires that the scientist or engineer has a trained sensitivity to ethical issues and a practiced method for exploring the ethical aspects of a decision and weighing the considerations that should impact the choice of a course of action. Having a method for ethical decision making in the scientific and engineering fields is, and when used regularly, such a method that becomes second nature assuming the scientist or engineer can work through ethical issues automatically without consulting the specific steps (Markkula, 2010).

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