Ethics in Science and Engineering
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Scientific and Engineering Societies

5.1 Introduction

The activities of the various science and engineering disciplines are essential to provide solutions for the future, for both individuals and society. Furthermore, society is demanding growing accountability from the scientific community as the implications of life science research rises in influence. While there are growing concerns about the credibility, integrity and motives of the science and engineering fields, both the scientific and engineering communities have responded to these concerns about their respective integrities; in part by initiating training in research integrity, and in part by teaching the responsible conduct of research. This approach, however, is minimal (Jones, 2007).

The scientific and engineering communities justify themselves by appealing to the ethos of science and engineering, claiming academic freedom, self-direction, and self-regulation, but no comprehensive codification of this foundational

ethos has been forthcoming. A review and formalization of implicit principles can provide guidance for recognizing divergence from the norm and provide a framework for discussing externally and internally applied pressures that are influencing the practice of science and engineering.

The time is now for scientific and engineering communities to reinvigorate professionalism and define the basis of their social contract. Codifying the basis of the social contract between science and society will sustain public trust in scientific and engineering enterprises.

Scientific societies can have a powerful influence on the professional lives of scientists either through professional activities or codes of ethics (Caelleigh, 2003; Chalk, 2005). Using this influence, they have a responsibility to make long-term commitments and investments in promoting integrity in publication, just as in other areas of research ethics (Jones, 2007).

Concepts that can inform the thinking and activities of scientific societies with regard to publication ethics are:

1. the hidden curriculum (the message of actions rather than formal statements),
2. a fresh look at the components of acting with integrity,
3. deviancy as a normally occurring phenomenon in research data, and
4. the scientific and engineering community as an actual community.

A society's first step is to decide what values it will promote, within the framework of present-day standards of good conduct in science, and given the society's history and traditions. The society then must create educational programs that serve members across their career fields. Scientific societies must take seriously the implications of

the problem by setting policies and standards for publication ethics for their members and educating the membership about, and enforcing, the standards. Any issues relating to misconduct must be brought before the membership early and often.

Thus, it is not surprising that over the last several decades, scientific societies have played an expanded role in the advancement of their fields and in the professional development of their members (Murray, 1947; AAAS, 2000). Most scientific societies have assumed roles and functions well beyond their founding missions as publishers of journals and conveners of annual meetings for scholarly exchange. For many, this larger role has included the development of codes of ethics and endorsement of policies regarding ethical practices in the conduct of research (Levine and Iutcovich, 2003).

Many scientific societies have developed codes of ethics that encompass a broad range of behaviors and practices as a means of fostering research integrity (Levine and Iutcovich, 2003). These codes presumably represent the ideals and core values of a profession, and can be used to transmit those values and more detailed ethical prescriptions as part of the education of scientists and engineers and practitioners. They also provide a benchmark of standards for reviewing claims of misconduct and for sanctioning improper behavior.

Scientific and engineering societies diverge in the roles they play regarding the promotion of ethical conduct among members of their disciplines.

There are at least three functions for societies that are important to track and trace over time and across fields:

1. general education and professional development,
2. prevention and advisement, and
3. complaint handling and enforcement of codes of ethics.

While societies vary in their levels of engagement in these three functions, they differ especially as to whether they are engaged in regulation of scientists and engineers within their disciplines.

Scientific and engineering societies vary both in the activities they pursue and in their levels of effort. Also, activities can be high or low profile, symbolic or concrete. In addition, they can be implemented on a case-by-case basis or be part of a more systemic effort to address integrity and misconduct (Levine and Iutcovich, 2003).

Guidelines setting forth acceptable standards of behavior in relation to such issues as fabrication or falsification of data, protection of human subjects, confidentiality, accurate reporting of results, and plagiarism have evolved over the years, with many societies embracing the value of education, development, and typical setting. Some societies also have mechanisms for investigation and enforcement.

While scientific societies are paying increased attention to research conduct, little is known beyond impressionistic observations about the nature of their role and impact. In general, research on research integrity is a very small specialty within the scholarly traditions of science and engineering policy, sociology of science and engineering, and ethics and values in science and engineering.

Many scientific and engineering societies also provide assistance to companies in terms of hiring staff and even in selecting consultants. Renting space and handling a paper process with copying and mailing are vital to the operations and join the work environment, human resource principles and compliance with employment regulations as important. The assessment of when to use a consultant, finding a consultant may also involve offering a sample consultant contract and advice in working and monitoring the consultant's work.

From this plethora of activities, it is always difficult to know how far to go involving the society of one's professional work. For a person looking at the long haul in science and engineering, the society will help with: career track, development, consulting, fund raising, planned-giving, advocacy, regional, and national or international growth, through knowledge, insight, and wisdom.

5.2 Scientific Societies

A development of great importance to science was the establishment in Europe of academies (or societies) which consisted of small groups of men who met to discuss subjects of mutual interest. Although some of the groups enjoyed the financial patronage of princesses and other wealthy members of society, the members' interest in science was the sole sustaining force. The academies also provided freedom of expression, which, together with the stimulus of exchanging ideas, contributed greatly to the development of scientific thought. One of the earliest of these organizations was the Italian Academy of the Lynx, founded in Rome around 1603. Galileo Galilei made a microscope for the society; another of its members, Johannes Faber, an entomologist, gave the instrument its name. Other academies in Europe included the French Academy of Science (founded in 1666), a German Academy in Leipzig, and a number of small academies in England that in 1662 became incorporated under royal charter as the Royal Society of London. This was an organization that was to have considerable influence on scientific developments in England.

In addition to providing a forum for the discussion of scientific matters, another important aspect of these societies was their publications. Before the advent of printing there were no convenient means for the wide dissemination of scientific knowledge and ideas; hence, scientists

and engineers were not well informed about the works of others. To correct this deficiency in communications, the early academies initiated several publications, the first of which, *Journal des Savants*, was published in 1665 in France. Three months later, the Royal Society of London originated its *Philosophical Transactions*. At first this publication was devoted to reviews of work completed and in progress; later, however, the emphasis gradually changed to accounts of original investigations that maintained a high level of scientific quality. Gradually, specialized journals of science made their appearance, though not until at least another century had passed.

Over the last several decades, scientific societies have played an expanded role in the advancement of their fields and in the professional development of their members. Most scientific societies have assumed roles and functions well beyond their founding missions as publishers of journals and conveners of annual meetings for scholarly exchange. For many, this larger role has included the development of codes of ethics and endorsement of policies regarding ethical practices in the conduct of research (Chalk et al., 1980).

Professional societies for scientists and engineers provide a service that not only involves complete day-to-day administrative management of non-profit organizations, but also specialized services including (but not limited to) code of ethics, annual and bi-annual meetings, trade show meetings, convention management, salary surveys, strategic and implementation planning, and government relations.

The society may also be concerned with activities such as professional development, planned-giving, preparing and carrying out a planned-giving program, developing and sustaining membership, and operating educational programs for various groups. Good citizenship, public service, to communities, and to the nation as a whole, may be seen as most significant.

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Beyond impressionistic observations, little is known about the role and influence of scientific societies on research conduct.

Acknowledging that the influence of scientific societies is not easily disentangled from other factors that shape typical practices, this chapter addresses the role and impact of scientific societies as part of that process. In particular, the chapter focuses on the means by which technical societies deal with integrity in research as well as the need for evaluation of ethics in scientific and engineering disciplines.

Science and engineering research is not the collection of facts but it is the treatment of facts to discover knowledge and its applications. So it has been the focus of scientists and engineers to use their intellectual independence to produce knowledge. However, very few scientists and engineers have capitalized financially on their work because to do so restricts progress by limiting the use of available information.

The freedom and independence of science and engineering has ordained the formations of Societies to enable discussion and exchange of mutual interest. The production of Society Journals makes carefully digested knowledge available to whosoever will read them, and so knowledge becomes disseminated openly for universal use.

These associations of scientists and engineers are not a Secret Society or Closed Order and through these meetings important discoveries are often available before they appear in print. Thus there has been developed, as another valuable function of Societies, the presentation of the results

of researches to a critical and understanding audience with privilege of discussion.

Some of the effects of this exposure of new work to the light of knowledge and experience of others are that solutions to unresolved difficulties, that are suggested and important implications which have been overlooked, are pointed out. This allows more complete work to be accomplished eventually, redounding to the credit not only of the author but of that branch of learning. Normally, an unworthy paper never reaches print because of adverse criticism at its presentation to the society.

If a society is to be worthwhile, the discussion and criticism must be frank and severe as well as constructive and helpful. In some societies, criticism is of the greatest severity, and proponents maintaining heat with their various opinions, do no injury to friendship, to mutual respect or to future relations. The most futile of meetings are those in which cautious members utter platitudes about, "this most interesting and valuable paper," and the brilliance of the author, and the little to be learned, if anything, from the ensuing discussion.

A supposed function of Societies is, supposedly, the opportunity that is presented for different workers in a field to get-to know one another. While this is important in itself, the meetings often represent an "old boys club" in which little is done towards the exchange of materials and information. Ethics may be mentioned but not discussed in any detail on the basis that it cannot happen here (in this society) because we are all honorable men (and women).

Also, there is the matter of awards. For many societies, it is a matter of the potential recipient of the award to serve his time (unfortunately, because of this, very few awards are given to women).

In fact some years ago, a multitude of us sat through many meetings of a particular society covering a period of

at least a decade. Once it became evident that the awardees would be chosen from those who sat in the front row of every meeting, and asked the "meaningful" questions to establish their presence, the meeting became of little value.

5.3 Engineering Societies

The term *civil engineering* was first used in the eighteenth century to distinguish the newly recognized profession from military engineering, until then preeminent. From earliest times, however, engineers have engaged in peaceful activities, and many of the civil engineering works of ancient and medieval times, such as the Roman public baths, roads, bridges, aqueducts, and many other monuments, reveal a history of inventive genius and persistent experimentation.

Formal education in science and engineering became widely available as other countries followed the lead of France and Germany. In Great Britain the universities, traditionally seats of classical learning, were reluctant to embrace the new disciplines. University College, London, founded in 1826, provided a broad range of academic studies and offered a course in mechanical philosophy. King's College, London, first taught civil engineering in 1838, and in 1840 Queen Victoria founded the first chair of civil engineering and mechanics at the University of Glasgow, Scotland. Rensselaer Polytechnic Institute, founded in 1824, offered the first courses in civil engineering in the United States. The number of universities throughout the world with engineering faculties, including civil engineering, increased rapidly in the 19th and early 20th centuries. Civil engineering today is taught in universities on every continent.

Engineers, like scientists, have a vital role to play in the developmental processes but the role that the professional engineering and scientific societies must play remains undefined.

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1. general education and professional development,
2. prevention and advisement, and
3. complaint handling and enforcement of codes of ethics.

While scientific and engineering societies vary in their levels of engagement in these three functions, they differ especially as to whether they are engaged in regulation of scientists and engineers within their disciplines.

Views on ethics, sense of morality and consequent responses to ethical issues by societies vary because of their different paths to authority, personalities, their perceptions of their responsibilities, and the contexts and challenges (Wagner and Simpson, 2009). Moral architecture would influence the level of appreciation for courtesies, acts of decency and respect and facilitates adjudication of a diversity of claims by members. In the absence of specifically written protocols, a high level of moral development within the membership could guide members' actions.

Scientific and engineering research offers many other satisfactions in addition to the exhilaration of discovery. Researchers have the opportunity to associate with colleagues who have made important contributions to human knowledge, with peers who think deeply and care passionately about subjects of common interest, and with students who can be counted on to challenge assumptions. With many important developments occurring in areas where disciplines overlap, scientists and engineers have many opportunities to work with different people, explore new fields, and broaden their

expertise. Researchers often have considerable freedom both in choosing what to investigate and in deciding how to organize their professional and personal lives. They are part of a community based on ideals of trust and freedom, where hard work and achievement are recognized as deserving the highest rewards. And their work can have a direct and immediate impact on society, which ensures that the public will have an interest in the findings and implications of research.

Research can entail frustrations and disappointments as well as satisfactions. An experiment may fail because of poor design, technical complications, or the sheer intractability of nature. A favored hypothesis may turn out to be incorrect after consuming months of effort. Colleagues may disagree over the validity of experimental data, the interpretation of results, or credit for work done. Difficulties such as these are virtually impossible to avoid in science and engineering. They can strain the composure of the beginning and senior scientist alike. Yet struggling with them can also be a spur to important progress.

Individuals operate according to their own beliefs of what is considered moral and what is not. There must be some over-riding code of ethics for scientists and engineers. However there will always be those scientist and engineers whose code is very simple: self first, self last, and, if there is anything left, self again.

The role of a *code of ethics* is characterized by both descriptive and prescriptive aspects. One can choose to affirm or deny role responsibility. Particularly when the occupant of a position is a scientist or engineer, it might be expected that the requisite knowledge and skills demanded in these esteemed positions would be sufficient to guarantee research integrity, except in a few extraordinary cases.

In as much as many researchers find themselves in such a quandary, a course pertaining to ethics for scientists and engineers is a must.

Furthermore, what constitutes integrity is subject to varying interpretations and right and true, ethical and fair may not be readily definable. Although the federal government in the United States has in recent years moved to implement greater oversight of the conduct of federally-funded research, focusing on the government definition of research misconduct is too narrow to address the range of behaviors that could threaten the integrity of research.

In late 1999, the U.S. Office of Science and Technology solicited comment on a proposed policy that defines the scope of the federal government's interest in the accuracy and reliability of research. This involved a definition of research misconduct and basic guidelines for responding to allegations of research misconduct (OSTP, 1999; UNESCO, 2006).

Research misconduct is defined as: "fabrication, i.e., making up results and recording or reporting them, falsification, i.e., manipulation of research materials, equipment, or processes, or changing or omitting data or results such that the research is not accurately represented in the research record, and plagiarism, i.e., the appropriation of another person's ideas, processes results, or words without giving appropriate credit (OSTP, 1999)." The goal is to recognize misconduct and questionable practices which, while not covered by federal regulations, often are far more prevalent than instances of misconduct, and must be confronted in order to avoid the *normalization of deviance.*

5.4 Codes of Ethics and Ethical Standards

Many scientific societies have developed codes of ethics that encompass a broad range of behavior and practice as a means of fostering research integrity. These codes

presumably represent the ideals and core values of a profession, and can be used to transmit those values and more detailed ethical prescriptions as part of the education of scientists and engineers. They also provide standards for reviewing claims of misconduct and for sanctioning improper behavior.

Codes of ethics should be developed by all scientific and engineering disciplines, with the process of development offering ample opportunity for contributions from all sectors of a society's membership.

Ethics and publication standards are not always effectively transmitted from one generation of scientists and engineers to the next, or even to current members of a society. Hence, any effort to develop standards should be linked to a plan for their dissemination and for the education of those to whom they (will) apply. For example, ethics consulting services sponsored by societies may help members assess options for responsible conduct.

If a society decides to enforce its standards with review and disciplinary procedures, it should be prepared to devote adequate resources to do so effectively. Enforcement procedures should accord due process and ways to initiate a grievance should be commonly known.

When misconduct allegations are reviewed by societies, the results may not be made public, thereby diminishing the potential deterrent effect. Societies should, therefore, consider making public the outcomes of their misconduct review.

One of the pivotal questions faced by a scientific society is whether to institute measures to enforce its code of ethics with disciplinary proceedings and sanctions. Many societies choose not to engage in enforcement, using their ethics codes primarily for educational purposes. For other societies, ethics code enforcement allows them to demonstrate their willingness to hold their members accountable for their conduct. Yet another option adopted by some

societies is referral of a grievance to the institution that owns the data to conduct an investigation, with the society reserving the right to publicize the findings of that investigation.

There are several considerations for any scientific and engineering society regarding enforcement. Due process considerations are essential in a review of misconduct if expulsion from society membership is a possible outcome. In addition, reviewers of misconduct allegations must have the right to access all sources of relevant information. There should also be a plan for transmitting a finding of misconduct to appropriate persons/institutions that should be in place to protect the integrity of the research record. All parties involved in the review of misconduct are vulnerable to being sued and junior scientists and engineers may be reluctant to participate in disciplinary proceedings out of fear of professional vulnerability.

Enforcement of a code of ethics is not an easy task and societies must be willing to expend sufficient resources to do it well. The question of whether enforcement will serve as a real deterrent to misconduct is by no means settled. Therefore, careful drafting or redrafting of society codes may permit enforcement while addressing some of these concerns.

The potential for and the limitations of codes of ethics to ensure research integrity provoke varying points of view. While codes are intended to codify standards of behavior in professional roles, their limitations are such that conduct cannot be guaranteed and, in some instances, cannot be predicted. The context of scientific research can present unique circumstances that create difficulty in describing behavior that is uniformly right or wrong. Any decision or dilemma requires an examination of competing values as well as good judgment and common sense, and the individual value systems of each member must also be factored into decision-making.

In the context of scientific and engineering disciplines, the most important factors are related to:

1. authorship determination,
2. reporting misconduct procedures,
3. plagiarism,
4. duplicate publication,
5. obligation to report misconduct,
6. data retention,
7. mentoring/supervising roles,
8. responsibility of authors,
9. timely reporting of data, and
10. order of authors.

However this list does not reveal how these provisions are interpreted by members of the societies and what impact they have on behavior.

All codes encourage general good conduct, summarized as:

1. perform research and consultation honestly,
2. work within the boundaries of competence, by following all applicable regulations and procedures, and
3. do no harm (to the discipline, to research subjects, to institutions, to clients, to the public, and to society).

This leads to the substantial commonalities that all among the codes will relate to honesty in conducting and reporting research, and integrity in intellectual ownership and authorship. However, differences among a selection of codes of ethics will, undoubtedly, be found to be in the breadth, (i.e., greater responsibility to one's role or to society) and the level of specificity (i.e., articulated more as principles or as detailed expected behaviors), as well as the

implied purpose (i.e., primarily to educate, to sanction, or to protect the public).

The foundational ethical guidelines for research integrity covered by the codes of the scientific societies include: scientific value, validity, falsification, fabrication, plagiarism, publication standards, authorship, conflicts disclosure, public/press announcements, data from unethical experiments, and confidentiality of review. Furthermore, collaboration between the scientific and engineering societies in developing codes of ethics may be useful to ensure that their members, whatever their backgrounds, are familiar with the ethical requirements of research, whether at the bench or at the conference table.

5.5 Promoting Research Integrity

Many scientific societies realize that the adoption of a code of ethics can be an important step, but insufficient for fostering responsible research practices. In seeking ways to reinforce the message carried by their codes, societies may engage in a range of activities such as the promotion of research integrity. Society-sponsored workshops in research ethics and professional responsibility are among the activities sponsored by scientific societies.

Ideally, prevention of scientific misconduct is the best protection of the public as well as of the reputation of the various scientific disciplines. To develop an appropriate focus on ethics standards, one should consider how a scientific community functions. The behavioral messages of established faculty members, for instance, are a significant source of learning. The influence of the informal curriculum may run counter to the educational messages of the formal means of communicating normative behavior and expectations. Trainees and junior colleagues model their professional behavior, to a large extent, on what their leaders do, not what they say. Established scientists and engineers are

effective if they openly explain their difficult decisions as based on issues of right and wrong. In other words, modeling is a primary factor in assuring ethical conduct.

In an effort to go mitigate unethical behavior, the ethics review process should be detailed in the code, although if a charge is brought against a member, where appropriate, it is recommended that the academic or other institution that employs the member should make the investigation and resolve the issue. When it is determined that an ethical violation has occurred, a recommendation is made to the society president for action the president must be able to follow specific guidelines. A finding of plagiarism may result in a letter of reprimand and an author can be barred from publishing in any society for up to five years; an author's correction or retraction should also be required.The penalties for fabrication or falsification need to be more severe. Publication of a retraction is mandatory and various publications, leadership roles, privileges and rewards are precluded. The society may decide to publish the charges and findings in the relevant society publications (e.g., a newsletter or weekly/monthly magazine). A report of the actions should also be forwarded to the author's employing institution as well as to the appropriate government offices if federal funds are involved.

In addition, the society must also be prepared to review and, if necessary, revise its code of ethics over a three-year period, even if the revised code is longer and more detailed than the original code.

Growing interest in public participation in the oversight of research and scientific inquiry counters long held traditions of homogeneous group responsibility. The societies and others charged with promoting ethical conduct and reviewing allegations of misconduct have subscribed to the idea that only members of their profession are competent to make judgments about it, that outsiders may have biases or are uninterested, and that it is cumbersome to involve persons without the pertinent expertise. Yet, self-regulation by

professional peers too often means that persons with similar backgrounds, training, and values as well as vested interests can, despite the best of intentions, fail in representing the public interest.

The person trained to perform a particular function is least capable of seeing negative consequences and harms that could be caused by the act. Similarly, the person who is most capable of seeing negative consequences or harms that could be caused by certain actions is the person most likely to be harmed. Token outsiders, at worst, would have no impact and serve primarily as a public relations function. Further, inclusion of laypersons in oversight or review roles might preempt government imposition of such "watchdogs" and, indeed, they would serve as surrogates for the public interest. If protocols and research findings are defensible to reasonable people, the public interest is served; the concept of objectivity known as the "view from nowhere" is advanced.

Many categories of people would likely fit this role of an "outsider": junior members of the profession and lower status students and trainees are semi-outsiders; scientists and engineers from related or distant fields, technicians, lawyers, historians, and persons from underrepresented groups such as women and ethnic minorities could make valuable contributions to deliberations. The practice is already in place among corporate boards of directors, state licensing boards, institutional review boards, consultants, and trainers. It may be appropriate for society ethics/review committees to adopt such practices as well.

5.6 The Effectiveness of Society Activities

As the public increasingly demands greater accountability on the part of the scientific community and as societies seek effective ways to promote research integrity, their activities must be subject to rigorous evaluation.

All codes of ethics of scientific and engineering societies encourage general good conduct. The codes encourage society to conduct and perform research honestly (including giving expert consultation and in delivering service). The work should be performed by working within the boundaries of competence, by following all applicable regulations and procedures). There should be no harm done to the discipline, to research subjects, to institutions, to clients, to the public, and to society). However, there are differences between the codes of ethics of the various societies, such as the level of specificity (i.e., articulated more abstractly as principles or as detailed expected behaviors), and the implied purpose (i.e., primarily to educate, to sanction, or to protect the public).

However, many scientific societies realize that the adoption of a code of ethics can be an important, but insufficient step for fostering responsible research practices. In seeking ways to reinforce the message carried by their codes, societies may engage in a range of activities. Furthermore, the range of activities reflects, at least in part, the fact that the societies are highly heterogeneous and some activities are a more appropriate fit to a specific society than others.

As the public increasingly demands greater accountability on the part of the scientific community and as societies seek effective ways to promote research integrity, these activities must be subject to rigorous evaluation. But neither resources nor strategies in support of evaluation appear to be a priority among the societies. The survey results revealed few means by which societies determine the effectiveness of their activities. Three indicated they conduct surveys and two mentioned informal feedback. Other categories mentioned once included outcomes of research projects, attendance at programs, meeting evaluations, annual reviews, peer review of research articles, disciplinary procedures, compliance with guidelines of society's instructions for authors, and the practice of addressing specific ethical concerns on a case-by-case basis.

Most, if not all, societies recognize that the following activities appear to be most effective for promoting research integrity:

1. publications on research ethics,
2. programs at annual meetings,
3. columns/articles in professional journals and newsletters, and
4. resource material with which mandatory compliance is specified, mentoring, and oversight of journal article reviewers.

Ethics committees, resource materials, and posting materials on a Website (unless a focal point of the site) were reported as least effective. But none of these appears to have been evaluated with any rigor. Indeed, it is not even clear what would constitute the criterion of "effectiveness" in order to draw valid conclusions. The reality is that these responses are more reflective of seat-of-the-pants judgments than any empirical evidence.

Scientific societies and professional associations should work closely together in developing and implementing codes of ethics as a way to bridge gaps in the understanding of ethical responsibilities across disciplines and professions. More research is needed on the importance of the societies (and other forces in the research system) in shaping the ethical climate in which scientists and engineers work. Worth explanation is how the exercise of professional discretion by individual scientists and engineers is affected by standards prescribed by his or her society.

In planning a research project, a clear delineation of roles, working relationships, credit allocation, and intellectual property policies is desirable. The design of methods of dispute resolution may help to promote responsible research practices and support collegial models for conducting collaborative research. Societies should consider

adopting partnering agreements, conflict resolution mechanisms, and mentoring strategies in support of scientists and engineers, and students in the respective disciplines.

At present, there has been very little formal evaluation of the effectiveness of the society initiatives described in this report. More rigorous evaluation is essential if resources are to be efficiently allocated and if scientists and engineers, and the larger public are to have confidence in the self-regulatory functions of the societies. Such evaluation should be sensitive to the heterogeneity of the population of scientific societies.

Beyond impressionistic observations, little is known about the role and influence of scientific societies on research conduct.

There can be little argument with the notion that societies can play a key role in developing initiatives to help prevent ethical infractions and promote responsible research conduct. Yet, a scientific or engineering society may not always be a sufficiently impartial judge of allegations of research misconduct. Like all institutions, societies can overtly or subtly engage in cover-ups to protect their good name or to avoid possible litigation. Nevertheless, scientific societies can and should do more to promote research integrity.

In their role as publishers, societies have the opportunity to influence research conduct. Societies should review their codes of ethics to determine whether they appropriately cover publication ethics, which is a critical element in promoting research integrity. The society's leadership should work closely with new editors and new generations of researcher-scholars regarding ethical standards and their crucial role in helping to ensure the integrity of research.

Society journals should develop educational programs regarding publication policies that promote integrity in publishing scholarly work. In fact, scientific societies should establish a consortium of journal editors to develop, where

appropriate, consistent standards for publishing scientific research. Furthermore, scientific societies should work together to establish a uniform policy regarding authorship in the context of multi-disciplinary research collaborations.

Criteria for authorship and the responsibilities – including relative contributions – of authors should be clearly stated by society journals. Specific standards for online publication should be developed by the societies.

Not enough attention is paid to the information and communications field, and only its positive effects and possible contribution to national development were mentioned while neglecting side effects and responsibilities.

In order for scientific research to be executed according to the ethical codes and be socially responsible, voluntary practice within the scientific community is more necessary than regulations from outside. Moreover, it is unconventional to solely depend on exterior regulations to deal with various social and ethical conflicts that arise during the research process. It is an individual scientist's/engineer's duty to execute socially responsible and ethical research practices. However, promotion of such acts, criticism of wrongful deeds, and enforcement of appropriate regulations should spring from the understanding of the entire scientific community. In other words, it is not a problem of the personal conscience of an individual scientist/engineer, but of the scientific community's firm understanding of the broader socio-cultural context.

Research misconduct must be examined comprehensively, in any narrow sense, by a society Board of Directors to construct a basis for strict penalties and in a broad sense, to encourage respectable research practices. Vagueness of the philosophical boundary of research misconduct does not undermine the concept of research misconduct, but instead demonstrates the intimate connection, not contradictions, between freedom of research and misconduct regulations. By relating "freedom of research" with exterior

and interior regulations of the scientific community concerning research practices, including misconduct, one could encourage a positive attitude on the part of scientists and engineers toward the code of conduct for scientists and engineers.

The range of provisions for research integrity is subject to change according to circumstances and history, and even though research integrity promotion and misconduct prevention do not coincide, misconduct prevention should serve as a presupposition to research integrity promotion. However, the "regulatory approach," which assumes the acceleration of research integrity by intensifying regulations, does not correspond to the current reality; yet, it is irresponsible and unfair to simply reinforce regulations without any institutional measures that respect the view of the majority of scientists and engineers. Furthermore, reducing misconduct does not result in the revitalization of research integrity, and considering the collective structure of modern scientific research, it is not fair to criticize the conscience of the hapless field researcher without corresponding improvements to the research environment.

Researchers' responsibility and duty are not fulfilled only by a researcher's individual self-awareness and effort, but require an overall change in the atmosphere and structure of the scientific community or society as a whole. Hoping that in the age of science technology, a new plan to induce both individual responsibility and duty and responsible practice by the scientific community, as well as the participation by society at large would be included in a Code of Ethics: First, with the changing scientific research environment, researchers should first acknowledge the danger factor, an innate characteristic of scientific research, identify and estimate possible dangers, and diligently manage them. Second, researchers should try to remain unaffected by financial profit-loss calculations. Third, in order to prevent scientific misconduct, a strictly controlled research process and scientists and engineers' honesty are called for.

Fourth, scientific researchers can fulfill their responsibility by concisely and clearly explaining his research.

The invisibility of the individual in group-focused situations is real and individual scientists and engineers should be recognized as individual moral agents. In addition, since the only reaction available for an individual is to blow the whistle or resign, a firm protection system should be developed.

However, confusion may always arise due to the overlap between research ethics and ethics of science and engineering focusing the government's sole attention on research ethics problematic. Nevertheless, scientific research misconduct is a problem that cannot be regulated by general means but is a matter to be decided by scientists and engineers. A mature community, it should hold its own set of rules, and these rules should be brought forward and invoked for educational purposes. The role of scientists and engineers and engineers is very important in this problem-solving process, and therefore they should be actively engaged in the discussion. There needs to be positive ethics to which the entire scientific community could assent as well as fluid communication between scientists and engineers and the public. The current attitude of "let scientists and engineers deal with science and engineering problems," clearly demonstrates the exclusiveness of the scientific community and it is becoming more distant with the continuing specialization of scientific activities. The scientific community should initiate open communication with the public.

A *code of ethics* may mean that civil society dictates the conduct of scientists and engineers, yet scientists and engineers seem to respond indifferently towards it. However, scientists and engineers should conform to the common goal of society and moreover, create new values for civil society and try to arrive at a consensus in our society which eagerly pursues economic development.

A role of ethical-minded teachers, research supervisors or professors is to train scientists and engineers properly from the beginning, in school and in university (Chapter 3), to prevent further serious problems. Despite possible resistance due to the indifferent and disapproving view of scientists and engineers, who complain of more duties imposed, a code of ethics should be established and written in detail above the general level of conception. There are also issues related to reeducation of senior researchers and part-time researcher training. Regarding whistle blowing, the need for a consulting desk rather than anonymous reporting was needed to reduce the fear of consequences.

Many scientists and engineers are too occupied with their research to study or learn about research ethics on their own. Therefore, education is the most urgent issue.

Since there is not a clear distinction between misconduct and proper research, scientists and engineers should actively project ethical values and judge based on their common understanding as a group. That is the way to secure freedom of research. In this common understanding social values should be projected, and in reverse values respected in the scientific community should be diffused in society. This interaction between values and society is crucial, and it should be reflected in a Code of Ethics.

Scientific societies diverge in the roles they play regarding the promotion of ethical conduct among members of their disciplines.

There are at least three functions for scientific societies that are important to track and trace over time and across fields:

1. general education and professional development,
2. prevention and advisement, and
3. complaint handling and enforcement of codes of ethics.

While scientific societies vary in their levels of engagement in these three functions, they differ especially as to whether they are engaged in regulation of scientists and engineers within their disciplines.

These three functions are realized through a variety of specific activities including, but not limited to:

1. Production of code of ethics and other normative statements
2. Providing leadership internal to field of science and engineering (e.g., with departments)
3. Collaborating across fields of science and engineering and education
4. Providing leadership external to field (e.g., national science and engineering policy)

Scientific societies vary both in the activities they pursue and in their levels of effort. Also, activities can be high or low profile, symbolic or concrete. In addition, they can be implemented on a case-by-case basis or be part of a more systemic effort to address integrity and misconduct.

Studies of the actual practices of societies to encourage responsible research conduct and to avert misconduct are important. Research should include attention not just to the types of activities scientific societies pursue but also to the intensity of such efforts, the level of deliberativeness, and changes over time. Also, it is important to examine the indirect and direct effects as well as short-term and long-term influences of such activities on shaping professional knowledge, attitudes, and behavior.

5.7 Academic Freedom

Although not really a society, many universities develop their own culture and own laws so that they appear to outsiders to be a society and law unto themselves. Therefore,

because there are references to academic freedom elsewhere in this book, it is appropriate at this point to delve briefly into the realms of academia and the meaning of the term academic freedom.

The academic tradition emphasizes, "intellectual honesty and critical self-discipline with respect to:

1. the scholarship of discovery;
2. the scholarship of integration;
3. the scholarship of application; and
4. the scholarships of teaching" (Hamilton, 2002, page 42).

Furthermore, academic freedom has been defined as "a condition of work, designed to enable academics without suffering adverse consequences in their employment" (Tight, 1988, page 4). This allows for expanding the current horizons of knowledge. Academic freedom also exists in the ethical space between, "the autonomous pursuit of understanding and the specific historical, institutional and political realities that limit such pursuits" (Scott, 1996, 177). Such freedom allows researchers to uncover, discover, contradictions, discrepancies, and information that has not been formerly revealed (Robinson, 2001).

However, the nature and status of a university depends on the extent to which academic staff appreciates, understands and behaves in an ethical fashion while enjoying their academic freedom (Steneck, 1984). Furthermore, external pressures that force universities to be more competitive in the expanding marketplace can be and have been, "corrupting both of the spirit of the university and academic freedom" (O'Hear, 1988, page 16).

In addition, there is the thought that the accumulation of knowledge has been due to academic freedom but this is only partly true. One must not forget the accumulation of knowledge that occurs outside of academia in

governmental organizations and other non-academic (commercial) organizations. The contribution to knowledge of such companies as: ExxonMobil (USA), Eastman Kodak (USA), RIM (Canada), IMP (Mexico), IFP (France), BASF (Germany), Statoil (Norway), SASOL (South Africa), and the now-defunct Imperial Chemical Industries in Britain (as well as many other companies) cannot, and must not, be overlooked or underestimated.

In some instances and in a different realm of their operations, mainly because of the autonomy that they have been allowed, including the lack of a well-defined peer review system and the overall lack of accountability of the professors, universities may knowingly or unknowingly engage in unethical practices (Swazey et al., 1993). Issues of ethics generally occur on the boundaries of academic freedom and therefore raise questions about the need for discussion and consensus about the limits of academic freedom and, by extension, whether or not there should be limits to autonomy bestowed upon universities (Neave, 1988, page 39).

These issues have to be addressed within the notion relating to the definition of a university and focus on views of university functions, such as the development of critical thinking and participation in and improvement of the quality of life while promoting self-reflection (Metz, 2009, pages 179–80).

The modern university is an institution for teaching, learning, protection of the culture, contributor to economic growth and a knowledge factory which is a shift from the university as, "a simple community of scholars and students united by a search for a deeper understanding of nature of nature and humankind" (Pocklington and Tupper, 2002, page 5). Moreover, the university has become, "a series of specialized factions, disciplines, students and research activities united only by occupancy of a common territory..... factions though, independent, broker deals with each other,

undertake research that the public does not understand and utilize a language that the public cannot understand" (Pocklington and Tupper, 2002, page 4–6), while professors establish academic tribes and territories.

In such a context, academic freedom is synonymous with academic subjectivity as individuals utilize disciplinary jargon to justify their actions and guard their respective territories. The university has also been viewed as radical when in fact, it is most conservative in its institutional conduct," (Kerr, 2001, page 71). It is also seen as, "a law unto itself; the external reality is that it is governed by history," (Kerr, 2001, page 71).

To mitigate these issues (recalling that the prime mandate of a university is to teach and foster leaning in the students) universities today have to adjust in three major areas:

1. growth,
2. shifting academic emphases, and
3. participation in the life of the wider society (Kerr, 2001, page 81).

This requires that universities contribute to the creation of an environment that explores both a more complete understanding of education, and a culture (and practice) that take education to higher levels of ethics and morals.

Furthermore, since academic freedom is, "socially engineered spaces in which parties engaged in specific pursuits enjoy protection from parties who would otherwise naturally seek to interfere in those pursuits," (Menand, 1996, page 3) the accountability for such freedom has to be persistently monitored, which becomes conducive to self-regulation within the university.

In an era of increasing demands for accountability, universities must make an ethical commitment to justify their claims for institutional autonomy and academic freedom not only to those within their walls but also to those outside.

As a result of the inclination to defer to academic authority in earlier times (Haskell, 1996, page 55), those with academic authority were simultaneously obligated to preserve their integrity and disciplinary recognition.

Academic freedom evolved through several phases. In the early years, such freedom was constrained because of a combination of financial, political, moral and religious concerns. Intellectual exchanges were only supposed to occur between competent academics who would clarify differences between error and incompetence (Hamilton, 2002, 20). Academic freedom is rendered special because of self examination by the faculty in peer review (Hamilton, 2002, 21). However, one must ask if the peer review system within a university actually exists as a formal means of evaluating the performance of all of the faculty members as well as the review of all academic treatises prior to publication.

To many, both inside and outside of the university system, the concept of academic freedom, implies opportunities to choose what topics one wants to investigate and how far one wants to go in that regard. Choice involves acting on and sorting out whatever one wants by examining the consequences of each choice, which requires making decisions about means and ends (Stehr, 2008, 28). In the determination of means and ends, ethical factors must be considered.

Statements about academic ethics, as reflected in the Codes of Ethics of disciplinary bodies usually establish parameters to guide the actions of professors but, in general, a faculty member (especially a faculty member at the top of the professorial rank) is really free if he is the one who decides on courses of actions. This means that the professor is free to present any material (objectionable or not) he chooses to students in whatever manner he wishes.

This is where responsibility and accountability and such accountability must be manifested in the behavior of the professor, which is related to ethical conduct. Every academic becomes obligated or it is the duty of academics to

provide undergraduate and graduate students with certain assurances of ethical and moral behavior, hence, accountability, even though the concept of academic freedom implies that there are no boundaries to thoughts, words, and deeds as stated before. In fact this might be at least one reason why the credibility of academic institutions is being questioned, especially when individuality in academia begins to override the requirements of sociality and ethical behavior (Downing, 2005).

In summary, academic freedom means that a faculty member has the autonomy to teach, to perform research, and publish the results of that research but (what is often failure to recognize) within the boundaries of ethical and moral behavior. Students are good imitators of professorial behavior. What students see, students do.

Indeed, the mere act of engaging in unethical practices (which is not always covert) is also evidence of the fact that scientists and engineers (in academia or outside of academia) are not always rational (Chapter 9), although they may be able to rationalize their emotions.

Academic freedom must be used in an ethically acceptable fashion in teaching or research or both. Following a Code of Ethics is much more needed by an academic than an intellectual because the latter knows that he has the freedom of choice to produce, visualize and justify new ideas.

It is, however, the man by which this freedom of choice (i.e., academic freedom) is followed and practiced.

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