Society for Scientific Values

Ethics in Scientific Research Development and Management

News And Views

Special Issue on Guidelines of Academic Ethics

Let Truth Prevail

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Main objectives of the 'Society for Scientific Values'

1. **To promote objectivity, integrity and ethical values in pursuit of scientific research, education and management.**
2. **To discourage the unethical acts in these areas.**

Website: scientificvalues.org

Editorial

News & Views, after a hiatus of two years, is coming again in the electronic form in this issue. This special issue is a compilation of the guidelines on Academic Ethics, formulated by international and National Science bodies. We do hope that a larger audience will be benefited in adhering to scientific and academic ethics from this issue. It is the interest of the Society for Scientific Values (SSV) that such scientific and ethical values are upheld by the academic and scientific community in particular and society in general. The editor and SSV gratefully acknowledge the help provided by Prof. A. K. Singhvi to make this issue possible. The articles are available on the internet as given in the web links and reproduced with permission from concerned authorities, our thanks to all of them.

Santa Chawla

SSV activity highlights in the current period

The Annual General Body (AGM) meeting of SSV was held on Jun 10, 2019, at CSIR National Physical Laboratory, New Delhi, for electing new Office bearers and EC members for the period 2019-22. New Executive Council (EC) members were elected and names of special invitees to EC were consented upon. The names of the office bearers of SSV are given overleaf. First meeting of the newly elected EC (98th EC meeting) was conducted following the AGM.

Academic Ethics – an issue of increasing concern

The issues of academic and scientific ethics have been matters of great concern for international as well as Indian academic and scientific organizations. Indian National Science Academy (INSA), Indian Academy of Sciences (IASc) and Council of Scientific & Industrial Research (CSIR) have formulated guidelines for ethics in science, research and governance. For ready references, some of the links of documents of international as well as national bodies are listed below.

1. **World Commission on the Ethics of Scientific Knowledge and Technology (COMEST).**

'Ethical Perspective on Science, Technology and Society: A Contribution to the Post-2015 Agenda'
(https://unesdoc.unesco.org/ark:/48223/pf0000234527)

2. **International Science Council**

'Standards for Ethics and Responsibility in Science - an Empirical Study'
The Standing Committee for Responsibility and Ethics in Science (SCRES)
(https://council.science/wp-content/uploads/2017/05/SCRES-Standards-Report.pdf)

'Standards for Ethics and Responsibility in Science: An analysis and evaluation of their content, background and function'
(https://council.science/wp-content/uploads/2017/05/SCRES-Background.pdf)

3. **The National Academies of Sciences, Engineering, Medicine**
(https://www.nap.edu/search/?term=Ethics)

4. **Indian National Science Academy (INSA)**

'ETHICS in SCIENCE EDUCATION, RESEARCH AND GOVERNANCE'
Edited by K Muralidhar Amit Ghosh AK Singhvi
(http://insaindia.res.in/pdf/Ethics_Book.pdf)

5. '**National Policy on Academic Ethics'**

Formulated by the office of the Principal Scientific Adviser (PSA),Government of India, with feedback from the Indian National Science Academy (INSA) and the Indian Academy of Sciences (IASc).

https://indiabioscience.org/policy-resources/resources-on-research-ethics/national-policy-on-academic-ethics

(https://www.ias.ac.in/public/Resources/News/NPAE.pdf)

6. **Indian Academy of Sciences (IASc)**

'Scientific Values: Ethical Guidelines and Procedures'
https://www.ias.ac.in/public/Resources/Other_Publications/Overview/EthicalGuidelines_20190204.pdf

7. **Council of Scientific & Industrial Research (CSIR)**

'**CSIR Guidelines for Ethics in Research and in Governance'**
(https://csirhrdg.res.in/SiteContent/ManagedContent/ATContent/20200407155759201OM%20Ethics%20Guidelines.pdf; https://www.csir.res.in/sites/default/files/OM%20Ethics%20Guidelines28-02-2020.pdf)

8. **Australian guidelines**
'Australian Code for Responsible Conduct of Research'
Published: 2018
Publisher: National Health and Medical Research Council
NHMRC Publication reference: R41
Online version: www.nhmrc.gov.au/guidelines/publications/r41

'Authorship: A guide supporting the Australian Code for the Responsible Conduct of Research'
Published: 2019
Publisher: National Health and Medical Research Council
NHMRC Publication Reference: R41C
ISBN Online: 978-1-86496-034-1

'Guide to Managing and Investigating Potential Breaches of the Australian Code for the Responsible Conduct of Research'
Published: 2018
Publisher: National Health and Medical Research Council
NHMRC Publication Reference: R42
Online version: www.nhmrc.gov.au/guidelines/publications/r42
ISBN Online: 978-1-86496-017-4

'Management of Data and Information in Research: A guide supporting the Australian Code for the Responsible Conduct of Research'
Published: 2019
Publisher: National Health and Medical Research Council
NHMRC Publication Reference: R41B
ISBN Online: 978-1-86496-033-4

9. **THE ETHICS OF SCIENCE An Introduction by David B.Resnik**
First published 1998 by Routledge, 11 New Fetter Lane, London EC4P 4EE
Later edition published in the Taylor & Francis e-Library, 2005.
(http://www.partsstop.com/the_ethics_of_science_an_introduction_philosophical_issues_in_science.pdf)

10. **What Is Ethics in Research & Why Is It Important?**
by David B. Resnik, J.D., Ph.D., December 23, 2020
(https://www.niehs.nih.gov/research/resources/bioethics/whatis/)

11. **Ethics in nanomedicine**
By David B Resnik,Sally S Tinkle (https://pubmed.ncbi.nlm.nih.gov/17716179/)

12. **The Ethics of Research with Human Subjects.** Protecting People, Advancing Science, Promoting Trust. By David B Resnik (https://www.springer.com/gp/book/9783319687551)

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World Commission on the Ethics of Scientific Knowledge and Technology (COMEST)

Ethical Perspective on Science, Technology and Society: A Contribution to the Post-2015 Agenda

Report of COMEST

SHS/YES/COMEST-8EXTR/14/3
Paris, 31 July 2015

Science governance and the science-society relationship are long-standing concerns in UNESCO and have been part of the work of the World Commission on the Ethics of Scientific Knowledge and Technology (COMEST) since its inception. The general orientation of the Commission's current reflection on this topic was adopted following detailed discussion at its Extraordinary Session in November 2008, and successive drafts of the present document were considered at subsequent Ordinary and Extraordinary Sessions from 2009 to 2013. At its 8th Ordinary Session in May 2013, COMEST considered a revised draft of the present document and gave a mandate to its Science Ethics Working Group to finalize it. The finalized draft, entitled Ethical Issues in Science Governance and the Science-Society Relationship was presented and discussed during its 8 th Extraordinary Session in October 2014. COMEST then decided to reflect this discussion in finalizing the document, and tasked the Working Group to revise the report in order to turn it into a "working document" that will be related to the revision of the Recommendation on the Status of Scientific Researchers (1974).
COMEST also decided to rename the report to Ethical Perspective on Science, Technology and Society: A Contribution to the Post-2015 Agenda. The revised document was presented to the entire Commission after the Extraordinary Session and was adopted via email in July 2015.

ETHICAL PERSPECTIVE ON SCIENCE, TECHNOLOGY AND SOCIETY: A CONTRIBUTION TO THE POST-2015 AGENDA

DRAFT REPORT OF COMEST

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ETHICAL PERSPECTIVE ON SCIENCE, TECHNOLOGY AND SOCIETY: A CONTRIBUTION TO THE POST-2015 AGENDA

DRAFT REPORT OF COMEST

I. INTRODUCTION

1. Concerns about science governance and the science-society relationship are long-standing in UNESCO and have been part of the work of COMEST since its inception. The present report articulates the outcomes of a series of activities and reflections designed to respond to a resolution adopted at the 2005 UNESCO General Conference requesting the Director-General to review existing ethical frameworks and normative instruments and report on the advisability of elaborating an "international declaration on science ethics" to serve as a basis for an "ethical code of conduct for scientists".[1] The context of this resolution was given by concerns about the substantive relevance and normative status of such existing instruments as the Recommendation on the Status of Scientific Researchers (1974) and the Declaration on Science and the Use of Scientific Knowledge [2] (1999). COMEST at its 4 th Ordinary Session (March 2005) adopted a recommendation including a proposal to undertake a feasibility study on elaborating an international declaration on science ethics that was taken note of by the General Conference. But in 2006, rather than developing a new normative instrument, UNESCO was invited to work towards a general ethical framework to guide scientific activity.

2. The general orientation of the present document was adopted following detailed discussion at an Extraordinary Session in November 2008 and successive drafts were considered at subsequent Ordinary and Extraordinary Sessions from 2009 to 2013. At the 8th Ordinary Session, held in Bratislava, Slovakia, in May 2013, COMEST considered a revised version of the present document and gave a mandate to the Science Ethics Working Group to finalize it. The finalized draft, entitled Ethical Issues in Science Governance and the Science-Society Relationship was presented and discussed during its 8th Extraordinary Session held in Québec, Canada in October 2014. COMEST decided to reflect its discussion during this session in the final document, as well as to rename the report to Ethical Perspective on Science, Technology and Society: A Contribution to the Post-2015 Agenda, which was eventually revised and adopted by the Commission in July 2015.

3. In parallel, COMEST has been closely involved with the UNESCO process to monitor and to consider the desirability of revising the Recommendation on the Status of Scientific Researchers (1974)[3] (hereafter "the 1974 Recommendation"). COMEST was also associated with the Preliminary Study on the Technical and Legal Aspects Relating to the Desirability of Revising the 1974 Recommendation, which was prepared by an Ad Hoc Expert Group including six individual members of COMEST. At the 8th Ordinary Session in 2013, COMEST endorsed

the draft Preliminary Study, on the basis of the final version of which the General Conference decided in November 2013 that a process to revise the 1974 Recommendation should be initiated. While institutionally separate from the present report, consideration of the desirability of revising the 1974 Recommendation raises many of the same ethical issues as those associated more generally with science governance and the science-society relationship.

4. Furthermore, the United Nations (UN) Post-2015 Agenda analysed the threats and challenges of the world situation (climate change, growth of human population, widening inequalities, etc.) and proposed ways to modify these trends in order to improve specific situations. Science, technology and innovation policies constitute one of the objectives of the agenda. The present document should also be considered as a contribution from COMEST highlighting specific ethical issues related to new dynamics of science and technology in relation to society.

5. “Science ethics” refers to the principles according to which scientific activity should be conducted and to the mechanisms by which conformity to such principles is promoted, fostered or ensured. An ethical approach to science shows that the quest for knowledge and understanding incorporates essential ethical values, such as integrity, truth and respect for reasoned argument and evidence. The criteria for what counts as “good science” are, in part, ethical. Such values are universal in the sense that they command broad acceptance, at a general level, across disciplinary, national and cultural boundaries. They have, indeed, been explicitly recognized in international normative instruments.

6. There is, on the other hand, discussion on how such rules should be applied to specific circumstances. The idea of science is compatible with multiple interpretations of what it entails, and diversity is therefore indispensable in the practical implementation of science ethics. The pressure under which science is conducted nowadays may weaken the ethical values of honest inquiry. Furthermore, public support for science depends on the perception that knowledge is not only pursued diligently and impartially for its own sake, but also contributes to broader human needs or well-being. Science thus connects to external values that neither clash with nor simply duplicate its own internal logic.

7. The field of science ethics is broad and in some respects controversial. It concerns not just professional scientists but also all those with responsibility for research policies and the communication of scientific knowledge to relevant audiences. It is thus considerably broader than “research ethics”, which refers only to one specific area of professional conduct.

[1] 33 C/Resolution 39. Records of the General Conference, 33 session, Paris, 3-21 October 2005, Vol. 1, Resolutions, UNESCO, 2005, p. 81. [http://unesdoc.unesco.org/images/0014/001428/142825e.pdf].

[2] The Declaration on Science and the Use of Scientific Knowledge was adopted by the participants in the World Conference on Science for the Twenty-first Century: A New Commitment on 1 July 1999 in Budapest, Hungary. [http://www.unesco.org/science/wcs/eng/declaration_e.htm].

[3] The text of the Recommendation on the Status of Scientific Researchers (1974) is available on UNESCO website:
http://portal.unesco.org/en/ev.php-URL_ID=13131&URL_DO=DO_TOPIC&URL_SECTION=201.html .

8. The thematic and disciplinary scope of science ethics is also broad. As defined by Article 1(a)(i) of the 1974 Recommendation, science "signifies the enterprise whereby mankind, acting individually or in small or large groups, makes an organized attempt, by means of the objective study of observed phenomena, to discover and master the chain of causalities".[4] There might be scope for debate whether this view of science extends to the human sciences, where the notion of "causality" may not be appropriate. In addition, current debates in epistemology might call into question the kind of "objectivity" taken for granted in 1974. Nonetheless, the emphasis on science as a socially organized activity characterized by its structures and procedures ensures that the definition is inclusive with respect to the many different ways of doing science.

9. The structure of this report reflects the concerns summarized above. Its purpose is not primarily to consider the basic ethical principles by which science should be guided, since these have already, to a large extent, been enshrined in international normative instruments. Reflection on principles should therefore proceed with a view to clarifying, and where necessary extending, the existing ethical framework. Principles, however, have little weight if they are neither implemented nor embedded in routine scientific practice. In addition to long-standing implementation gaps, there may be new challenges that put specific pressure on ethical scientific behaviour. It is on making ethical principles real, with due sensitivity to the contemporary context of science, that this report concentrates its attention.

10. The second section describes the new dynamics of scientific activities and the various forms of science-society relationship that emerged. The third section identifies the key principles in relation to these new issues. The fourth section settles priorities in the governance of science.
The conclusion is a summary of the report.

II. CHALLENGING NEW DYNAMICS

11. Science and technology are currently in a process of rapid change. Change relates to areas of research that offer the potential for powerful new interventions in the fabric of matter and of life, with possible world-changing applications.

12. In addition, however, change is institutional and social. Forms of academic

[4] Article 1(a)(i) of the 1974 Recommendation further stresses this point by adding two additional features to the definition. First, science "brings together in a coordinated form the resultant sub-systems of knowledge". The various sciences are thus explicitly components of science. Secondly, science provides humankind with knowledge that it can use "to its own advantage". No definitional line is drawn, therefore, between science and technology or between basic and applied science. Finally, Article 1(a)(ii) explicitly states, for the avoidance of doubt, that "The expression 'the sciences' (...) includes the sciences concerned with social facts and phenomena", at least in so far as they comprise "a complex of fact and hypothesis, in which the theoretical element is normally capable of being validated".

and scientific organization established in the 20 th century have been reshaped and in some respects transformed. What it means to be a scientist in 2015 is not what it meant in the 1930s with figures such as Albert Einstein and Marie Curie, or even in the 1960s with figures like James Watson, Francis Crick and Jacques Monod.

13. Cultural meanings and social understandings of science have themselves shifted, in part for very familiar reasons related to developments in the 20 th century, through the deployment of science and technology, of weapons of mass destruction, but in part also for broader and more elusive social reasons that have to do with changing notions of authority and with the erosion, at least in Western Europe and North America, of modern faith in science and progress.

14. This reflects a background of certain fear of science and technology in Western societies. For example, the social dynamics of the debate on “human enhancement” and “post- humanism”, as well as concerns about specific misuses of technology and moreover about unknown risks for humans and the environment are different forms of this fear of scientific innovation.

15. The concept of “technoscience” is helpful in making sense of these trends. It aims at summarizing a new conception of science intrinsically related to technological devices and its relation to society that entails a growing orientation of science – and of public thinking about science – towards technological applications. At the same time, science is more complex and specialized and involves greater levels of uncertainty. Technoscience is also more global, more economically oriented and more privatized than more traditional modes of organization of knowledge production.

16. This new conception of the role of science and technology in economic development progressively arises and has influenced both policies and institutional practices since the 1990s. Research is now regarded as key factor of innovation and thus as a priority issue in economic competitiveness. As a result, research funding and the status of researchers are increasingly shaped by considerations of efficiency and competitiveness that are not directly related to the content of scientific activity itself. The tendency to more quantitative evaluation of individuals and institutions, which underpins the fashion for ranking institutions, scientific journals and publications, is in turn a direct consequence of this trend. Finally, issues of political control – which have never been absent from science and technology especially concerning military research – apply to a much broader range of knowledge processes.

17. It is the comprehensive and far-reaching nature of these new dynamics which emerged during the 20th century that requires adjustments both in principle and in practice of the science-society relationship. The following sections provide more detailed analysis of some of the most significant new dynamics.

II.1 Scientific and technological change

18. Quite apart from the changing social and institutional context, the internal development of science itself is producing new ethical challenges. These may require new principles or refinement of existing principles with also new mechanisms for the institutionalization of ethics that are adapted to a changed environment. Key scientific changes tend to fall into three interrelated categories.

19. First, scientific and technological development throws up new objects that may have ethical implications. For instance, it should be considered whether nanoscale manipulation of matter (nano-object) or living being ("artificial life" in synthetic biology) raises specific issues even without reference to actual or hypothetical technological applications. Aspects of this discussion are epistemological, but are related to ethics. In particular, the nature of knowledge relates closely to the responsibilities attendant on its possession.

20. Secondly, and much more importantly in light of current concerns in public debate, scientific and technological development produces new capacities for action and therefore new risks of ethically undesirable consequences, whether intended or unintended. Examples are familiar with areas in which science and technology give rise to new fears and new expectations. The possibility that new technologies might, through deliberate use or accidental release, cause serious and irreversible harm calls for new forms of vigilance that affect both the burden and the standard of proof. In particular, it is a major challenge – exemplified by debates on nanotechnology, genetically modified crops, nanofoods and on atmospheric and electromagnetic pollution – to establish scientifically sound ways of dealing with public debates about competing unproven hypotheses that claim to demonstrate or to dismiss harmfulness.

21. Thirdly, new scientific and technological developments may reshape the professionallandscape of science in ways that challenge established institutional ethics procedures. A relevant example in this respect is converging technologies: the reshaping of connections between areas of technology might undermine or destabilize existing ethical frameworks. For example, codes of conduct or ethical codes based on disciplines and enforced by disciplinary scientific associations might be rendered obsolete by people working in cutting-edge converging technology, whose work may escape existing normative frameworks or regulations. There is a need, therefore, to adapt on an ongoing basis the institutional framework guiding scientific conduct in order to ensure that cutting-edge research is not escaping the purview of ethics. Adaptation at this level should be one important component of follow-up of international normative instruments such as the 1974 Recommendation and the Declaration on Science and the Use of Scientific Knowledge (1999). Action at a global level may be required to make scientists aware of their social responsibilities and to help Member States develop and implement mechanisms to inform about the pros and cons of such technological developments.

II.2 Scientific integrity and social benefits in new social and institutional contexts

22. Science is also a social activity. To be a scientist is to be a certain kind of professional, and not simply to be the producer of a certain kind of knowledge. Therefore changes in the social or institutional context within which science is conducted have consequences for science.

23. Many of the significant changes that have occurred in recent decades are a consequence of the considerable expansion of student numbers along with forms of globalization that have combined to erode traditional academic communities and self-understandings. It has also undermined the historically constituted basis of scientific integrity. The challenge is that any global standard of integrity now needs to incorporate a greater diversity of cultural practices and value systems than in the past.

24. Expansion and globalization have also coincided with growing commercial pressures, due to the movement towards privatization, greater pressure to rank and to evaluate researchers and institutions, public funding retrenchment in higher education and research, and the high profitability expectations associated with cutting-edge development (for example, nanotechnology, biotechnology). One practical consequence has been a tendency towards contractualization of scientific research, with conditions attached that may conflict with traditional principles of open access and public benefit. Furthermore, it can be highly tempting, especially in the context of international cooperation, to engage in what has been termed "ethical dumping", i.e. locating research deliberately in the jurisdictions where the lowest ethical standards apply, notably with regard to informed consent on the part of subjects and stakeholders[5] or to environmental risks assessment.

25. In so far as privatization may be one aspect of contractualization, the question remains whether mechanisms for implementation of ethical principles can apply in the same way to privately funded research. It is at least conceivable, therefore, that current modes of institutional organization of science, including such features as large-scale cooperation, capital-intensive "big science", confidentiality requirements and evaluation-driven pressures on scientists, might tend to erode ethical standards. They certainly make it unrealistic to regard ethical science as something that can be achieved through, or even defined in terms of, purely individual attitudes and behaviour.

26. It is under discussion whether the frequency and severity of scientific research misconduct – fabrication, falsification and plagiarism – and of questionable research practices have increased. The problems are certainly more extensively studied and investigated. Further research is undoubtedly

[5] This issue is further discussed, with reference to the work of the OECD Global Science Forum, in section III.3 below.

needed to improve knowledge not just of the nature and frequency of misconduct but also of the social and institutional conditions that encourage or discourage ethical conduct in science.

27. Finally, new expectations addressed to science point towards the need for a more expansive conception of science ethics.

28. One example is heightened expectations in connection with environmental issues, with respect to which science is called upon both to enable societies to understand the threats they face and to provide tools to counter such threats and to minimize their impact. These issues are of particular significance in developing countries, the territories of which include a large proportion of the natural goods (fauna, flora and mineral resources). From an ethical perspective, the much-discussed precautionary principle is exemplary of this new context.[6] Broader conceptions of risk and uncertainty are current within contemporary societies and create challenges not just for the predictive capacity of science but also for its ability to maintain public trust. While there is general agreement that science should take responsibility for its unintended consequences and contribute to sustainable development via the capacity of humankind to deal with ever more complex and long-range causal chains, specific responsibilities of scientists or scientific institutions in this regard are questioned.

29. Science and technology are also expected to contribute to the achievement of key social goals and values still connected to the idea of “progress”. However, their content has undoubtedly changed, first because progress is no longer taken for granted as an outcome of scientific endeavour, and secondly because the goals and values at stake are increasingly diverse, and perhaps contested. A particularly important area of debate is the relation between science and the economy. Concern that science stands in excessively close connection to economic values leads to questions about the ethically desirable relation between science and human values. In this respect, ethical issues in relation to science are closely connected to broader social issues about equity and inclusion.

30.The trends described above have several potentially damaging implications, which may need to be counteracted by specific response measures. Scientists may have limited control over their own intellectual agendas, which are set more and more by the priorities of external funding agencies. Similarly, scientists everywhere may be hampered in pursuing research that does not fit into currently fashionable directions, whether defined thematically or in terms of scale and scope. “Big science” is indispensable in certain areas; it may be much less relevant in others. Finally, as noted above, the way in which research careers are evaluated is highly significant for the way in which science is actually done, and may bias intellectual activity in a number of ways.

II.3 Tensions between private and public interests

31. A primarily public conception of science has long been dominant and has shaped science institutions in most countries. In this conception, of which the influential 1947 report Science: the Endless Frontier by Vannevar Bush[7] was one powerful statement, the state has a leading role in setting priorities, in channelling funding and in establishing institutions to enable the internal dynamic of science to flourish. In playing its role, the state can also ensure that large-scale public projects of strategic importance are effectively implemented and their social benefits harnessed. The scientific institutions that emerged in the mid-20th century in most countries, including developing countries after independence, followed a similar generic pattern.

32. The role of the private sector followed the same template and was based on similar epistemological and organizational principles. The major role of corporations such as IBM, Bell and Xerox in funding high-quality basic research is well-known.

33. In the last 30 years, this framing conception of science, along with the institutions and social representations attendant on it, has been profoundly transformed. Henceforth, in a context of relative public retrenchment, private corporations have a major role, in science as in other areas, in shaping processes, institutions and outcomes that may be inadequately regulated.

34. In addition, the shifting balance between public and private funding – which is just one dimension of the change – has consequences for the institutional organization of research and for the status of researchers that require both better empirical assessment and enhanced ethical reflection. Among issues that might deserve detailed consideration in this regard are the freedom and autonomy of researchers; their employment rights, in particular at doctoral and postdoctoral level; the implications of project funding; and the consequences of competition between institutions, notably through rankings.

II.4 Divisive globalization

35. Science does not function in isolation from other global trends that are tending to reconfigure and in some respects sharpen inequalities. A challenge for ethical thinking is thus to interpret general principles in light of social settings that hamper equitable benefit sharing.

36. In addition, in practice, the ethical framework for science does face other

[6] Cf. COMEST, The Precautionary Principle, Report. Paris, UNESCO, 2005. [http://unesdoc.unesco.org/images/0013/001395/139578e.pdf].

[7] Science The Endless Frontier. A Report to the President by Vannevar Bush, Director of the Office of Scientific Research and Development, July 1945, Washington, United States Government Printing Office, 1945. [https://www.nsf.gov/od/lpa/nsf50/vbush1945.htm].

challenges of implementation in developed countries. Yet it is equally important to consider the status of researchers in the developing world.

37. It is important to emphasize, furthermore, that global divides do not operate just between countries, but also at the global level between a range of different actors, issue areas and processes.

38. With respect to the social sciences, the 2012 World Social Science Report noted a series of overlapping divides.[8] Many of these apply equally to the physical and life sciences, although the relation between lay and professional knowledge is undoubtedly different in the latter cases.[9] The list, and the comments below, may serve as a reminder of the complexity of the issues under consideration:

- geographical divides (the most familiar and obvious, although it is equally true that the geography of science has changed considerably over the past 20 years);
- capacity divides, including between institutions in the same country;
- unequal degrees of internationalization of knowledge production across disciplines and knowledge areas;
- disciplinary divides, in a context where significant moves towards transdisciplinary science are in evidence in certain areas;
- the divide between mainstream and alternative approaches;
- divides produced by the increasingly competitive nature of research, embedded in new management practices;
- divides between academics, policy-makers and society, which are among other things linguistic in nature;
- divides within societies with respect to their conceptions of science and attitudes towards its applications, which are in some cases (e.g. climate change, biotechnologies) highly polarized.

39. These divides need to be taken into account. Those that are of ethical significance need to be overcome, or at least reduced, lest they preclude any serious realization of the human right to share in scientific advancement and its benefits.

40. International, intergovernmental and multinational actors have a growing role in the funding of research, and thereby also shape its priorities and structures. Furthermore, such actors may exert a powerful influence over outcomes, and in particular the ways in which research is used, not least through the elaboration of rules on trade and intellectual property rights.

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[8] International Social Science Council (ISSC), 2010, *World Social Science Report*, 2010. *Knowledge Divides*. ISSC/UNESCO Publishing. [http://unesdoc.unesco.org/images/0018/001883/188333e.pdf].

[9] For more systematic and geographically differentiated discussion, see the UNESCO Science Report, 2010. The Current Status of Science around the World, UNESCO Publishing, 2010. [http://unesdoc.unesco.org/images/0018/001899/189958e.pdf].

41. The challenges that arise from the globalization of science, technology and innovation are of several kinds. In essence, they are not so much distinct from the challenges discussed in the previous section, which occur at all levels of society and vary according to institutions.

42. The first set of challenges relate to "ethical dumping" and regulatory gaps, in other words to issues that, because they cross boundaries and involve entities subject to different jurisdictions, end up escaping regulation altogether, either in the strictly legal sense that they are beyond the law, or in the practical sense that no effective mode of regulation is available. There are also regulatory gaps that relate to intellectual property, to certain forms of experimentation (for instance, with respect to geo-engineering), and to health, safety and risk assessment (for instance, with respect to potential cross-border propagation of controlled substances).

43. A second, rather different set of challenges concerns policy issues such as priority setting, funding, evaluation, organization of public debate, etc., which are not in the strict sense regulatory. While scientific practice is increasingly globalized, science policy remains primarily national, with some significant regional exceptions such as in the European Union. In which respects such absence of policy coordination might have ethical implications is a matter that deserves further discussion.

44. Governance of science must thus be conceived at several distinct and interlocking levels, including the much expanded group of states that are major actors in science and technology, the global and regional institutions with competence in various areas relevant to science governance, and non-state actors including powerful multinational corporations.

II.5 Development ethics and social inclusion

45. Article 27(1) of the Universal Declaration of Human Rights (1948)[10] has an inherently distributive character and thus bears directly on issues of social justice. Failure to give substance to the right to participate in science, on the basis of fair opportunities, and to enjoy the benefits of technology as well as to assess their risks, constitutes a primafacie injustice as does, at a systemic level, failure to promote an institutional framework within which the right is likely to be realized.

46. While these considerations are abstract, as argued above, technoscience in the context of globalization impedes equitable benefit sharing in specific and ethically challenging ways.

[10] The official website of the Universal Declaration of Human Rights contains 443 different translations of its text in various languages and dialects: http://www.ohchr.org/EN/UDHR/Pages/Introduction.aspx .

47. Differential access to the scientific process and to the applications of technology thus leads to social exclusion within societies and to unequal development opportunities between them. Development ethics[11] tackles these issues. Development is understood as a way to liberate people from various servitudes, to enhance environmental protection and development, and promotes a more just global order. Development ethics encourages empowering communities and individuals to take responsibilities for their lives and to become closely involved in taking decisions on all problems which determine their current reality and desired future.[12] In this perspective, the concept of development is seen as beyond economic growth and incorporates political, social, technological, moral, intellectual, and other aspects of the cultural whole. Development is then required to transform the victims of underdevelopment into conscious subjects and makers of their history.

48. Ethical consideration of development has a number of interlocking dimensions – including such areas as trade, finance and global governance – and the role of science and technology is of central significance, especially perhaps in the emerging areas of converging technologies.

49. These issues go to the heart of science governance and the science-society relationship. They cannot be reduced to linear "applications" of science, but rather bring into play complex configurations of policy environments, commercial pressures and societal expectations that are value-laden and potentially value-transformative. They are thus inherently ethical.

III. KEY PRINCIPLES AND ISSUES

50. Science does not lack an ethical framework. Its basic principles are well-established, and have been enshrined in numerous international documents, some with legal force, as well as a wide range of statements, codes, declarations and other frameworks adopted by institutional and professional communities.

51. However, even with respect to the traditional challenges of taking seriously article 27 of the Universal Declaration of Human Rights, the science ethics

[11] Development ethics is an interdisciplinary field that studies the ends, means, and processes of local, national, international and global development. According to Denis Goulet, development ethics is a dialogic eclecticism, which, "masters not only its own philosophic discipline, but is well conversant with the sciences of economics, sociology, politics, agronomy, and all upon which it depends" (Denis Goulet, Development Ethics at Work Explorations – 1960-2002 (Routledge Studies in Development Economics), First Edition, p. 6, Oxon and New York, Routledge, 2006).

[12] Although Denis Goulet was reluctant to propose what he takes to be the final and authoritative moral answers, as he favours the communities to decide for themselves, he is committed to and advocates "the values for which oppressed and underdeveloped groups struggle: greater justice, decent sufficiency of goods, access to the collective gains realized in domains of technology, organization, research, etc.". Cited in David A. Crocker, "Forward", in Denis Goulet, Development Ethics at Work Explorations – 1960-2002 (Routledge Studies in Development Economics), First Edition, p. xviii, Oxon and New York, Routledge, 2006.

framework is still limited in regard to new dynamics. Since the existing international framework is incomplete and only partly operative, it is an open question whether established principles require development, expansion, refinement and perhaps even revision in light of changing circumstances or emerging ethical challenges.

52. There is a body of internationally agreed ethical principles for science, as thus broadly defined, that includes universal normative documents (e.g. the 1974 Recommendation, the Declaration on Science and the Use of Scientific Knowledge (1999)); regional agreements (e.g. within the European Union and the African Union); and agreements on matters other than science ethics that include principles of direct relevance to science ethics (e.g. the Convention on Biological Diversity (1992)). While these principles are of continuing relevance, and provide valuable guidance for practical action to support a general ethical framework for scientific conduct, they are neither complete nor fully consistent. The extensive network of complementary principles adopted in professional or institutional settings helps to provide a more complete framework but, given their diversity and lack of coordination, such principles do not guarantee consistency. Furthermore, their authority typically does not extend beyond those individuals or institutions that have subscribed to them.

53. There is thus no comprehensive normative instrument that deals exclusively with science ethics and addresses all aspects of the subject. As a result, any attempt to analyze the existing normative framework must start from a disparate set of documents, adopted at different times and levels and for different purposes, and the content of which is not coordinated. For instance, the Declaration on Science and the Use of Scientific Knowledge (1999) makes no reference to the 1974 Recommendation, even though they cover much of the same ground.

54. Unsurprisingly, the various components of the existing normative framework dovetail imperfectly. In some cases, different documents may overlap, with the result that distinct and possibly incompatible principles may apply to the same issue. In other cases, there may be gaps covered by none of a range of potentially applicable instruments. The likelihood of such gaps is increased by the dynamic of scientific and technological change, which, as argued in section II, redraws the boundaries of disciplines and scientific fields.

55. Furthermore, even considered in isolation, some normative instruments may appear dated or even obsolete. This affects not so much the general principles they state, which are as durable as the basic conception of science that underpins them, as the language in which they are expressed, the institutional setting they presume, and the mechanisms they are related to. The 1974 Recommendation is particularly open to challenge in this respect, which explains the decision by UNESCO to initiate its revision.

56. Finally, certain issues of major contemporary relevance appear inadequately covered, at least by the 1974 Recommendation, which, in particular, predates the notion of sustainability as currently emphasized in international thinking on environmental issues. In so far as sustainability is itself an ethical principle, involving responsibility for assessment of the impact of current choices on the unknown interests and values of future generations, this gap is an important one, that is only partly filled, with respect to science ethics, by the later provisions of the Declaration on Science and the Use of Scientific Knowledge (1999) or of instruments not specific to science ethics, such as the United Nations Framework Convention on Climate Change (1992) or the Convention on Biological Diversity (1992).

57. While the principle of sustainability is uncontroversial as a general ethical principle relating to the satisfaction of human needs over time, it is important also to note that sustainable development constitutes a knowledge regime that goes considerably beyond its core. Sustainable development serves as a banner for scientists, as a source of international funding, as a new knowledge market, and as a basis for authority claims based on the observation that management of the global commons requires urgent attention. These questions are reflected in different ways in developing countries.

58. Principles that might facilitate ethical framing of such issues, in particular bioethics and environmental ethics, are available in various international statements and agreements that are not explicitly ethical in scope, such as the UN Millennium Development Goals. Such statements and agreements can help to identify principles that could contribute to a general ethical framework to guide scientific activity.

59. What this entails for science ethics at the international level is the need to establish a basis for practical discussion, involving all relevant stakeholders and taking account of the very different levels at which ethics may call for institutionalization, on the new ethical developments that may be required by contemporary social pressures or by the internal logic of ethical deliberation itself.

60. The following sections offer some brief indications on the issues that need to be addressed in the elaboration of a more comprehensive and up-to-date normative framework for science ethics.

III.1 Producing and sharing benefits and managing risk

61. The general question of benefit sharing has already been referred to (section II.5 above), and the overarching ethical principle that applies to it, derived from article 27(1) of the Universal Declaration of Human Rights, is well-established and widely recognized.

62. Applications in specific areas, on the other hand, raise issues that require further consideration. The example of nanotechnologies is instructive in this regard. Nanotechnologies are still in an early stage of development and there are still opportunities to be prospective and anticipatory in identifying ethical issues that may emerge. In addition, the impact of nanotechnologies is global. As industrial and commercial development proceeds, the focus is gradually moving from possible technological futures, with a view to better understanding of the scientific potential and possible societal impact of new developments, to the regulation of conduct in areas of science where cutting-edge agendas are already being pursued. Thus, to take just one interesting example, the European Commission Recommendation on a code of conduct for responsible nanosciences and nanotechnologies research[13] specifically calls upon research funding agencies to refrain from funding research in certain problematic areas and, calls upon "responsible" researchers to abstain from engaging in such research. This exemplifies the connection between ethical concerns about science and technology and science ethics in the strict sense. However, the practical emphasis on nanotechnologies should not be interpreted as a statement that this area is of unique or overriding importance from an ethical perspective.

63. Earlier work of COMEST emphasized state-of-the-art review and conceptual development,[14] awareness raising[15] and reflection on policy implications[16]. Noting that the invisibility and rapid development of nanotechnologies, their possible military and security uses and global impact, and the risk of a "nano-divide" between the developing and developed countries, give rise to specific ethical concerns, COMEST pointed to four areas of action: articulating an ethical framework, awareness raising, ethics education, and research and development policies. Nanotechnologies should be regarded, in this respect, as one set of issues to which a general ethical framework to guide scientific activity needs to apply. Conversely, science ethics principles developed to address specific features of nanotechnologies should be considered as prima facie applicable to other areas with similar background features. Many such areas, including the general field of "convergence", imply overlap between science ethics and other areas, including particularly bioethics. Effective management of such overlap calls for recognition of the institutional specificity of bioethics, which is not within the competence of COMEST, alongside with appropriate collaboration, especially between COMEST and the International Bioethics Committee of UNESCO (IBC), with respect to science ethics as applied to professional conduct in the life sciences.

[13] Document C (2008) 424 final of 07/02/2008, Brussels, Commission of the European Communities. [http://ec.europa.eu/research/participants/data/ref/fp7/89918/nanocode-recommendation_en.pdf].
[14] Henk T.A.M. ten Have (ed.), 2007, Nanotechnologies, Ethics and Politics, Paris, UNESCO Publishing. [http://unesdoc.unesco.org/images/0015/001506/150616e.pdf].
[15] The Ethics and Politics of Nanotechnology, UNESCO, 2006. [http://unesdoc.unesco.org/images/0014/001459/145951e.pdf].
[16] COMEST, Nanotechnologies and Ethics - Policies and Actions – COMEST Policy Recommendations, 2007 UNESCO, 2007. [http://unesdoc.unesco.org/images/0015/001521/152146e.pdf].

64. There is a well-documented tendency to over-simplify issues of ethical concern in ways that make them difficult to address, for instance by splitting technical assessment, cost-benefit analysis and ethical scrutiny. One negative effect of this approach is to make ethics an external constraint on techno-social choices, whereas ethics should be regarded as a constitutive feature of them.

65. With this in mind, it is important to engage in reflection on the application of the language of risk and uncertainty to scientific and technological issues that have been framed by the existing normative framework in terms of “dangers”, taking account of and extending the previous work on the precautionary principle, with the objective of clarifying the “vigilance” required of scientists with respect to possible misuses of science.

III.2 Bridging and reducing knowledge divides

66. At the most general level, based on article 27(1) of the Universal Declaration of Human Rights, access to scientific information may be regarded as a human right. The benefits of scientific advancement could, conceivably, be shared equitably while science remains under the restrictive control of certain social groups, corporate entities or states. However, the Declaration specifically refers not just to the benefits but to scientific advancement itself. This implies equitable participation in the global community of science, and therefore a fair basis for access to scientific information.

67. What this entails in practice is less clear-cut, particularly as several distinct issues are involved, including the distinct intellectual property regimes of copyright and patent and the controversial application of the latter to scientific discoveries, mobility of scientific personnel, and confidentiality for research considered sensitive by its funders. The 1974 Recommendation does state explicitly “that open communication of the results, hypotheses and opinions – as suggested by the phrase "academic freedom" – lies at the very heart of the scientific process, and provides the strongest guarantee of accuracy and objectivity of scientific results”.[17] Similarly, and more vaguely, the Declaration on Science and the Uses of Scientific Knowledge (1999) does enshrine “the importance of total, unrestricted access to scientific research and education and to information and data” (Article 16). The institutional implications are, however, left unspecified except with respect to the right of scientists to publish their work.

68. Clarification of such matters is an important issue for science ethics. Contemporary challenges such as changing modes of publication, new commercial and security pressures, evolving technologies, etc., are redistributing the conditions of access to scientific information in ways that threaten creating new barriers detrimental to developing countries even as they remove some traditional obstacles to the circulation of scientific information. For clarification, appropriate distinctions should be made between the processes by which

[17] The quotation marks around ’academic freedom‘ are in the original text.

information is produced, within the scientific process itself, disseminated, through both scientific and general media channels, and used, through technology in its various forms.

69. Further discussion of open access principles for publications and data, which are one institutional response to knowledge divides, is discussed in section IV.1 below.

III.3 Promoting integrity and responsible research and innovation

70. What is important is less to propose alternative or overarching frameworks than to underline the necessity of multi-stakeholder dialogue to ensure coherence between existing and emerging frameworks along with reasonably shared perspectives on what these values entail in contemporary settings.

71. The work of the OECD Global Science Forum (GSF) is of direct relevance in this regard, since it was premised on the ethical gaps and discrepancies that may emerge in global science.

72. In 2007, a workshop was organized in Tokyo by the GSF and the Ministry of Education, Culture, Sports, Science and Technology of Japan (MEXT) to explore ways of dealing with allegations of misconduct. Identifying misconduct in international collaborations is a major challenge. One of the results of the workshop was a recommendation to strengthen contacts among the responsible national officials, to foster exchange of information, assist one another in promoting integrity, and consider ways of harmonising principles and procedures across national boundaries.[18]

73. In response to this recommendation, the GSF Co-ordinating Committee for Facilitating International Research Misconduct Investigations brought together research funding and evaluation bodies from a number of OECD countries to consider the practical issues related to research misconduct in the contemporary context. The GSF Co-ordinating Committee adopted a "Practical Guide", annexed to its report, which incorporates a fundamental set of principles, guidelines and suggested procedures for conducting international research misconduct investigations.[19]

74. One outcome of the work conducted in the GSF was the Second World Congress on Scientific Integrity, which was held in Singapore in July 2010. The

[18] OECD Global Science Forum, Report from the Workshop on Best Practices for Ensuring Scientific Integrity and Preventing Misconduct, November 2007. [http://www.oecd.org/sti/sci-tech/globalscienceforumreports.htm http://www.oecd.org/sti/sci-tech/40188303.pdf].

[19] OECD Global Science Forum, Co-ordinating Committee for Facilitating International Research Misconduct Investigations. Final Report, submitted by the Delegations of Canada and of the United States, OECD, May 2009. [http://www.oecd.org/sti/sci-tech/42713295.pdf].

[20] Information on the Second World Congress on Scientific Integrity (Singapore, 21-24 July 2010) is available at: http://www.icsu.org/events/ICSU%20Events/2nd-world-conference-on-research-integrity and the home page of the Singapore Statement on Research Integrity is http://www.singaporestatement.org/ .

Congress generated the “Singapore Statement on Research Integrity”,[20] basedon four basic principles:

- Honesty in all aspects of research
- Accountability in the conduct of research
- Professional courtesy and fairness in working with others
- Good stewardship of research on behalf of others

75. Parallel work was done, with many of the same stakeholders, in the context of the European Science Foundation (ESF) Member Forum that, together with the All European Academies (ALLEA) produced the consensus document “The European Code of Conduct for Research Integrity” [21] , launched at the Second World Conference on Research Integrity. The code addresses good practice and bad conduct in science, offering a basis for trust and integrity across national borders.[22] The ESF Member Forum 23 has also developed guidelines for setting up national structures to foster and supervise research integrity. 24 The code is intended to offer a reference point for all researchers, complementing existing codes of ethics and complying with national and European legislative frameworks. It is not intended to replace existing national or academic guidelines, but represents agreement across 30 countries on a set of principles and priorities for self-regulation of the research community.

III.4 Ensuring public participation and rethinking expertise

76. Most research agendas and their technological applications, have direct impacts on human health and well-being and the environment. Ensuring public participation when it comes to explaining, assessing, and implementing is far from being simple and straightforward. Experience in many national and institutional settings shows that relevant debates can turn adversarial and preclude serious citizens’ scrutiny of choices about issues that fall, or may be considered as falling, within the regulatory competence of states.

77. In order to address these issues, it is important to reflect on the question of lay competence and on the issues relating to the establishment of “hybrid” forums for multi-stakeholder discussion of ethical challenges. The conceptual and practical challenge is to avoid establishing a clash between citizen participation on one hand and the indispensable role of experts on the other. This is a key area where enhancement of both reflection and institutional procedures is required, with ethics playing an integral role by providing the critical and reflexive tools for formulating the pressing questions.

IV. THE THINGS TO DO: SOME PRIORITIES

78. The need to embed ethics in routine scientific practice establishes a strong connection between science ethics and science policies. The integrity and credibility of science do not depend solely on the values, attitudes and behaviour of individual scientists. There are crucial background institutional conditions,

defined in particular by science policies, for which individual scientists cannot be held responsible.

79. Ethics is therefore not just a matter of principles, but also of governance. At national level, ethical institutions and mechanisms may need strengthening, especially in developing countries. Action may also be required to address gaps in international coordination at regional and global level. In order to reflect on what might need to be done, it is important to clarify what the global governance might entail and what its ethical features might look like.

80. In general terms, science governance depends on answers to three interrelated questions:
i. How to build response to key social needs and promotion of human well-being into science policies, in the differentiated ways appropriate to the various levels at which the interface operates (priority setting and programming, funding, higher education, institutional design in research systems, etc.)?
ii. How to address the tension between the necessary autonomy of science, which is internally connected to its integrity, with accountability and with responsiveness to externally generated priorities?
Iii. How to channel the results of science into a policy process that can actually address social needs and citizens' choices and thereby produce the intended outcomes by which it is legitimized?

81. Adequate answers to these questions may be expected to have positive, mutually reinforcing effects on both the conduct of science itself and public understanding of and participation towards science. In turn, such positive effects serve as favourable preconditions for more dynamic science backed and effectively utilized by more vigorous policies.

82. Among the key issues to be addressed within a framework for global governance of science are science divides (notably in relation to development) and the related capacity-building challenges, private-sector science, research policies, public participation and applications of science to concrete policy issues. The challenge in this regard is not to establish some kind of global regulatory mechanism but rather to facilitate cooperation, interchange, coordination, etc. of existing mechanisms and across disciplines in order to improve the effectiveness of ethical frameworks that already exist.

[21] The text of the European Code of Conduct for Research Integrity is available at:
http://www.esf.org/fileadmin/Public_documents/Publications/Code_Conduct_ResearchIntegrity.pdf .
[22] Source: http://www.esf.org/activities/mo-fora/research-integrity.htm l .
[23] The home page of the ESF Member Organization Forum on Research Integrity is available at:
http://www.esf.org/coordinating-research/mo-fora/research-integrity.html .
[24] Fostering Research Integrity in Europe. Report by the European Science Foundation Member Organization Forum on Research Integrity, ESF, 2010.
[http://www.esf.org/index.php?eID=tx_nawsecuredl&u=0&file=fileadmin/be_user/CEO_Unit/MO_FORA/MOFORUM_ResearchIntegrity/ResearchIntegrity_report_finalpublished.pdf&t=1438423777&hash=a28000fd5c3c122ab0c2d9f8c0242196c3c772ef].

83. The existing normative framework implies a pluralized and “distributed” model of ethics in which multiple sites with distinct logics combine to promote and entrench ethics at all levels of scientific conduct. For present purposes, six levels of ethical institutionalization may be distinguished:

- international normative standards and indicative ethical frameworks;
- national legislation and regulations;
- national ethics committees and similar bodies of citizen consultation;
- institution-specific processes, including employment contracts and institutional ethics committees;
- ethics education and training, including the full range of awareness-raising activities;
- the various issues relating to dissemination and circulation of scientific information, including in particular the ethical aspects of publication.

84. It is important to consider which levels of action should be emphasized, and which institutions should take responsibility for them. In this context, ethical consideration of governance points in two directions.

85. On the one hand, in principle, governance should be rule-based, otherwise it is unlikely to be inclusive or equitable, given the strategic significance of science and technology in the contemporary world. Rule-based governance requires a degree of inclusion from day-to-day political debate and lends itself naturally to an emphasis on expert knowledge. Ethics when based on explicit principles has a natural affinity with rule-based governance.

86. On the other hand, democratic deficits are very visible in the areas of science and technology, and in principle call for stronger citizen engagement and thus a more process-based than rule-based approach to governance. Obviously, such an approach further calls for a pluralistic understanding of knowledge and expertise that leaves the possibility for citizens to contribute significantly. Here, ethics shape a shared language of justification.

87. The tensions between these two perspectives are real, but should not be exaggerated. Rules also require processes in order to be interpreted and implemented, and conversely processes can operate effectively only if they can rely on (second-order) rules.

IV.1 Open access

88. Publication issues are of great significance in this respect, and ongoing debates about open access deserve careful ethical consideration.

89. Open Access[25] is a new way of disseminating research information, made possible because of the World Wide Web. The development of the concept is summarized as follows: the Web offers new opportunities to build an optimal system of communicating science – a fully linked, fully interoperable, fully-

exploitable scientific research database available to all. Scientists are using these opportunities both to develop Open Access routes to the formal literature and for informal types of communication. For the growing body of Open Access information, preservation in the long-term is a key issue. Essential for the acceptance and use of the Open Access literature are new services that provide for the needs of scientists and research managers. There are already good, workable, proven-in-use definitions of Open Access that can be used to underpin policy. There is also a distinction made between two types of Open Access – gratis and libre – and this distinction also has policy implications. Two practical routes to Open Access (‘gold’ (OA journals) and ‘green’ (OA repositories)) have been formally endorsed by the research community. The primary, and original, target for Open Access was the journal literature (including peer-reviewed conference proceedings). Masters and doctoral theses are also welcome additions to this list and the concept is now being widened to include research data and books. There is already considerable infrastructure in place to enable Open Access although in some disciplines this is much further advanced than in others. In these cases, cultural norms have changed to support Open Access.

90. A number of issues contribute to the importance of Open Access: there is a problem of accessibility to scientific information everywhere. Levels of Open Access vary by discipline, and some disciplines lag behind considerably, making the effort to achieve Open Access even more urgent. Access problems are accentuated in developing, emerging and transition countries. There are some schemes to alleviate access problems in the poorest countries but although these provide access, they do not provide Open Access: they are not permanent, they provide access only to a proportion of the literature, and they do not make the literature open to all but only to specific institutions. Open Access is now joined by other concepts in a broader ‘open’ agenda that encompasses issues such as Open Educational Resources, Open Science, Open Innovation and Open Data. Some initiatives aimed at improving access are not Open Access and should be clearly differentiated as something different.

91. The benefits of Open Access may be summarized as follows: Open Access improves the speed, efficiency and efficacy of research; it is an enabling factor in interdisciplinary research; it enables computation upon the research literature[26] ; it increases the visibility, usage and impact of research; it allows the professional, practitioner and business communities, and the interested public, to benefit from research.

92. As Open Access has grown, new business models have been developed for journal publishing, for Open Access repositories, book publishing and services built to provide for new needs, process and systems associated with the new

[25] Extracted from the Executive Summary of The UNESCO Policy Guidelines for the Development and Promotion of Open Access by Alma Swan published in 2012, which is a comprehensive document useful to all stakeholders to clarify basic issues in the field of Open Access. [http://www.unesco.org/new/en/communication-and-information/resources/publications-and-communication-materials/publications/full-list/policy-guidelines-for-the-development-and-promotion-of-open-access/].

methods of dissemination. It is therefore equally important to reflect ethically on what should be published – and how – and on access to resources such as data that are not in any strict sense publishable.

IV.2 Codes of conduct

93. The issue is less to develop an "ethical code of conduct for scientists" (in the singular) than to develop appropriate (plural) ethical standards and mechanisms for the regulation of scientific conduct with due regard to the diversity of (national, disciplinary, etc.) situations and to the fact that not all regulation is or should be within the competence of Member States. The emphasis on a participatory process involving scientific communities and other stakeholders follows directly from this requirement. One implication is that State-level monitoring of implementation would be inadequate if not supplemented by monitoring at a more general level of the multiple processes by which ethical principles for science are institutionalized. There is a place for regulation as for exhortation, for labour contracts as for professional standards, for national uniformity as for institutional specificity. [27]

IV.3 Ethics education

94. To prevent unethical behaviour, it is essential to act at a range of different levels to build awareness of science ethics among not just professional scientists but also technicians, people actively working in science and technology and citizens. Public awareness is a constitutive and not simply incidental aspect of governance. Avoiding deliberate misuse of science is undoubtedly an important ethical issue, but cannot be addressed solely through education. Avoidance of inadvertent failure to meet high ethical standards, on the other hand, depends on education and training, and is achieved by adequate institutional oversight.

95. Consideration should also be given in this regard to gaps in existing provision of education and training and possible action, with a particular focus on international coordination and cooperation and on capacity building in developing countries.

96. Finally, awareness of ethical issues in science and of the steps taken by relevant institutions to promote science ethics can contribute usefully to public trust in science. There is much existing and valuable work in outreach, public information and popularization, and to a lesser extent in effective public participation in social choices about science and technology. There may however be gaps that need to be addressed by new kinds of initiatives.

[26] For more information about the concept of "computation upon the research literature" please refer to the "Policy Guidelines for the development and promotion of Open Access" by Alma Swan, UNESCO, 2012: http://www.unesco.org/new/fileadmin/MULTIMEDIA/FIELD/Tashkent/pdf/PolicyGuidelines.pdf .

[27] More information on codes of conduct can be found on the website of the International Council for Science (ICSU): http://www.icsu.org/freedom-responsibility/research-integrity/statements-codes-reports .

IV.4 Consulting citizens on controversial innovative technologies

97. As argued in section III.4, enhancing public consultation and citizens' engagement requires both a different approach to expertise and a degree of institutional innovation. In particular, experience in many countries and on many issues suggests that conventional forms of democratic pluralism cope poorly with the societal and regulatory questions raised by controversial innovative technologies.

98. Patterns of exclusion in public consultation are of ethical concern. An ethical approach to science governance and the science-society relationship therefore requires serious consideration to be given to alternative procedures that can ensure that the citizens broadly understood, and not just pre-constituted interest groups, is effectively represented in reflection and decision-making on controversial innovative technologies.

IV.5 Local, indigenous and traditional knowledge

99. With respect to the societal challenges of science and technology there are diverse groups that stand in very different relations to scientific, political and policy processes. While a full review of the cleavages and inequalities of power and resources that lead to profound differences in the ability of different groups to make their voice heard or to achieve exit from unpalatable knowledge and policy regimes would be beyond the scope of this report, it is important to make specific reference to the situation of indigenous people, and more generally local, indigenous and traditional knowledge.

100. Alongside patterns of dis empowerment that are often shared with other social categories and groups, indigenous people occupy a distinctive position with respect to the cultural meaning of their interaction with contemporary techno science. Thus, in addition to the general question of benefit sharing and risks assessment, from which they have often unjustly been excluded, indigenous people have consistently raised the broader question of whether the extraction and distribution of "risks and benefits" is the right way to envisage the interaction of science and technology with the world. In so far as local, indigenous and traditional knowledge involves alternative understandings of what constitutes the world that humans inhabit – understandings that do not so much clash with science as they operate at a different level – it may be threatened, when power relations are unequal, by very instrumental technoscientific worldviews.

101. The combination of these two concerns – about benefit/risks assessment and about cultural vulnerability – has led the international community to adopt a number of decisions specifically designed to assert the value of local, indigenous and traditional knowledge and to protect the rights of those who define themselves by it.

102. For example, the Conference of the Parties to the Convention on Biological Diversity also adopted the “The Tkarihwaié:ri Code of Ethical Conduct to Ensure Respect for the Cultural and Intellectual Heritage of Indigenous and Local Communities”. [28] The code, which is voluntary, takes into account, in the language of the preamble, “the holistic concept of traditional knowledge and its multi-dimensional characteristics which include but are not limited to spatial, cultural, spiritual, and temporal qualities”. It combines general ethical principles (respect for existing settlements, cultural aspects of intellectual property, non-discrimination, transparency/full disclosure, prior informed consent and/or approval and involvement, inter-cultural respect, safeguarding collective or individual ownership, fair and equitable sharing of benefits, protection of affected indigenous and local communities, precautionary approach) with considerations specific to the situation of indigenous and local communities. This instrument is exemplary both of the major ethical considerations and of the way in which established ethical principles can be mobilized to address emerging issues.

V. CONCLUSIONS

103. The first analytical conclusion of this report is that science, its governance and the science-society relationship are currently being reshaped by comprehensive and far-reaching dynamics that require both new thinking and new ethically based institutional responses. Among these dynamics, the most significant are:

- Scientific and technological change, which induces new intellectual and institutional models as well as new pathways for technology to reshape societies;
- New social and institutional contexts within which scientific integrity and the equitable distribution of social benefits are placed under pressure;
- Tensions between private and public interests that call for renewed safeguards to
- preserve the public good;
- Divisive globalization, which integrates the world without equipping it with broadly
- shared worldviews on background ethical principles and virtues that can be relied
- upon to produce practical consensus;
- Patterns of exclusion between and within societies, driven by differential access to science and assessment of technology, that demand ethical approaches both to adapted development and to social inclusion.

104. In the face of such dynamics, existing ethical frameworks within the numerous international documents, as well as the wide range of statements, codes, declarations and other frameworks adopted by institutional and

[28] Convention on Biological Diversity, COP 10 (2010), Decision X/42. The full text is available online at: http://www.cbd.int/decision/cop/?id=12308 .

Professional communities, may not be fully adequate to address current and especially emerging ethical challenges.

105. This report points to five areas in which new ethical thinking and new institutional developments are required:

- Bridging and reducing knowledge divides, working towards the realization of article 27(1) of the Universal Declaration of Human Rights;
- Promoting integrity with responsible research through adapted and sustainable innovation, including through normative initiatives at relevant levels;
- Assessing and managing risk, taking account of and extending the previous work
- on the precautionary principle, with the objective of clarifying the vigilance required of scientists with respect to possible misuses of science;
- Ensuring public participation and citizen consultation, even on complex and controversial issues, which in turn means rethinking expertise to recognize the
- diversity of forms of knowledge and competence;
- Strengthening ethical and institutional frameworks to ensure that benefits in regard to risk assessment and sustainability are both produced by the application of technologies and equitably shared.

106. The connection between ethical thinking and institutional developments is absolutely crucial in this respect and needs to be articulated with governance in the broad sense, including not just formal processes of regulation but also the full range of self-regulatory dynamics that emerge from society itself.

107. In order to achieve this, six areas of priority concern are identified in this report.

- Development of an open access model for science, including but not limited to publication, that favours intellectual dynamism, integrity, responsibility and contribution to the well-being of humanity;
- Review and where necessary revision of existing codes of conduct to ensure consistency with a coherent overarching ethical framework and to eliminate the gaps that have emerged from the institutional development of science;
- Updating and refinement of existing frameworks to clarify the status of scientific researchers, including but not limited to the UNESCO Recommendation on the subject, with a view to ensuring consistency between the institutional structures of science and the agreed ethical standards by which it is to operate;

- Promotion of ethics education, both for scientists, professionals and for citizens, in order to embed agreed ethical principles in the institutional routines of science and technology;
- Enhanced efforts to consult the citizens on controversial innovative technologies, mobilizing new institutional modalities where appropriate;
- Sustained efforts at all relevant levels to assert the value of local, indigenous and traditional knowledge and to protect the rights of those who define themselves by it.

https://www.psa.gov.in/psa-prod/publication/Draft%20National%20Policy%20on%20Academic%20Ethics%202.pdf

National Policy on Academic Ethics

1. Introduction

Ethical practice is essential in every kind of academic activity. Any violation of basic ethics will affect the value and credibility of the activity being carried out, whether it is teaching or research or administration. This document lays down broad guidelines and norms to be followed to ensure ethical practices in all academic institutions in the country. Here, "institution" includes all recognized universities, colleges and research institutes, as well as government agencies promoting or supporting academic activity. Other academic entities, including high schools, are also encouraged to adopt this policy. Different areas of academic work, such as work involving human or animal subjects, medicine, engineering etc. may have their own, detailed and specific codes of ethics, but the essence of those guidelines should be aligned with the norms mentioned in this document. These guidelines should be required to be read and accepted by every member of the institution.

2. Policy of ethical conduct

This section states the general principles of ethical conduct which should be followed in different aspects of academia:

(i) Teaching and research –

✓ The selection and training of students should involve a just and fair procedure. During tests and interviews there can always be subjective judgements, however they must avoid any considerations unrelated to the student's academic ability.

✓ During teaching, the dignity of the classroom/laboratory should always be maintained.

✓ Cheating in tests and exams is never acceptable.

✓ Through their own actions, mentors must communicate positive ethical values and professionalism to their students. In research projects, the Principal Investigator should monitor the procedures and, if relevant, write down policies for recording data and compiling results. These policies should be made known to all collaborators.

✓ Every institution must have fair procedures for proper use and sharing of equipment and facilities.

(ii) Purity of Data –

✓ Wherever any kind of experimental or data-driven work is involved, it is essential to present the results correctly and honestly. One must carefully avoid all unacceptable forms of data manipulation, for example adding or subtracting data points at will, editing images to produce a false result, creating images artificially and presenting them as data or using the same figure or table to describe different experiments. The conclusions claimed in a research paper must follow honestly from the data collected.

✓ It is understood that data often has to be processed. Details of acceptable/unacceptable processing can be quite complex and will vary from subject to subject. The relevant norms in the given area should be applied in each case.

✓ Data fraud should be considered as a very serious offence as it harms the image of the entire community and country. Deliberate falsification of data should attract stringent punishment.

(iii) Publications –

✓ The list of authors in research papers, reviews, books, monographs or policy documents should not be manipulated to give undue credit to those who have not contributed (``honorary authorship''), or deny credit to those who have contributed sufficiently. Sometimes a genuine author's name is suppressed to hide a conflict of interest and the name of a ``ghost author'' is substituted. Such a practice is unethical for both parties. Also, no one can be made an author of a document without their awareness and consent.

✓ In recent years there has been a rise in so-called ``predatory journals'' which publish papers with minimal or no review, typically for a fee. It is unethical to publish in journals of this nature. However, it is essential to distinguish predatory journals from legitimate open-access journals which may also charge a publication fee. Authors should be cautious of such journals before submitting their work for publishing and authorities should take serious note whenever a candidate for any position or award has publications in proven predatory journals.

✓ Plagiarism –
It is the practice of using ideas/words/data from other sources, in a manner that conveys a false impression that they are original. Publishing one's own results more than once as if they are new, is "self-plagiarism". Plagiarism is relevant not only for published papers but also project reports, textbooks and grant proposals. Plagiarism of any kind is unacceptable. The ethical practice is to use only a limited amount of ideas and words by other authors in one's writing and with proper acknowledgement. While plagiarism is always wrong, the extent of it can be variable and sometimes it can also be unintentional. Text-matching software

can only alert us that plagiarism might have taken place, but this has to be verified by a qualified human being familiar with the area. Authors are responsible for learning about correct writing practices, and institutes also should impart training in this direction. When plagiarism is detected, it must be corrected by immediately publishing a retraction or revision. Deliberate and/or serious forms of plagiarism should entail strict punishment.

(iv) Safety and Environment –

✓ Academic work must not pose a risk or danger to people or the environment.

✓ Guidelines and regulations concerning safety must be formulated and carefully followed. This is especially important for handling, storing and disposing of radioactive, toxic or dangerous materials. Clearances and permits/licenses, if required, must be obtained.

✓ Wherever relevant, due attention must be given to industrial safety, sustainable development, sharing of intellectual property rights, environmental loading and related issues.

(v) Bias and discrimination –

✓ Academic communities are enriched by the presence of people of different ethnicities, genders, religions, castes, tribes, socioeconomic strata, affiliations, backgrounds and sexual orientations. There must be no direct or indirect bias or discrimination against any individual based on the above categories. Members should pro-actively strive to improve the balance of under-represented sections.

✓ The nation should aim for the full and equal participation of women in all academic activities. It is everyone's responsibility to support a gender- neutral and supportive environment to achieve this goal. Gender sensitivity should form an essential part of direct ethical training.

✓ Sexual misconduct and/or gender-based harassment in the workplace are totally unacceptable. Legal structures and rules regarding how to deal with sexual misconduct must be rigorously followed. There also exist many forms of behavior which may not amount to harassment in the legal sense but constitute gender-based discrimination. Institutions should strive to ensure that their members do not engage in such actions and should pro-actively sensitize their community on these issues.

✓ Bullying in the workplace is a form of harassment that usually targets the most vulnerable members. This can include abusive language, frequent use of insults, threatening letters, sabotage of others' work, exploiting juniors to carry out personal errands etc. Such actions are highly unethical and are not acceptable.

(vi) Public interaction and outreach –

✓ It is a duty, particularly for publicly funded academics, to communicate the results of their work to the society on a regular basis to educate the public of the fruits of their research and to stimulate the aspirations of young students in schools and colleges.

✓ While interacting with the press and members of the public, it is essential for academics to avoid making exaggerated or false claims. Statements made in public should be balanced and professional. As practitioners of rational thinking and scientific temper, academics are encouraged to voice their professional opinions openly and without fear.

(vii) Science administration –

✓ High standards of professionalism and objectivity should be shown by leaders and officials of institutions, departments and governmental agencies. This should be manifested in how they handle policy, performance assessment, grants and proposals and hiring.

✓ Officials must do their best to ensure that a culture of professionalism permeates the organization. Misuse of power is unethical and must be avoided. When committees are constituted, they must involve members known for their fairness and balance rather than personal loyalties or willingness to be influenced. Committees should be constituted keeping diversity in mind and should have appropriate gender representation.

✓ Where policy opinions and decisions are involved, officials must stay clear of commercial, social and political pressures. Conflicts of interest have to be avoided. When potential conflicts are liable to occur, the official must make this known to the concerned colleagues.

✓ Infringement of the right to privacy by an academic institution is not ethical. Not only the legal requirements but also more general professional standards for maintaining privacy should apply.

(viii) Role of whistleblowers –

✓ Individuals who complain about unethical practices may find themselves in a difficult or sensitive position. A negative impact on their career is one among many possible risks following their actions. It is important to safeguard the interests of the whistleblower against any retaliatory repercussions.

✓ On the other hand, deliberately making false accusations is itself highly unethical and must be dealt with.

3. Regulatory Norms

(i) Implementation –

✓ It is essential to prevent unethical practices in the first place by suitable ethical training, promoting a culture of professionalism and a clear statement that unethical behavior is not tolerated in the institution. To this end, institutions must create or adopt suitable ethics documents and impart direct ethical training to its staff through lectures and interactive workshops on a regular basis, so that the community is fully aware of these issues.

✓ The detailed ethical guidelines for each institution must be made available to all employees and should clearly spell out procedures for grievance redressal at that institution.

✓ Despite all this, if ethical violations are found then they must necessarily be addressed on an urgent basis and for this purpose, it is recommended that the institutions should set up a standing committee which ensures timely and impartial redressal of all grievances alleged to arise out of policy violations.

(ii) Handling policy violations –

✓ Institutions should employ formal mechanisms and procedures for dealing with allegations of research misconduct, as well as any other kind of misconduct as described in this document, against its staff and students based on the following fundamental principles:

Corrective action –

If a publication is found to contain plagiarism or manipulated data, the institution must ensure that a correction or retraction is published in the same place as the original paper. On the administrative side, if a decision is found to have been made based on a bias or conflict of interest, then it should be overturned and the process repeated if necessary. In general, every effort must be made to ensure that an unethical action does not succeed in propagating false knowledge or incorrect decisions.

Punitive action –

This covers not just misconduct involving data and publication, but also harassment, discrimination and other issues covered in this document. Punitive action communicates not just to the violator, but also to society at large, that unethical behavior is unacceptable. The degree of punishment should be carefully calibrated in proportion to the offence. First-time offenders, particularly if the offence is minor or unintentional and the offender is inexperienced, may be let off with a warning. Serious, multiple or repeat offences must be treated with utmost seriousness. Large-scale ethical violations should be met with severe disciplinary action and, if appropriate, dismissal.

Institutions should endorse the following principles when implementing disciplinary procedures:

➢ The responsibilities of those dealing with the allegation should be clear and understood by all concerned parties.

➢ Measures should be in place to ensure an impartial and independent investigation and to ensure that interests of those dealing with the allegation do not conflict with these procedures.

➢ The organization should safeguard the rights to confidentiality of the concerned parties.

➢ All concerned parties should be informed of the allegation at an appropriate stage in the proceedings.

➢ Anyone accused of misconduct should have the right to respond.

➢ A policy should be in place to ensure that no employee who makes an allegation in good faith against another employee shall suffer a detriment, but equally that disciplinary procedures are in place to deal with malicious allegations.

➢ The allegation should be dealt with in a fair and timely manner.

➢ Proper records of the proceedings should be kept.

➢ The outcome should be made known as quickly as possible to all concerned parties.

➢ Anyone found guilty of misconduct should have the right to an appeal.

➢ Appropriate sanctions and disciplinary procedures should be in place for cases when the allegation is upheld.

➢ If appropriate, efforts should be made to restore the reputation of the accused party if the allegation is dismissed.

Acknowledgements

Guidelines of the Indian Academy of Sciences and the Department of Biotechnology on ethical scientific conduct are duly acknowledged.

This is a draft policy document issued by the Office of the Principal Scientific Adviser to the Government of India. It is intended as a baseline document for scientific and academic institutions to develop their guidelines and implementation programmes for ethical conduct in the work environment.

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https://csirhrdg.res.in/SiteContent/ManagedContent/ATContent/20200407155759201OM%20Ethics%20Guidelines.pdf

Council of Scientific & Industrial Research

CSIR Guidelines for Ethics in Research and in Governance

Guidelines Drafting Committee:

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1. Preamble

1.1 Need for these guidelines:

Maintaining ethics in research and governance is of paramount importance in organizations like CSIR. This calls for the development of appropriate guidelines in the practice of science, publication of scientific/technical/biomedical data and results, making them available in the public domain and, in the administration of scientific establishments at all levels.

Guidelines on responsible conduct in research institution have now been laid out by various agencies. These include Govt. of India Gazette notification by the University Grants Commission (1), the Policy document by ICMR (2), Draft National Policy on Academic Ethics by Office of PSA (3), a book on Ethics in Science- Education, Research and Governance by the Indian National Science Academy (4), The Ethics in Science by Resnick (5), The Australian Code for the Responsible Conduct of Research (6), the ICSU Strategic Review (7), Policy Report by the Inter Academy Council (8), Best Practice Guidelines on Publishing Ethics by Wiley (9), Policy statement by INSA on Dissemination and Evaluation of Research Output (10), Recommendations by the ICMJE (11); COPE Guidelines for Good Publication Practice (12), Williams et al in JCI 2019 (13), Clinical Trial Guidelines by CDCSCO (14), Compendium of CPCSEA (15), Handbook on Sexual Harassment of Women (16), as well as a relevant compilation on the levels of misconduct and suggested advice on action (17).

Some of the root causes that tempt one for attempting short cuts for success in scientific pursuits, and in particular publications, are:

a. Increased reliance on ‘quantification’ of the value of a publication/report, (and of the authors who produced them), e.g., impact factor, H index and related numbers which are used in various places for ‘recognition’ of an author for career advancement, awards and honours and the like;

b. Overemphasis on the ‘scientometric ’ reputation of the journal where the paper is published in contrast to an evaluation of what new science is published;

c. Demand from institutions that a researcher must publish a minimum number of papers for obtaining PhD degrees, and promotions; and

d. The resultant ‘explosion’, in recent years, of a number of fake and predatory journals.

1.2 Guidelines suggested by several agencies, authors and groups (Ref. 1-16) have must be clarified that the value of any such guidelines will lie exclusively with the sincerity of their application. Thus, the guidelines enunciated below may not perhaps deal with every individual case that can or will arise, but it is expected that these will provide broad contours and trajectories within which appropriate decision making processes could proceed.

1.3 Beyond academic and publication guidelines, emphasis has been (and needs to be) given to honesty, scientific validity of the work being published, aspects of freedom to pursue new ideas and criticize old ones, apportioning due credit to others, mutual respect, conflict of interest, education and mentorship, social responsibility and the law.

2. What is scientific misconduct

Scientific misconduct is the violation of the codes of scholarly conduct and ethical behaviour in the publication of professional scientific research. These include all acts from the initiation of an idea, its experimental verification, accuracy of results, accurate reporting without resorting to any malpractice in the presentation of data/images, due acknowledgement of all sources of information and people. It is against this background that this document provides CSIR institutions and individuals working in them, an explicit list of acts that constitute scientific misconduct. These are given below.

Scientific misconduct(s) can be of various types and can occur at various stages- from the initiation of the scientific study to publications and/or patent generation. While these involve violation of generally accepted research practices, inadvertent errors or genuine differences in interpretation or judgement in assessment of the results may not constitute scientific misconduct. Scientific misconduct may be categorized into the following:

2.1 Embezzlement of ideas:

Claiming an idea to be one's own while it was obtained from privileged access while reviewing manuscripts, grant proposals or through participation in lectures and personal discussions and earlier publications (but not citing them). This also includes acts wherein ideas of others are presented as one's own through slight changes of words, phrases and illustrations.

2.2 Plagiarism:

Using other's words, results, or published work without appropriate citation. This includes using one's own published work (self-plagiarism) without appropriate disclosure/citations.

2.3 Falsification:

Misrepresentation or suppression/ addition of a part of data to generate cherry-picked results or improper reporting of results in order to present a misleading outcome.

2.4 Fabrication:

Reporting 'results' of experiments which were never done. This also includes images/ photographs being morphed to reach a particular interpretation.

2.5 Fraud:

Deliberate suppression of previous work in publications and inappropriately claim originality and/or avoiding quoting previous publications which are contrary to present results.

2.6 Non-compliance of Regulatory Guidelines:

Deliberate violation of ethical guidelines accepted for human and animal research, non-adherence to bio-safety regulations or inappropriate use of research funds.

2.7 Inappropriate Authorship:

Excluding genuine contributors from authorship, including non-contributors, or claiming authorship for oneself without having made any meaningful contribution is inappropriate. In cases of publication of work carried out during a Ph.D. thesis, due care should be taken by the thesis Supervisor to ensure that the scientific contributions of a student are neither diluted nor exaggerated.

2.8 Withholding data from Validation:

Not providing data or research material to the institute/journal for verification/validation purpose.

2.9 Wrong versus Fraudulent paper:

It occasionally happens that a conclusion drawn in an earlier publication is negated, modified or shown where it went wrong- either by the same author or others. This is how science progresses. The earlier paper is thus not fraudulent.

3. Good Science Practices

3.1 Laboratory Records:

It is vital to keep proper records of each experiment, details of materials obtained from varied sources and how they were used, procedures, analysis and other related material. Graphs and printouts from instruments should be numbered and filed appropriately. If any software is used for handling and analysing the data, its name, version and other details should be recorded. The laboratory records of experiments carried out using a publicly funded institution should carry every single detail of the experiment. Such records are the property of the laboratory and are to be kept for archival and later retrieval purposes; a copy will of course be that of the researcher and can be used by anyone till after a defined moratorium period of 18 months. Due permission and acknowledgement of the researchers who carried out the experiments is essential at all times.

3.2 Consultancy work:

External consultation should be done with explicit permission from the Institutional Head where the scientist/technologist works. At the same time, permissions, if denied, should be justified and the reasons thereof be formally recorded. If the facilities of the institution are used, the details should be declared and recorded with due confidentiality in terms of the interest of the client. A clear statement on the resources to be used and finances that would accrue to the consultant and the institution should be recorded ab initio.

3.3 Collaborative studies:

The role played by each collaborator, and the benefit (both material and intellectual) which accrues to each collaborator should be decided ahead of time, should be accepted by each participant, and formally recorded. Given the uncertain nature of scientific research, the collaborators should be flexible in apportioning benefits in case there is a significant change in the actual contributions by participants as compared to those agreed to earlier. The benefit that accrues to each of the researcher's institutions, if any, should also be agreed upon ahead of time. Patent rights of each collaborator (and of his/her institution, if any) should be decided and be recorded ahead of time. Institutions need to agree upon the operating procedures for such Memoranda of Understanding (MoUs) and for the exchange of materials and samples.

3.4 Authorship:

In a multi-authored paper, authorship should accurately reflect the contribution of each author and these be pointed out in the acknowledgment section of the manuscript. There should be no **'honorary**' or '**ghost**' authorship. Both, namely the offer of such authorship, or demand for the same, are scientific misconducts and unethical practice. Each publication must provide details on each author's contribution in the paper and the explicit consent of each author should be obtained. Acknowledgment should also be made about the funding source, and of any research material received as a goodwill gesture from other scientist groups or institutions. **Appendix-A** provides some general guidelines for authorships.

3.5 Plagiarism:

As mentioned in 2.2, plagiarism involves using other's words, results or published work without appropriate citation. This includes using one's own published work without disclosure. An internal check by the authors using software must be done before a paper/report is submitted for publication or distribution. The authors should provide a statement to this effect in the acknowledgement section. With the soft-wares being available for such checks for inadvertent duplication, there should be no room for accidental plagiarism.

In the CSIR system, the Library/Knowledge Resource Centre/ Standing Publications, Ethics and Scientific Vigilance Committee or any other designated Division of each institution may be requested to provide such software, and to help with such checks for each manuscript rigorously.

3.6 Redundant /Salami Publications:

Resorting to 'Redundant' publications for artificial enhancement of the number of publications is also a serious act of misconduct. Also, the simultaneous submission of the same manuscript in multiple journals, in order to have one of them accepts it, is gross misconduct.

3.7 Safe laboratory practices:

It is obligatory that CSIR institutions train their staff for safe laboratory practices and provide sufficient budget for training programs to be conducted at regular intervals. Proper attire, use of gloves, proper ventilation, proper shoes, proper instruction and training in handling hazardous chemicals/gases/ radioactivity, and safety sheets for proper fire, electrical and other facility must be in place in all places of work. These should be checked regularly and a proper record be maintained.

Provisions for these and for training are the ethical and administrative responsibility of the management of the institution. The scientists and staff are also responsible in ensuring proper information and usage of facilities. Appropriate budgetary provisions in a separate budget head, should be created towards these, by the institution/CSIR.

A **'Laboratory Procedures and Safety Officer'** should be appointed in each of CSIR centres/institutions with a defined responsibility. Periodic checks and repeated training of researchers through mandatory in-house courses or workshops should be held at least once a year and at the time of induction of new colleagues. Safe laboratory practices are listed in Ref 4.

3.8 Research on humans and human biological materials:

Stringent guidelines on the use of humans as experimental participants in clinical trials, and the use of human biological material in research, exist. The Union Health Ministry has provided guidelines on these, as well as on the exchange of human biological materials and these should be adhered to (Ref.2). Similarly, clinical trials (all phases) should be held as per the guidelines and with prior approval from the concerned agency group (Ref. 13).

On the use of human biological materials for experimental research, even in the laboratory and the clinic, one needs first 'informed consent' from the individual from whom the material is obtained, and based on this, approval from the human ethics committee of the institution. Details of these are found in the guidelines published by the Indian Council of Medical Research (ICMR, Ref.2) and all in the CSIR system will need to follow these guidelines by ICMR, sensu stricto .

3.9 Use of animals in research:

The Ministry of Environment, Forests and Climate Change (MoEFCC), India has provided guidelines on the rules and regulations on the use of animals in research (Ref.14). Due and humane care should be taken of animals before, during and after the experiments. The animal houses should comply with the best possible standards of hygiene and upkeep, regular training program should be conducted, and regular interaction with animal welfare groups and scientists is recommended in order to ensure minimal distress. All in CSIR system will need to follow these guidelines of MoEFCC, sensu-stricto.

4. Gender issues

National and institutional guidelines must be followed. The handbook on sexual harassment of concern at workplace, published by the Ministry of Women and Child Development (Ref.15) will be the guiding principles for all CSIR institutions. Each institute shall have a committee on various aspects of these issues, and this committee should meet on a periodic basis and proactively work towards programs to create awareness on such issues.

Gender equality should be the core value system of every academic individual and institution in CSIR and full, unbiased equal opportunity to women should be provided. A regularly conducted orientation program on gender sensitivity, awareness of the rights of workplace and its environments, should be carried out so that everyone, at all levels, is sensitized.

CSIR Institutions should endeavour to develop a system of accessible and affordable care services, lounge services to cater to special needs for women to provide them with a gender equitable environment. The option of working out of home in case of women with small children should be explored and approved on a case by case basis. Every CSIR institution should carry a gender audit and its report should be placed as open access. Novel steps and efforts to encourage women in their work places should be enumerated and listed.

As far as possible, it will be desirable to have women experts on each panel of selection and administration and the Institute Committee should examine all cases of gender related misconduct as an academic misconduct and within the provisions of existing laws. Gender harassment of men in any respect should also be treated at par with those for women.

5. Dealing with Misconduct

The suggested **Standard Operating Procedure (SOP)** for inquiry in any act of scientific misconduct is detailed in the **Appendix-B** and **Table-1** which provides for the fair and transparent trial of an accused and safeguards the interest of whistle-blowers (Ref. 16; Section 13). An Institutional Committee on Ethics called the **Standing Publications, Ethics and Scientific Vigilance Committee (SEC)** involving people at different levels (scientific, administrative, technical, students, and with gender representation) should be established. The committee would be chaired by a Chief Scientist or higher with an Ethics Officer as member secretary. The SEC would be responsible for training staff members on all aspects of scientific ethics and looking into best lab practices and publications to be observed by the scientific community.

Scientific misconducts would be investigated by the **Scientific Investigation Board (SIB)** comprising scientific/technical personnel of appropriate expertise (with gender and SC/ST/OBC representation) and with at least one external expert to investigate the matter, fact finding and recommending the punitive action. The SIB would be set-up by Director of the laboratory, and DG, CSIR for the headquarters.

6. Types of reports and related documents covered under this umbrella

In addition to publications in professional journals, the recommendations highlighted in Section 3 above as “Good Science Practices” will apply for all research papers, academic theses for M. Phil, M. Tech, PhD, DSc, and other degrees, technical reports, grant applications as well as consultancy reports and certifications.

7. Intellectual Property

Any publication or a report that has the possibility of a consequential patent that could lead to a marketable application or product is defined as intellectual property. The authors who are involved in the publication/report should first ensure, before making it public, as to who did what and the share that accrues to each of them in the proceeds ahead of time. And when this ‘property’ is patented and licensed for commercialization, no dispute should then occur about the share of each in the property and its proceeds. Any share that accrues to the laboratory/institute where the discovery/invention was made (using its facilities) must also be agreed upon a priori and in writing.

Towards this, each academic institution/research laboratory is advised to have an in-house intellectual property rights (IPR) expert, or have one as a consultant. The rules that apply in the institution must be adhered to by the authors and users of the patent. A handy and updated manual on IPR and technology transfer has been published by the Indian Council of Medical Research (Ref.2) and the CSIR laboratories and individuals are advised to refer to the same.

8. Ethics in Governance and Conflict of Interest (CoI):

Governance is an integral part of any institution and involves several layers of activities ranging from appointments and periodic evaluations, allotment of funds, approval for training programs and deputation for various meetings related to the institution, allotment of staff and students, to name a few. All these require fairness in judgement in decision making, despite the fact there is often a considerable room for subjectivity. Institutional systems must be created such that the decision making process is fair and transparent, providing equal opportunity to all.

An important element in the decision making is the aspect of Conflict of Interest (CoI), which has been addressed to in detail (Ref. 4-6). CoI arises when an individual finds himself under multiple loyalties arising due to either of personal/professional relationships or due to extraneous financial considerations. These lead to a compromise on the interest of the CSIR system as these impact a person's impartiality in the decision making process (be it a selection process for a new employee; promotion of a colleague; financial matter in respect of purchases; financial grants for research, or for selection of an award or a fellowship).

It is therefore essential that in every decision making process, all the members who are involved with decision making process, necessarily sign a Conflict of Interest Statement indicating that none of his/her relatives, students, collaborators, group members or institutional members is/are being considered in the proposed meeting for decision making. This procedure should apply to all committees relating to the work of CSIR, i.e., institutional issues and matters such as funding for research under its Extramural Programs, various awards and prizes, and the like. Those conflicted may recuse themselves from the committee proceedings.

Conflicts of interest can also arise from competitions in research work when one favours his students/institutional colleagues in comparison to others with comparable merit. This may be, for an eventual quid pro quo from his colleagues. The same applies to grant process for sponsored research on behalf of National funding agencies. In all such meetings which lead to a decision of long term consequence, a conflict of interest form given in Appendix-C should be signed by each member and countersigned by the Chairman and kept as a part of the minutes.

9. Other Recommendations

9.1 Suggestions for action to reduce the stresses that lead to unethical conduct: an important aspect of reducing such cases is appropriate training and understanding of the issues involved. Thus, CSIR may evolve a system of regular workshops on various aspects, such as good laboratory practices, safety issues, publication and plagiarism, gender sensitivity, data analysis and statistical procedures and importantly training in communication. To ensure that these courses occur at regular intervals, a dedicated Ethics Officer and Safety Officer can be appointed. He/she will be responsible to ensure that the training is imparted effectively and regularly including for those inducted afresh. These courses should carry credits in terms of career advancement. The

Safety Officer will also ensure and report on non-compliance of safety norms. Deliberate incidences of misconduct in respect of safety and ethics, may attract a mention in the confidential file of the officer/employee concerned and may affect his assessment itself.

Performance parameters for career advancement must be focussed on the quality of work and not on number of publications, nor where the research work is published. Agencies across India (UGC, MHRD, DST, DBT, SERB, CSIR, ICMR and others) must agree on a common set of parameters which should be followed.

CSIR may take a lead in reorienting its evaluation procedures to take cognizance of what is published and not where is published. INSA policy statement (10) may be used as a general guideline.

9.2 In doing so, predatory journals must be avoided. Periodic updates of the names of such journals are published (e.g., the Beall's List; https://beallslist.weebly.com/) and such others). As a simple rule, with the exception of some highly reputed journals published by scientific societies that charge publication fee to ensure open access, rapid publication through payment should be strictly avoided.

9.3 Prior to sending for publications, scientists should check for plagiarism using current software tools that should be made available by the institute. The library of the institute/ Knowledge Resource Centre / Standing Publications, Ethics and Scientific Vigilance Committee or any other designated Division of the Institute can provide this service as a part of their mandate.

9.4 Archival of all primary data including field records related to publication to be deposited with the institute's knowledge resource centre or any other designated Division of the Institute with appropriate security for intellectual property. Both soft and hard copies should to be kept. This will imply creation of a data archival system within CSIR systems with appropriate security. This will require resource allocation.

9.5 Due acknowledgement of the work at CSIR should be made.

9.6 Under safe laboratory practices, due attention must be given frequently on areas such as fire safety, use of hazardous chemicals, disposal of waste of various kinds (chemical, biological, material, radioactive) and related issues. Mock drills should be conducted from time to time in order to keep all in the institution prepared and ready. Intervals between such drills should be no more than 6 months.

10. Personal Ethics/introspection:

Much of CSIR work is based on public funds and hence should be used with abundant caution. More importantly, it should be the duty of each individual to personally evaluate if the work done by him/her would lead to any tangible benefit to CSIR or the country in terms of a definitive novel idea, product or a patent. Most institution have a cell for outreach activities and it is a part of the duties of scientists working with public funding that they provide regular overviews of their work to the stakeholders in a clear to understand manner, without any attempt to overstate the achievement. It is essential that scientists use proper and easured language while presenting their work and mentioning the limitations of the work. On a subtler nuance is the fact that many laboratories are well funded due to the system they belong to. These laboratories then procure large equipment and use these to work as material characterization centre and then demand their pound of flesh in the intellectual property, without any serious contribution. This is a gross unethical use of public funds, and should be discouraged. Every instrument bought with public funding should be treated as a public property and with reasonable caution on their misuse, should be made available to all, based only on the scientific merit of the analysis being done. It is also ethical that precious public funds are used judiciously in the choice of a program. Only those programs that conform to the overall contours of CSIR's mandate be taken up. Please refer to Chapter 6 of Ref.3 for further elucidation.

11. EMR grants and CSIR grantees:

These guidelines shall also apply to researchers availing of CSIR extramural grants, as well as to CSIR Fellows including the Distinguished and Bhatnagar Fellows.

12. Grievance Redressal Mechanism Appointment of Ombudsman:

The scientific misconduct would be investigated by Scientific Investigation Board (SIB). The report of the SIB would be shared with the accused while implementing the punitive action. Any scientific/technical staff or a research worker, who is not satisfied with the recommendation of the SIB and the punishment/decision based on same by the competent authority can appeal, within 60 days, to Director General, CSIR for Grievance Redressal.

The appeal should be based on merits, clearly bringing out facts and with supporting evidences that were not taken into consideration by the SIB. DG, CSIR may, in turn, and based on the merits of the appeal, refer the matter to an Ombudsman of the concerned subject group for recommendation. The decision of DG, CSIR on recommendation of the Ombudsman shall be final and binding on all sides.

Any researcher or student who is being pressurised by his/her supervisor for unethical practices related to publications and laboratory practices may approach Standing Publications, Ethics and Scientific Vigilance Committee (SEC)/Ethics Officer.

An **Ombudsman** here is defined as an independent, impartial, free-service provider, who has not been associated with, or a beneficiary of the CSIR system ever. The Ombudsman would investigate complaints that have not been solved by the organization complained against. He/she would investigate complaints where something has been handled badly or unfairly, making someone suffer as a result. The Committee suggests the appointment of one Ombudsman to each of the five major groups of CSIR institutions (groups of Physics, Chemistry, Biology, Engineering and Information sciences). Such an Ombudsman should be a non-CSIR person of proven scholarship, integrity and administrative experience. It is also suggested that all the Ombudsmans work in close synergy and as a group, for an overall coherence of application of rules, within the CSIR system. The Ombudsman may take the support of any technical expert, if so required.

The Ombudsman would be provided necessary support by Standing Publications, Ethics and Scientific Vigilance Committee (SEC) coordinated by Ethics Officer of the institute/CSIR Hqs. The Ombudsman will be paid honorarium, TA/DA and provided accommodation for holding the meetings.

13. Whistle Blowers and his/her identity and Protection

Whistle blowers are people who inform the authorities of some wrong doings. In an ideal case, any unsigned report from an unidentified source/person should not be acted upon. However, in the larger interest of CSIR, the DG may initiate an inquiry in cases where any anonymous complaint is accompanied by factual and verifiable data for a particular case. Fraudulent and inappropriate complaints made for reasons other than the larger interest of CSIR, will also attract a departmental enquiry, but this will also be in the scope of an approach Ombudsman. All such cases will be dealt with by the CSIR HQs and the protection of whistle blower will be ensured by it.

14. Acknowledgments

Committee thank Dr. Sudeep Kumar (Honorary Advisor to the DG), Sh. R. P. Singh (Chief Scientist & In-Charge, Mission Directorate) and Sh. Anoj Kumar Chadar (Principal Scientist, Mission Directorate, CSIR) for active participation and for appropriate advice and suggestions. And Committee thank Dr. S. Mande, DG, CSIR for his active interaction and advice.

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Appendix – A

A.1 Authorship Guidelines

While it is clear that authorship accrues to all those who contribute to the study that being submitted as a research paper/book/monograph, often differences arise on the sequence of the authorships and credits therein. A few general guidelines are provided below, though there should be a room in these for a case- by- case adjustment. Normally the person who is responsible for ideation and conceptualization of experiments/ problems, creation of a work plan/ identification of potential collaborators and their role and the one who ensures the veracity of data becomes the **Corresponding Author**. The person who carries our most of the actual work in the laboratory or on the computational/calculation/formalism aspect normally becomes the **first author**. This person is also responsible for the first draft of the paper. Normally this would be a younger worker like a graduate student or a junior colleague.

Co-authorship accrues to all those who have made a reasonable scientific contribution to the work including generating new data/ developing algorithms or like. Co-authors are also expected to explicitly contribute to the science being presented and agree to the final results in a formal sense. Any change in the sequence of authorship, post-submission, should be done by informing the editor with clear reasons. Care should be taken to ensure that such actions are not required as they reflect somewhat poorly on the group and the institution.

In the case of reviews/report where consolidation/synthesis of information is generally presented, the sequence of the authorship should be discussed a priori. In such cases, the lead author is the one who takes the initiative of writing the first draft.

Authorship is a serious matter and be accepted with all responsibility that accrues with it. Thus, by agreeing to a co-authorship/authorship one **implicitly assumes shared accountability** for the scientific content, its accuracy vis-a-vis its being genuine, and other related aspects. This applies in all cases even when a fraudulent data/manipulated image was not sourced from one of the co-authors. Every co-author shares a role in any part of a fraudulence in the entire work chain, if detected at any time. A written consent of all authors to any report that is submitted for publication in some form is desirable, along with an explicit statement of who did what and contributed in which manner.

It is unethical to offer, expect or accept **honorary** or **guest authorship** based on some ones administrative/scientifically higher position. This is unethical.

Acknowledgement is another area that needs due care. Normally, in any study many people and all these should be acknowledged in a proper manner. These include, people, funding sources and the laboratory staff. Routine discharge of duties by staff need not be acknowledged, but those who contribute to science/experiments in a meaningful manner should not be ignored either.

Appendix – B

B.1 Standing Publications, Ethics and Scientific Vigilance Committee (SEC):

Every CSIR lab as well as the HQ should have a **Standing Publications, Ethics and Scientific Vigilance Committee (SEC)** look into the best lab practices and publications to be observed by the scientific community. The committee would be chaired by a Chief Scientist (or one at a higher level) and comprise scientific and technical, administrative, and research fellows/students as members (with gender representation), with the Ethics Officer as the Member Secretary. The Committee in each lab would be constituted by its Director, while for the Hqs, it would be constituted by the DG. The Terms of Reference (TOR) of the committee would be as follows:

i. The Committee shall regularly conduct seminars in Good Laboratory Practices and publications;

ii. shall make mandatory implementation of communication numbers at the time of publications after obtaining approval from competent authority;

iii. shall check Similarity index and Plagiarism of all publications;

iv. shall ensure that the scientific audit of each publication is done;

v. shall advice and guide the Director/DG, CSIR on all matters pertaining to misconduct in scientific practices and research ethics;

vi. shall respond to any external parties (on behalf of CSIR) for compliance with ethical standards in respect of research projects undertaken by staff;

vii. on an entirely voluntary basis, researchers may seek the inputs of this Committee for consultation on ethical aspects of their research;

viii. shall work on any other matter as assigned by the Director / DG, CSIR

B.2 Standard Operating Procedure (SOP) for dealing with Scientific Misconduct

The following SOP is suggested for dealing with alleged cases of Scientific Misconduct:

i. Complaint/information can be entertained from ‘identified’ individual. Anonymous complaints are not to be entertained.

ii. The scientific misconduct is to be investigated by the **Scientific Investigation Board (SIB)**.

iii. Director (for individual laboratory) and/or DG-CSIR (for CSIR Hqs) will set up a Scientific Investigation Board (SIB) comprising scientific/technical personnel of appropriate expertise (with gender and SC/ST/OBC representation) and with at least one external expert to investigate the matter, fact finding and recommending the punitive action (taking input/response of the accused, if needed).

iv. The SIB will do due diligence including interaction with the concerned scientific staff, examine the records and suggest the suitable punitive action commensurate with the offence done as per the Table-1 given below. Based on the above, SIB will submit the report to the Director and/or DG, CSIR as the case may be for consideration and appropriate action.

v. In case of minor, moderate and major penalties (except those covered in section B.2.vi below), the same will be imposed on the accused directly by the Director for the laboratory and DG, CSIR for the Hqs.

vi. The cases of major and severe transgressions involving penalties such as Deferred promotion/ Deferred increments/ Reduction to lower stage/ Compulsory retirement / Removal from Service, will be dealt as per the established administrative process (as per the rules and regulations adopted by the CSIR) by administration with the approval of the competent authority.

vii. **Appellate Authority for Grievance Redressal**: The report of the SIB would be shared with the accused while implementing the punitive action. DG, CSIR will be the Appellate Authority for reviewing the punitive action recommended by SIB and implemented by the competent authority. The accused shall have the right to appeal, within 60, days against the recommendation of the SIB (and the punishment/ decision based on the same by competent authority), to the Director General, CSIR, for Grievance Redressal. The appeal should be based on merits, clearly bringing out facts and with supporting evidences which were not taken into consideration by SIB. DG, CSIR may in turn, based on the merits of appeal, refer the matter to an Ombudsman of concerned subject group for recommendation. The decision of DG, CSIR on the recommendation of the Ombudsman shall be final and binding on all sides.

B.3 Table-1: Levels of misconduct and suggested advice on action to be taken

Category	Characteristics	Examples	Action
I. Simple Error/ Minor Transgression	Non-deliberate, evidence of experiments having been performed via lab books or other records, with minimal or no change to primary scientific conclusions	Plagiarism – materials and methods Unmodified/Unmanipulated image duplication between figures or panels, where original data can be shown Mistake in matters of credit/authorship where there is no clear misconduct	First: No action required other than correction of mistake /Counselling Second: Minor penalty such as warning for person(s) held responsible
II. Moderate Transgression	Very frequent instances of category I transgressions (>10). Deliberate, errors with changes to primary scientific conclusions, probable data fabrication	Plagiarism – main text Modified image duplication between figures or panels or Instances of image duplication between publications, inability to provide original data Deliberate denial of authorship or credit	Minor penalty commensurate with frequency and degree Removal from responsible position/ Ban supervision/ Ban submission of proposals/ Ban consultancy/ Defer increments/Deferred promotion / Take a credit course on Ethics.

III. Major Transgression	Frequent instances of category II transgressions Any instance of clear data fabrication,	Plagiarism – data or >50% of text Clear image manipulation sufficient to change scientific interpretation Instances of repeated image duplication between publications, with different labels Deliberate usurping of credit, fake authorships	Penalty to responsible person(s) Take a credit course on Ethics/ Deferred promotion/ deferred increments/ reduction to lower stage/ compulsory retirement
IV. Severe Transgression	Very frequent instance of category III transgressions		Major penalty commensurate with the severity of misconduct Compulsory retirement/ removal from service

Appendix - C

Conflict of Interest Statement

I hereby certify and undertake that none of my relatives, students, collaborators, group members or institutional members is/are being considered in the proposed meeting for decision making.

S. No.	Name, Designation and Institutional Affiliation of the Member	Signature	Remarks (viz. recused due to Conflict of Interest etc.)
1.			
2.			
So on…			

(Signature of Chairman of the Committee)

Name:

Designation:

Institutional Affiliation:

Date:

Place:

Note: Any member can 'recuse' oneself from the meeting because of a potential conflict of interest and same need to be recorded in remarks section.

Indian National Science Academy (INSA)

ETHICS in SCIENCE EDUCATION, RESEARCH AND GOVERNANCE

Edited by K Muralidhar Amit Ghosh AK Singhvi

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Ethics in Science Governance

Manohar Lal Munjal
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"The philosophy of the school room in one generation
will be the philosophy of government in the next".

– Abraham Lincoln

Introduction

Ideally science is an individual driven creative activity and scientific progress in a broad sense results from the fair play of free intellects, working on subjects of their own choice, in the manner dictated by their curiosity for exploration of the unknown (Bush, 1945). Nevertheless, as the consequences of scientific research have deep impact on society, governance of scientific research, whether it be at the level of an individual scientist making a choice of the problem to work on, or by the agencies providing funding, or the government through its policies, etc. involves key ethical issues.

Over the last 500 years, scientific enterprise has grown enormously. In India, science is mostly public funded through legislative action. An Estimated 200,000 scientists work in India (www.nature.com/news/India-by-the-numbers-1.17519) both in R&D institutions and in the larger sector of universities and, in PG/UG colleges. Amartya Sen (2009), quotes Hungarian polymath and thinker, Michael Polanyi who pondered deeply 'about the knowledge of the world and the world of knowledge' and put forward the view that scientists are the best judge to determine what research to do as they understand best the issues involved (Polanyi, 1962). Although not everybody agrees with this position (Tyler, 2013), even today, more or less, scientists themselves organize, govern and 85Manohar Lal Munjal & Ashok Kumar Singhvi regulate their enterprise. Governments decide science policies and thrust areas in them, in broadest terms. Every component of scientific enterprise at different levels is carried out by and large by sub-groups of scientists themselves. Governance is thus done basically by sub-groups of working scientists and at times by professional bureaucrats and other entities.

Professional ethics in decision making at all levels of governance should therefore be seriously considered by the decision makers. It is in the vested interest of working scientists that governance of scientific activities is carried out keeping this in mind.

This chapter discusses different areas of science governance where ethical conduct is of crucial importance. Interested reader may also like to see the discussion paper on the subject published by the World Commission on the Ethics of Scientific Knowledge and Technology (Report of COMEST 2015). A major factor in these arises from the issues of conflict of interest.

Conflict of Interest

Cambridge Dictionary defines conflict of interest (CoI) as a situation in which someone’s private interests are opposed to that person’s responsibilities to other people i. e. a situation in which someone cannot make a fair decision because they will be personally affected by the result. Transparency is an essential ingredient of any governance process and the conflict of interest then becomes a serious component of this process, though often overlooked, either through deliberate design or through sheer ignorance. Both have detrimental effect on the fairness of any process of evaluation.

Conflict of interest can arise from personal issue when one sits in judgment of his kith and kin and colleagues with a prospect of providing them undue favor. This can also arise from institutional affiliations where one could favor his institution or colleagues for some gains or for an eventual quid pro quo. It could also arise from similarity of research problems being pursued by two groups and one holds back the review of the other to gain time for his work to be first published. These acts give rise to nepotism and compromises on the aspects of scientific integrity.
Normally under such cases, it will be desirable to opt out of evaluation process, when even a minor conflict of interest is seen. In many committee meetings overseas and now often in India, all the members do make a formal statement on possible conflicts of interests and it is up to the wisdom of the Chair and the committee to take a call on such statements. The CoI applies of all cases where a selection or a choice is to be made. These include all aspects ranging from election of fellows in the academies to the selection committees, purchase process, promotions, peer review process and everything. One needs to be conscientious in these matters and use his/her judgment in each situation.

Assessment of Research Output and Impact

Peer assessment of the research output of a scientist is necessary in order to:

a. Measure its impact on the state of the art, i.e. the contemporary science;
b. Appreciate the scientist’s contribution to the society which supports his/her research, although indirectly;
c. Check if the research grant or funding has been utilized properly;
d. Assess the particular scientist’s standing with respect to his/her contemporaries in the scientific world;
e. Decide upon his/her suitability for promotion to a higher rank or chair.

While the subjective factor is unavoidable and indeed necessary in peer assessment, quantitative assessment of the scientist's research output in terms of, 1) the number of papers published in peer-reviewed journals and presented at conferences in India and abroad, 2) impact factor of the relevant journals, and 3) the citation and the H-index, are also needed for objective assessment of performance of the scientist under review. In doing so, care should be taken that these indices are used only as indicative judgment and it should be ensured that the quality of work itself is rigorously evaluated by the expert/committee. This requires due diligence on the part of the experts/committees.

Unbiased assessment of the scientist's research output and impact involves the following ethical issues:

- The reviewer(s) selected for peer assessment should not be in any way, professionally or personally, related to the candidate to minimize any possibilities of nepotism, parochialism and favoritism.

- They should be sufficiently competent in the area of the candidate's proposal and above board. The committee should comprise people of core competence to professionally examine the vision of the candidate vis a vis institutional mandate.

- There should be no conflict of interest in the subject matter of research of the candidate and the reviewer.

- The assessment procedure should be as transparent as possible. The reason and process, and merits/demerits of the case be recorded explicitly and if possible be placed in public domain.

Record keeping is an essential aspect of such activities and as far as possible both written and audio recording of the meeting should be preserved for future scrutiny.

Funding of Sponsored Research

The academia and scientists depend on public money for the purchase of necessary equipment(s), software, consumables and services, and for supporting their research assistants and associates. For this, they apply to the funding agencies (mostly public) through project proposals prepared in a specified format. These applications are generally peer reviewed. Subject to positive reviews, the PI is often invited by the appropriate Program Advisory Committee (PAC) to make a presentation and answer the reviewers' questions. Based on this presentation, the PAC makes recommendations to the funding agency (like SERB/DST, DRDO, DAE, CSIR, AICTE, ISRO, etc.) for full or part funding. Often the PAC reviews the project periodically for progress or fulfillment of the project objectives or deliverables. It is eminently desirable that the parameters for evaluation are decided a priori and made known to the candidates in advance. For judicious utilization of the tax payers' money, the project must lead to

- publication of papers in reputed journals thereby leading to tangible progress to our understanding of the natural forces and phenomena; or
- amelioration of public suffering by helping purification of air, water, or environment in general; or
- some product/process/technology of use to industry or public at large; or
- augmentation in yield and quality of crops; or
- prevention and/or treatment of diseases leading to mitigation in human suffering.

Success in this whole process of sponsored project depends on the following ethical issues:

a. The process of selection of projects for full or part funding should be transparent so that the prospective PIs know in advance what to expect, how to formulate a good proposal, how to defend it, how to execute it, and how to further their research career through successful execution of the project.
b. The chosen reviewers of the project proposals should make sure that there is no conflict of interest.
c. Members of the PAC should be accomplished scientists or academicians with proven track record so that they can do justice to the job of advising the funding agency. The onus here lies with the funding agency to identify and approach such persons. It is eminently desirable that during their tenure the members of PAC/PAMC do not submit their project to the committee or if they must then recuse from the entire process. The chair may co opt experts for such cases. *Sensu stricto*, any committee funding its own members without recorded statement on conflicts of interest is grossly unethical and should be scrupulously avoided.
d. The funding agency should call for project proposals in the identified thrust areas if they want to ensure social relevance or applicability of the project outcome. Of course, this would not apply to project proposals in fundamental research, which in the final analysis are equally important.
e. The handling scientists at the funding agency must always remember that they are discharging a public duty; they should not adopt the attitude of a 'giver'. They should understand that they are not doing a favor to PIs by releasing the sanctioned grant in time. They should also refrain from seeking personal favors from the funded PIs or their institutions. The committee members should explicitly refrain from seeking any favors from the PI.
f. For large or costly projects, there should invariably be a Co-PI to ensure that the project is not abandoned midway if for some reason(s) PI leaves the institution or is unable to carry on further for a variety of reasons. Institutional guarantees for any proposal for its successful completion should be an essential requirement for any publicly funded proposal. It is unethical to let a project suffer both due to the movement of people concerned as also due to bureaucratic

hurdles. It is desirable for institutions to have separate account for research projects for ease of accounting and accountability.

g. Implementation of proposals in a timely manner is also important. This implies ethical conduct on the part of the Finance and Administrative authorities to release grants in a timely manner so that the work is done in a smooth, seamless manner. Delay in funding negates the basic tenets of research, which needs to be contemporary. Appropriate checks and balances should exist in any funding system for a timely disbursal of funds. Also the perspective with which a project is funded should be kept in mind while evaluating the financial and administrative aspects. Science capacity building should be viewed as an important national objective.

Ethical Aspects of Recruitment

Institutions are made (or marred) by the quality and attitude of their scientists or academicians. Therefore, recruitment of scientists or younger faculty is of crucial importance. The head of the institution must pick up his/her senior advisors extremely carefully, who then may be charged with identifying, recruiting and nurturing promising young scientists. For example, (Late) Prof. Satish Dhawan, as Director of the Indian Institute of Science, would make it a point to personally chair every selection committee not only for the selection of lecturers or scientific officers but also Senior Research Fellows who could eventually rise to become Assistant Professors. He would find time for this important job even when he was simultaneously the Secretary of Space. To ease this process, he created the posts of Divisional Chairmen, who would in turn involve international reviewers for recruitment and promotion of the Institute faculty. The Divisional Chairmen would paraphrase and present the reviewers' reports to a standing Promotion and Assessment Committee (PAC) consisting of distinguished academicians, which would then make appropriate recommendations to the Governing Council. This practice has served IISc very well and has helped the organization to reach and retain its position as a world class institute.

Every recruitment exercise must avoid the following ethical pitfalls:
a. The entire recruitment process must be transparent to all aspirants;
b. The relative importance of the different assessment criteria should be understood and adhered to by all members of the selection committee;
c. None of the selection committee members should have an apparent conflict of interest, or else the concerned member should excuse himself/herself from the exercise;
d. The selection committee should guard against any non-technical or parochial considerations; merit must be the predominant criterion. They must remind themselves of the proverb, 'one bad fish can spoil the whole pond';
e. The expert members identified for the selection / interview committee must have impeccable academic/scientific credentials as well as integrity.

Organizations/Institutions should guard against the tendency to poach from sister institutions as this does not help the nation. To an extent however this is unavoidable and should be examined on case to case basis – exclusively on the aspects of scientific merit and on the long-term interests of the institution and the individuals.

Ethical Aspects of Social Recognition of Scientific Excellence

Some academicians and scientists have a tendency to announce their research findings in the social media and local newspapers before communicating the same to a peer reviewed journal. This is unethical. Social recognition naturally follows when a scientist gets recognized by his peers. However, some of the scientists who may not have the caliber or strength to face critical peer review, tend to resort to the practice of using the social media to create pressure on their institute authorities for augmentation of their career. This is unethical.

There is, however, another aspect to this unethical practice. The science correspondents of the news media often sniff around the Institute/ Laboratory campuses for sensational stories for their periodical science columns. Scientists should refrain from talking to these correspondents about their unpublished work. This is the job of the Institute Information Center or Public Relations Officer, who would apply the necessary filters or checks before sharing the scientific stories with the news media. Such official hand-outs would neither embarrass the Institute nor mislead the public.

Of course, the Institute or Laboratory authorities should be happy to share the exciting or promising discoveries made by its scientists/ academicians with the public, and the credit or social recognition would accrue to the concerned scientists. This would be an ethical practice.

Ethical Aspects of Funding Policies

Do the Means Serve the End? Capacity Building vs. Achievement of Excellence

Several universities/institutions in India have magnificent buildings and open spaces. However, there are comparatively little funds for the maintenance and working expenses of scientists/faculty. Many of these institutions have beautiful laboratory spaces which are however ill- equipped and/or suffer from poor maintenance. This policy or practice of capacity building at the expense of excellence in achievement is basically unethical. Impressive facades and infrastructure deceive the public (including NRIs) and lots of students are enticed into seeking admission in such institutions paying high fees, and they finally pass out with sub-standard level of education. A large percentage of such ‘cheated’ students are unemployable and remain unemployed or underemployed for no fault of theirs.

Another aspect of this problem is the tendency of some scientists/academicians to equip their laboratories with latest/costly equipments (electron microscopes) and keep publishing tons of papers on material. There is little or no new science in this kind of work. While capacity building is necessary to some extent, it cannot be an end in itself. Scientific excellence should be showcased; not just advanced imported equipments. It does not behove a scientist to reduce himself/ herself to a research assistant or laboratory technician as that can be construed as unethical use of public funding.

Ethical Aspects of the Choice of Academic Leaders

For a healthy scientific environment, leadership is very crucial. An efficient and distinguished leader would attract and nurture capable and promising scientist/faculty. On the other hand, a leader of mediocre credentials would repel talent and excellence. For his/her own survival, he/she would appoint only mediocre staff, thereby doing permanent damage to the institution. Devoid of academic vision and leadership, such leaders often pride themselves on the creation of infrastructure and other non academic matters.

Therefore the choice of academic leaders is of paramount importance. In the past several education commissions and committees have emphasized the basic criterion for the choice of leadership. Thus, for example, the Kothari Commission states that, 'A Vice Chancellor should be a person with vision and (have) qualities of academic leadership with ability for administration. He should command high respect among all sections of the society. The Vice Chancellor should be a distinguished academic... have commitment to the values for which the universities stand....He must have the ability to provide leadership to the university by his academic worth, administrative competence and moral stature (Kothari Commission 1964 66:334)'. Such a vision is applicable to the entire spectrum of scientific leadership and any deviation from such vision on the choice of leadership in Science will be an unethical practice.

Academic leaders should have impeccable credentials so that their younger colleagues look up to them with awe and respect. To choose such leaders, the search-cum-interview committees must be manned by eminent scientists of high integrity, known for their fair practice and for whom scientific standing and leadership potential of the candidate should be the primary criteria. Succumbing to non-technical considerations must be eschewed.

Confidential reports from distinguished or established peers can be a good source of impartial and considered advice. This, however, is subject to proper choice of reviewers as well as search committee members. It will be necessary that all the evidence used in the final selection be decided *a priori* and then recorded *sensu stricto*.

It is important to avoid inbreeding as far as possible or feasible, otherwise the selected scientist or academician will not be able to exercise authority. More importantly, an inbred leader may bring with him/her prejudices and obligations which may adversely affect his/her decision making. The umbilical cord of a student and his department/institution must be broken, as it were. Besides, inbred leaders, with their pre-conditioned minds, often find it difficult to get out of the rut and are unable to look for out-of-the-box solutions for the deep-rooted problems in the system.

Ethical Aspects of Establishing and Organizing Centers, Departments, Schools and Institutes – Static vs. Dynamic Models

The Director/Vice Chancellor of an Institution/University should have a vision to establish and organize new centers, departments, schools and institutes. They should not be impulsive or parochial. Nor should they set up a new Center just to accommodate or placate a particular scientist or appease a vocal lobby.

Perpetuation of the conventional setups or laboratories constitutes a static model of science administration. In keeping with modern trends, the Director may choose to think beyond the conventional contours and establish new schools of study and possibly close down less contemporary areas. In Germany for example, each centre of an academy has a well-defined tenure and on their completion, centers in new areas get initiated. This ensures the vibrancy of the academic system. As more and more of the present-day research is multi-disciplinary that calls for a dynamic model of administration as well as leadership.

Due diligence needs to be applied to the need of a new center, and how it would fit into, or add to, the existing centers. It is very important for the Director or Vice-Chancellor to seriously consider the long-term maintenance or sustenance of this new center and ensure that the funds will be available. Often funding is available for setting up a new center for an immediate perceived need, but not for its healthy maintenance. Self-sustenance of the center is a desirable feature and must be considered seriously right at the start. Absence of a well reasoned and deeply researched economic viability model for a centre also in a way constitutes an unethical practice.

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2. He should never have plagiarized, or made false claims or indulged in or encouraged any kind of unethical or dishonest activity in science.
3. He should whole-heatedly support the decisions and actions to be taken collectively by the Society after such decisions and actions had been approved by him.
4. He should agree to withdraw from the Society if he ceases to adhere to guidelines 1, 2 and 3 above.

Executive Council of SSV
(Jun 2019 to May 2022)

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Scientists who wish to join the efforts of the Society to promote ethics (support right and oppose wrong) in scientific research, development and management and, who meet the following requirements are welcome to become the member of the society.

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