Broader Impact Area #4:

Broad Dissemination to Enhance Scientific and Technological Understanding

This document provides a summary of the discussions related to broader impact area #4 at the National Science Foundation (NSF) Broader Impacts Summit held on June 22-23, 2010. While much of the discussion focused on issues and ideas specifically related to dissemination, a significant amount of time was spent discussing broader impact in general. This document reports on both of these discussion threads.

1 Definition of Broader Impact Area: Dissemination

The fourth of NSF's five broader impact areas, broad dissemination, refers to activities that promote an increased societal awareness, understanding, and appreciation of the field of computer science. The appropriate target audience for dissemination activities can be defined in many ways — as professionals in other disciplines, as legislators, as the general public, etc. The audience can also span a range of targeted ages and education levels, from kindergarteners through senior citizens.

Members of the group struggled to answer the question: What does *broad* mean? Does it mean diversity, or size, or both? The group explored all of these interpretations, and came to the conclusion that the definition could be any of these ideas. For a diverse dissemination, the activity must, at a minimum, reach people outside of the area of specialization of the intellectual merit. Examples include: reaching across social communities, such as working with kids; and reaching across professional communities, such as interacting with people who work in education, in other disciplines like physics or chemistry, in industry, or in government. The group was conflicted about whether dissemination to other subspecialties within computer science was diverse enough. For a significant size dissemination, an activity strives to reach a large number of people.

2 Current Exemplary Activities for Broadening Participation

While much of the discussion focused on the challenges of dissemination and broader impact, the group did come up with a brief list of effective dissemination activities. This list is not meant to be exhaustive, but rather a sampling of possible activities.

2.1 RET, not just REU

The NSF Research Experience for Teachers (RET) program supports the active involvement of K-12 teachers and community college faculty in engineering research in order to bring knowledge of engineering and technological innovation into their classrooms[1]. This program not only reaches out to teachers, but it can also serve as a great source of local-interest stories for media organizations. For example, a RET program at UMass Lowell was written up in the Lowell Sun.

2.2 New media about research

New and creative sources of information are continually making their way into the mainstream media, giving researchers novel outlets for dissemination. A few examples are:

[1] `http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5736`

- **comics:** *Logicomix: An Epic Search for Truth*[2] by UC Berkeley computer science professor Christos Papadimitriou, along with Apostolos Doxiadis, Alecos Papadatos, and Annie Di Donna. This graphical novel introduces readers to logic and its history. Reviews of the book have appeared in such news outlets as Salon and the New York Times.

- **blog:** *Computational Complexity*[3] blog by Lance Fortnow and Bill Gasarch. The authors write about their views on "computational complexity and other fun math stuff", including podcasts and videocasts.

- **video:** *Large Hadron Rap*[4] by the folks at CERN. This catchy rap written by CERN science writer Kate McAlpine talks about the physics behind the Large Hadron Collider and about particle physics in general. As of August 2010 the video had almost six million views on YouTube.

2.3 Helping researchers become better presenters to the public

Researchers are not, in general, formally trained in public speaking, audience engagement, and improvisation. Many professional acting and comedy groups offer courses to help researchers gain these valuable skills. For example, professors from Northwestern University worked with the Second City improv group in Chicago[5]. This group offers such courses as *Improvisation for Creative Pedagogy.*

2.4 Science cafes with presentations for the public

For the cost of a cup of coffee or a glass of beer, people interested in various scientific topics converge to hear talks by local scientists and engineers. These informal talks are a chance for researchers to bring their ideas and work to the local community. Examples include domestic grassroots events announced on the Nova ScienceNow webpage `sciencecafes.org`[6], and the Cafe Scientifique events[7] in the UK sponsored by the Wellcome Trust. Many of these events are founded by university groups, such as the Boulder Colorado Cafe Scientifique[8].

2.5 Seminars, workshops, and conferences

Organizing and running seminars, workshops, and conferences can bring computer science ideas and research to many different types of people, as well as provide insight about the efficacy of methods for dissemination. For example, the *Supercomputing in Plain English* workshop[9] at the OU Supercomputing Center was designed to answer the question: Can scientists and engineers with relatively modest computing experience learn HPC concepts well enough to take advantage of them in their research? The development of this workshop required the organizers to define and articulate what the fundamental concepts in HPC are, and to develop a syllabus appropriate for nonexperts.

The *Women in Theory* workshop[10] sponsored by the computer science department at Princeton is another example that reaches out to female students at both the undergraduate and graduate levels. This workshop brings together women from different departments through an insightful and engaging educational program.

[2] `http://www.logicomix.com/`
[3] `http://blog.computationalcomplexity.org/`
[4] `http://www.youtube.com/watch?v=j50ZssEojtM`
[5] `http://www.secondcity.com/`
[6] `http://sciencecafes.org/`
[7] `http://www.cafescientifique.org/`
[8] `http://www.cafesciboulder.org/`
[9] `http://oscer.ou.edu/education.php`
[10] `http://www.cs.princeton.edu/theory/index.php/Main/WIT08`

2.6 Interactive museum exhibit

Every year, millions of people visit science museums across the country. Engaging exhibits can have a lasting impact on both young and old alike. For example, a recent addition to the Museum of Science and Industry in Chicago is the *Science of Storms* exhibit[11], which explores the science behind dramatic weather. The exhibit includes numerous interactive pieces like a user-controlled tornado vortex and a wind tunnel.

2.7 Attracting kids to computing

Teaming up with organizations that provide outreach programs to kids can bring computer science to a wide range of students. For example, MIT professor Leah Buechley developed a *Math Handbags* activity[12] as part of the Science Discovery program at the University of Colorado at Boulder. This workshop allowed kids to design decals from mathematical functions which were then used to decorate bags they brought from home.

3 Other Potential Dissemination Activities

The group very briefly brainstormed a few ideas for new dissemination activities.

- *TED talks for kids and by kids.* Inspired by the popularity of the TED conference and the emergence of local events, gearing talks to kids could inspire as much science enthusiasm in children as the talks do in adults.
- *Exhibition of kids' simulations and animations in the spirit of an art-exhibit opening.* Digital art is bringing computing to kids that might not otherwise consider themselves engineers. This activity could be modeled after the FIRST robotics program.
- *Political activism.* Complement the release of large amounts of government data with computing tools to equip and engage citizens in political activism.
- *Maintenance of Wikipedia articles.* Commit to maintaining a series of Wikipedia articles about a new field of computing research.

4 Characteristics of a Good Broader Impact Activity

During discussions, the group proposed several general characteristics a good broader impact activity should have:

- *A measurable effect.* The impact of a proposed broader impact activity cannot be established without methods to evaluate the success of the activity. Thus it is important that activities are designed with clear goals and targets.
- *Institutional support.* The persistence of a broader impact activity will likely rely on continued support from outside of an individual principle investigator's (PI) research lab. Institutional support can come from many sources, such as a department, university, or nonprofit like the National Center for Women and Information Technology (NCWIT).

[11] `http://www.msichicago.org/whats-here/exhibits/science-storms/`
[12] `http://web.media.mit.edu/~leah/grad_work/science_discovery.html`

- *Good alignment.* The message of the broader impact activity needs to be engaging and aligned with the target audience. Also, a broader impact activity that connects to a PI's personal passions and interests is more likely to succeed and to be persistent.

The group also discussed several characteristics specific to dissemination:

- *A connection to people's passions.* A good dissemination activity engages people by connecting computer science with the things they care about most.
- *Research that seeks to improve people's lives.* Research that inherently seeks to improve people's lives will likely have a compelling story for dissemination.
- *An engagement of people in participatory activities.* Activities that go beyond *informing* about computing and instead seek to *transform* people through participatory activities have a high potential for success.

5 Suggestions to NSF

A large amount of the group's discussion focused on the challenges of designing, implementing, and reviewing broader impact activities. Below is a summarization of those conversations.

5.1 Challenges in Broader Impact Activities

There was a consensus in the group that broader impact is viewed by many researchers as more of an obstacle to getting funding then an engaging component of the research process. How to make good broader impact activities more accessible and rewarding to PIs was a major theme throughout our discussions. Below is list of challenges to broader impact in general:

- *PIs need help to design and implement an effective broader impact activity.*

  PIs need help designing, proposing, implementing, and evaluating broader impact activities for several reasons: research time is precious; computing researchers are (usually) not outreach experts; not all activities are suitable for all PIs (*e.g.*, some can't or don't want to work with kids).

  The group proposed several suggestions to NSF to address this issue. First, NSF should beef up their resources for PIs to reflect the existing broader impact infrastructure and resources, such as matchmaking between researchers and outreach organizations[13], and a database of NSF-funded entities that have computing facilities and resources to realize broader impact ideas (participatory sensing, crowd sourcing, etc.). This lack of resources is in contrast to the existing infrastructure for intellectual merit — resources such as research conferences and journals help researchers succeed in intellectual merit activities without the need to build an infrastructure. We need a similar framework for broader impact.

  The second suggestion is a method for disseminating broader impact definitions and ideas to PIs and future PIs. Specific suggestions include: regional broader impact summits like BIRDS; broader impact sessions at existing conferences; a broader impact session at the CISE annual meeting; an annual meeting of PIs to share and brainstorm about broader impact activities. The third suggestion to NSF is to map the broader impact gaps in order to have a purposeful national strategy and for enlisting PIs in these specific gaps.

[13]Organizations mentioned: CSTA, CAHSI, NCWIT, CRA, CRA-W, ACM-W, ABI, STARS, ISTE, LRC, ITest

By providing PIs more extensive tools and resources for designing broader impact activities NSF can accelerate the efforts of all researchers by making PIs more efficient and helping them to avoid reinventing the broader-impact-wheel.

- *PIs need a reward for good broader impact activities and success.*

  The group generally agreed that there is little incentive in the system to reward successful broader impact activities. Two suggestions are: 1. incorporate past broader impact successes into the evaluation of grant proposals; 2. the creation of a recognized, NSF sponsored award, such as *Broader Impact of the Year*.

  Many successful activities are opportunistic and unforeseen (such as the advent of the internet) and thus there may not be adequate funds in a grant to support the continuation and growth of these activities. NSF should consider specific, targeted funding for activities that gain traction or scale up. Another suggestion was for NSF to encourage the lowering of indirect costs on the broader impact activity budget.

- *PIs need more clarity and guidance on what constitutes a good broader impact proposal and measures for success.*

  PIs need a more descriptive definition of the broader impact categories, beyond just a single sentence and examples. However, it is important to balance the level of detail with an amount of vagueness to support out-of-the-box ideas. It is not clear how closely the proposed broader impact activity needs to be related to the intellectual merit.

  There was a philosophical discussion on whether or not all research projects should be held accountable to broader impact. Several questions were raised along a spectrum: If the intellectual merit is directly affecting the public, should they need to do more? If the intellectual merit is very theoretical and abstract, how much broader impact do they need to do? Is it valid to double-count what would have been done for intellectual merit anyway? (No: presenting at a conference. Yes: intellectual merit that is closely integrated with broader impact, such as voting access projects). There was a general consensus that broader impact needs to be integrated with research and intellectual merit, and not just tacked onto the end of a grant — that broader impact should be embedded within a research story. The group agreed that mentoring activities are not enough.

The group also hit upon several challenges specific to dissemination:

- *"Informing is easy. Transforming is hard."* — Mitch Resnick

  Both informing and transforming an audience counts as dissemination, but should they be rewarded differently? The group felt that great dissemination activities will do the latter. To design a transformative dissemination activity, some members of the group suggested thinking of studio activities and not just engineering problems, and to also focus on lifelong learning, and not just K-12. The target audience should be amateur computer scientists.

- Many channels for dissemination using the internet have been defined, such as blogs, podcasts, and YouTube. What are the new, up-and-coming media outlets?

- It is difficult to reach out the press, and most researchers have no training for doing this. Information cannot just be pushed to news organizations. Coverage usually requires a connection with an outlet such as a university's public information officer.

- Not all great dissemination can be foreseen. Sometimes the impact timescale is much longer than the project timescale. As a grant proposer, the extent of long-term dissemination impact can be difficult to envision, making it challenging to line up the right resources. This is especially true for grants with short life spans of one to three years.

- What are the appropriate evaluation metrics for dissemination? Can we go beyond just measuring the number of people reached?

The group felt that the field of computing needs a better public message. To tackle this problem, some members suggested talking to the specific people you want to impact, and also to use the tools of computer science to tell the story of computer science, such as visualization, the web, etc.

5.2 Reviewing Guidelines

To help reviewers evaluate the quality of a proposed broader impact activity, a metric that takes into account the nature of research, the stage of career, and the size of project is needed — the scope of a realistic broader impact activity is a factor of all three of these dimensions. Also proposed by the group is the idea that successful proposals could be determined based on a (possibly weighted) summation of the intellectual merit and broader impact proposed activities, as opposed to requiring excellence in both. The group felt strongly that proposed broader impact activities do not need to be novel, and that proposals that utilize time-proven, successful broader impact methods should be rewarded. Feasibility is more important than novelty.

A proposed broader impact activity should include a budget in the proposal. The proposal should also include a definition of a reasonable target audience and an implementation plan (timelines, letters of commitment, resources, etc). PIs should report on broader impact activities in annual reports, and NSF should provide clear evaluation metrics to help PIs measure the success of their activities.

Proper evaluation of broader impact activities requires review panels that include reviewers competent in evaluating broader impact merit.

A challenge is to figure out how to evaluate projects that have an impact past the lifetime of the grant, and how to reward PIs for long-term success. One suggestion for this latter challenge is to factor in success in previous broader impact activities in the consideration of new grant proposals.

5.3 Broader Impacts Document

It was proposed by several group members that the Broader Impacts Document could serve as a summative evaluation of an activity for reporting on past broader impact work by grantees.

General document text additions:

- Which organizations and/or partners helped with the activity (*e.g.*, NCWIT, CSTA, etc.)?
- What challenges were encountered?
- (optional) What are the anticipated long-term plans? What is the plan to follow and sustain the activity?

Dissemination specific document text additions:

- Who is the appropriate audience and why?
- How many people were, or are expected to be, reached?
- What is the scale of the impact?
- What kind of message was sent or what need is being filled? Why is this important?

Document text changes:

- "activity leaders" to *project team*
- "citations" to a more generalized description of documentation like papers, documents, media mentions, etc.
- The subheadings for "What is needed to implement" are too specific.

6 Names and Organizations of Participating Members

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