

Making Sense of the “Broader Impacts” of Science and Technology

Preliminary Report of a Research Workshop held at the Colorado School of Mines, Golden, Colorado on August 5 – 7, 2007

<http://www.ndsciencehumanitiespolicy.org/workshop/>

Sponsors

- National Science Foundation
- Department of Philosophy, University of North Texas
- Division of Liberal Arts and International Studies (LAIS) Hennebach Program in the Humanities, Colorado School of Mines,
- AAAS Scientific Freedom, Responsibility, and Law Program

Introduction

Although NSF’s “Broader Impacts” merit review criterion (BIC) has been in effect for ten years, its reception by members of the science, technology, engineering, and mathematics (STEM) community has been mixed. The initial goals of this workshop were to reflect on the rationale behind BIC, as well as to investigate whether researchers *on* science, technology, and society (ROSTS) – from disciplines such as History, Philosophy, Policy Studies, and Science and Technology Studies (STS) – can assist STEM researchers in addressing the “broader impacts” of their research.

Participants quickly reached consensus on four points:

- (1) BIC is susceptible to multiple justifications.
- (2) ROSTS are well suited to help articulate why addressing “broader impacts” is important.
- (3) ROSTS can help advise STEM researchers on how they might address “broader impacts.”
- (4) ROSTS have potential not only to aid STEM researchers, but also to help inform decision making vis-à-vis BIC.

Background and Rationale

NSF’s current generic merit review criteria for project selection (“What is the **intellectual merit** of the proposed activity?” and “What are the **broader impacts** of the proposed activity?”) went into effect on October 1, 1997. In the intervening decade, although proposers and reviewers have demonstrated facility with understanding, articulating, and assessing the “intellectual merit” of proposed activities, many remain confused about or resistant to the “broader impacts” criterion. Indeed, by 2002 proposer and reviewer attention to BIC was deemed so lax that, in an effort to reemphasize its importance, NSF issued Important Notice No. 127, which advised the STEM community that NSF would return without review proposals that did not address *both* merit review criteria.

Although the *quantity* of proposals and reviews that address BIC has shown steady improvement since 2002, even the most recent reports from NSF’s Committees of Visitors (COVs) and Advisory Committee for GPRA Performance Assessment (AC/GPA) note continuing problems with the *quality* of responses.

Since 2005, several efforts have been undertaken by education and public outreach (EPO) professionals – who assist in communicating scientific and technical information to members of the public, e.g., through museums and other informal education venues – to help STEM researchers learn how to use EPO methods or partner with EPO professionals to address “broader impacts” in their NSF proposals (for a list of “how to” workshops, see: http://humanitiespolicy.unt.edu/sci_eng/criterion2_workshops.php).

Despite such efforts, confusion and resistance on the part of some members of the STEM community concerning BIC remains strong. A recent article in *American Physical Society News* characterizes reaction among members of this scientific community as “mixed” toward BIC, noting that some view the criterion as “confusing, burdensome, inappropriate, or counterproductive,” and quoting one who describes it as “punitive” (June 2007, Volume 16, Number 6, available online at: <http://www.aps.org/publications/apsnews/200706/nsf.cfm>).

The rationale behind our research workshop is, in part, that knowing *why* to address broader impacts may be as important to motivating STEM researchers to address BIC as knowing *how* to address broader impacts. Just as there exists a professional community with knowledge relevant to answering “how to” address BIC in terms of EPO, there also exists a professional community with knowledge relevant to answering “why” scientists and engineers should become more sensitive of the possible broader impacts of their research – researchers on science, technology, and society, such as philosophers and historians of science and technology and scholars from STS and policy studies. Moreover, ROSTS can help in extending “broader impacts” beyond EPO activities alone by providing more options for “how to” address BIC. Thus far, however, unlike EPO professionals, ROSTS have put forth little sustained effort to make their expertise on the “broader impacts” or science and technology available and useful to members of the larger STEM community.

Finally, it is important to note that independent of our research workshop planning, on August 9, 2007, the America COMPETES Act (H.R. 2272) was signed into law. The America COMPETES Act (in Section 7022) requires the Director of NSF to issue a report to Congress “on the impact of the broader impacts grant criterion used by the Foundation” within one year of the date of enactment of the Act. Although America COMPETES was not part of the original motivation for our workshop, workshop participants agreed that our research represents an important potential source of independently gathered information of value to NSF and the Director in answering this Congressional charge.

Goals and Participants

The primary goals of our workshop were to reflect on the rationale behind BIC and to investigate whether ROSTS might assist STEM scholars in addressing the “broader impacts” of their research.

The organizing committee gathered together 26 participants from 16 institutions and two foreign countries. The disciplinary backgrounds of participants included Applied Mathematics, Atmospheric Physics, Biology, Classics, Ecology, Electrical Engineering, Environmental Studies, Geology, History, Law, Mechanical Engineering, Neuroscience, Philosophy, Physics, Political Science, Public Policy, Social Science, STS, and Zoology. See Appendix 1 for a complete list of participants.

Issues Raised, Conclusions Reached, and Deliverables Planned

Presentations were given and vigorous discussions were held covering four broad, BIC-relevant themes: (1) describing the historical background of BIC's introduction by NSF; (2) placing BIC within a larger context vis-à-vis review criteria at other Federal granting agencies, as well as internationally; (3) outlining various alternatives for implementing BIC; and (4) offering a broader range of approaches to interpreting BIC.

Some Issues Raised

- Whether problems with the quality of responses to BIC were a question of the *wording* of the criterion or a question of the *implementation* of the criterion.
- Whether researchers whose primary expertise covers a specialized area of science or engineering possess the relevant expertise to assess and address broader impacts.
- Whether and how ROSTS should/could be included in the proposal preparation and review process across a broad range of NSF programs (i.e., a range that extends beyond the Science and Society Program, e.g., as members of proposal review panels in the BIO Directorate).
- Whether STEM researchers should set aside a small percentage of their funding to be dedicated to BIC-related activities (e.g., following the model of the ELSI Program of the Human Genome Project), and whether this approach would be consistent with the goals of BIC (i.e., would it absolve the STEM researchers of their responsibility for thinking through the broader impacts of their research if they merely set aside a percentage of funding to be used to subcontract EPO professionals or ROSTS?).
- Whether addressing broader impacts is a task best left to each individual NSF grant recipient, or one more suited to collaboration between and among recipients on some higher organizational level (e.g., research cluster, academic department, or university).
- Whether interpreting BIC only as “the education and outreach criterion” tends toward “advertising” for science and technology and away from BIC’s potential to inspire critical reflection (e.g., about the responsible conduct of research).

Some Tentative Conclusions Reached

- That the goals and wording of BIC merit further consideration inside NSF, by the larger STEM research community, and by society.
- That ROSTS can provide a valuable service to NSF, to the STEM community, and to society at large by focusing their attention on BIC and by communicating their results independently of NSF’s internal efforts.
- That ROSTS should attempt to join forces with EPO professionals in order to disseminate a broader view of BIC that incorporates a critical element.

Deliverables Planned

- A website: <http://www.ndsciencehumanitiespolicy.org/workshop/>.
- Publication of a special issue of *Science and Engineering Ethics* devoted to BIC.
- An article in *Professional Ethics Report*.
- Submission of a “Policy Forum” piece to *Science*.
- Submission of an “exchange” among workshop participants to *Social Epistemology*.
- Offering a briefing (if desired) on workshop findings to NSF.

- Preparing a panel presentation for the 2008 AAAS Forum on Science and Technology Policy.
- Networking with EPO professionals and STEM researchers in order to share information, as well as to organize a future “Conference on Creating a Broader Impact.”

Summary

This workshop was an important step in focusing the attention of ROSTS on issues associated with BIC, as well as in bringing the contributions ROSTS can make to the attention of the larger STEM community and to decision makers. Having ROSTS focus on BIC makes sense because of their professional involvement with issues relevant to the broader impacts of science and technology on society (not to mention the impacts of society on science and technology). Given the recent passage of the America COMPETES Act, which requires the Director of NSF to report to Congress on the “broader impact of the broader impacts grant criterion,” focusing the attention of ROSTS on BIC could not have come at a better time: workshop participants stand ready to offer information relevant for policy formation at NSF. Beyond such immediate considerations of use, however, workshop participants also aim to raise the overall level of awareness of the complexities involved in the relation between science, technology, and society by offering their perspectives to the STEM community and beyond.

Report Authors

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Workshop Organizing Committee

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Carl Mitcham, Workshop Host
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Mark Frankel
Director, Scientific Freedom, Responsibility, and Law Program of the American Association for the Advancement of Science

APPENDIX 1: Workshop Participants

Wayne Ambler, CU Boulder (Director, The Herbst Program of Humanities for Engineers)

Marilyn Averill, CU Boulder (Environmental Studies Graduate Student)

Stephanie Bird, MIT (Co-editor of Science and Engineering Ethics)

Warren Burggren, UNT (Biologist, Dean of College of Arts and Sciences)

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Kristen Intemann, Montana State (Feminist Philosopher of Science)

Sheila Jasanoff, Harvard (STS Studies)

Shirley Malcom (AAAS, formerly National Science Board)

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Barbara Olds, CSM (Associate Vice President for Education and Innovation)

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Faculty Affairs)

Charmayne Staloff, UNT (Philosophy Graduate Student)

Nicholas Steneck, Michigan (Historian)

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Larry Winter, NCAR (Deputy Director)

APPENDIX 2: Workshop Agenda

Day One (Sunday, August 5)

3:30pm – 3:45pm

Participant Meet and Greet, Room 201 General Research Lab

3:45pm – 4:00pm

Welcome: Barbara Olds and Warren Burggren
 4:00pm – 4:15pm
 Introduction: Robert Frodeman and Carl Mitcham

Session I: Introducing the “Broader Impacts” Criterion (BIC)

4:15pm – 4:30pm
 J. Britt Holbrook: “Why the BIC Still Needs Introducing 10 Years After its Introduction”
 4:30pm – 4:45pm
 Shirley Malcom, “Inside Takes on the Development of the ‘Broader Impacts’ Criterion”
 4:45pm – 6:00pm
 Discussion, with Opening Comment by Mark Frankel
 6:30pm – 8:30pm
 Dinner, Golden Hotel

Day Two (Monday, August 6)

7:30am
 Continental Breakfast, Room 201 General Research Lab

Session II: Contextualizing the “Broader Impacts” Criterion

8:00am – 8:15am
 Sheila Jasanoff: “Broader Impacts of STS Research on Science and Technology Policy”
 8:15am – 8:30am
 Nicholas Steneck: “Do Criteria Make a Difference? Lessons from the NIH Training Grant RCR Requirement”
 8:30am – 8:45am
 Steve Fuller: “International Perspectives on the Social Assessment of Science”
 8:45am – 10:00am
 Discussion
 10:00am – 10:15am
 Break

Session III: Implementing the “Broader Impacts” Criterion

10:15am – 10:30am
 Tim Miller: “The Broader Impacts of Education and Public Outreach”
 10:30am – 10:45am
 Warren Burggren: “NSF Funding for ‘Broader Impacts’: Alternative Approaches”
 10:45am – 11:00am
 Eric Fisher: “‘Broader Impacts’ and the Embedded Humanist”
 11:00am – 12:15am
 Discussion, with Opening Comment by David Guston
 12:30pm – 2:00pm
 Lunch, CSM Student Center

Session IV: Interpreting the “Broader Impacts” Criterion

2:15pm – 2:30pm
 Kristen Intemann: “‘Broader Impacts’ and the Participation of Under-represented Groups”

2:30pm – 2:45pm

Susan Cozzens, “Measuring ‘Broader Impacts’”

2:45pm – 3:00pm

Clark Miller: “Interpreting ‘Broader Impacts’”

3:00pm – 4:15pm

Discussion, with Opening Comment by Heather Douglas

4:15pm – 4:45pm

Toward a Broader Impacts Manifesto?

5:15pm – 7:15pm

Dinner, Hilltop Bistro

Day 3 (Tuesday, August 7)

7:30am – 10:00am

Ruminations: a Working Breakfast, Table Mountain Inn