



National Science Foundation
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Dear Colleague Letter: Exploring Mechanisms to Enhance the Economic and Societal Impacts of Fundamental Advances in Information and Communications Technologies

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Dear Colleague

Advances in information and communications technologies (ICT) are addressing a wide range of economic and societal challenges. For example, researchers are investigating how advances in learning science and technology can help close the educational achievement gap between children in different income classes and aid non-college-educated workers in gaining new technical skills. Additionally, as the nation's technically trained workforce grows, it will need new forms of work including entirely new industries to achieve full employment and social progress. However, identifying effective technology and successfully deploying it broadly remains a challenge. For instance, although individualized health sensor technologies that track heart rate and physical activity offer the potential to provide more densely-sampled medical data that can be useful for diagnosis and prescription, research suggests that use of these devices may be reduced over time, diminishing their overall impact.

Some of the characteristics and capabilities of ICT that can be harnessed to help address societal challenges include:

- Low marginal cost of ICT-enabled solutions, which will make it easier to scale effective interventions;
- Artificial intelligence, which can identify signal and noise patterns to predict physiological and psychological states and behavior, and request medical interventions that can guide change in those states;
- Rapid, low-cost, at-scale experimentation, data analytics, and machine learning, which can support continuous improvement of digital services;
- Mobile devices, which can provide anytime, anywhere access to digital services;
- Computer-supported cooperative work systems that maximize the ability of people with a diversity of skills, tools, and work settings to collaborate for accomplishment of shared goals;
- Educational systems that allow individuals to gain valuable scientific and engineering knowledge through participation in scientific projects (i.e., public participation in science and engineering research); and
- Simulation, which can support learning by doing, authentic tasks that are predictive of on-the-job performance, and embedded assessment.

Through this Dear Colleague Letter (DCL), the Directorates for Computer and Information Science and Engineering (CISE) and Social, Behavioral, and Economic Sciences (SBE) announce the intention to explore new models for maximizing the societal, psychological, and behavioral impact of these and other advances in ICT, particularly for low-income and disadvantaged individuals, families, and communities.

Some types of ICT have been demonstrated to be effective, but have not been sufficiently developed to achieve the potential societal impact. This may be a specific problem when the market potential for such

technology appears insufficient to stimulate new technology development. For example, the global health community has recognized that companies will under-invest in health technologies such as vaccines for the more than 2.8 billion people living on less than \$2 per day, given their lack of purchasing power. Accordingly, the health community has experimented with “market-shaping” mechanisms to accelerate the definition, development, rigorous evaluation and widespread adoption of health technologies for the global poor. Examples of market-shaping mechanisms include advance market commitments, incentive prizes, milestone payments, and pooled procurement. This type of approach can potentially stimulate the development of new technologies that are not currently explored because of the perceived lack of market future for such technologies.

Other types of ICT may actually be developed sufficiently for market distribution, but following initial adoption are not used effectively. As noted previously, the use of heart rate and behavior tracking devices that have potential health benefits falls off dramatically six months after purchase. What kinds of behavior-shaping strategies can be employed to promote and sustain continued effective use of technologies with positive societal benefits?

Still other types of ICT are recognized to have the potential for substantial societal impact, but there is insufficient agreement on evaluating the effectiveness of these technologies. Does ICT applied in an educational context result in measurable improvements in learning, especially for populations for which traditional classroom methods are not effective? Does continued use of health-tracking sensor technologies result in measurable health benefits? There is a need to improve the assessment of ICT-enabled solutions for societal challenges.

Finally, successful adoption of new technologies often requires innovation in other, supportive technologies that may include major investments in public infrastructure, organizational innovation such as development of new kinds of corporations, and adjustment in public perceptions to overcome cultural lag. This is not only true for ICT innovations, but also for innovations in other fields in which ICT plays important supportive roles and may be the crucial factor facilitating their success.

CISE and SBE invite principal investigators to submit proposals for community workshops and EARly-Concept Grants for Exploratory Research (EAGER) that will explore one of the different approaches outlined above to promote the definition, development, rigorous evaluation and adoption of ICT-enabled solutions to societal challenges.

In the case of community workshops, NSF is open to activities that are designed to stimulate a wide range of novel ideas and approaches that may lead to the models described above. It is anticipated that these workshops will bring together multi-disciplinary perspectives including considerations of cultural change, behavioral science policies, and effects on psychological states and behavior.

In the case of EAGERS, NSF funding will support the initial “high-risk/high-reward” planning work needed to develop approaches in the dimensions described above to stimulate societally-positive ICT development, adoption, and effective use, as opposed to the larger levels of funding that may be required for advance market commitments, milestone payments, incentive prizes, pooled procurement, etc. Successful proposals will provide a plan to answer questions such as:

- What is the societal goal to be addressed (e.g., increasing the wages of non-college-educated workers through innovations in training and employer-employee matching)?
- What is the potential of advances in ICT to make a meaningful contribution to this problem? What is an ambitious but achievable goal, and what metrics exist to evaluate progress relative to the status quo?
- What are the social and psychological mechanisms that need to be addressed to achieve the potential societal benefits of developing and effectively using ICT?
- What approaches can accelerate progress in societally-beneficial ICT, and how should they be implemented? What are the policies required for such approaches, and what are the projected

policy impacts?

- How can different types of innovation be combined to accelerate progress towards a given societal goal (e.g., scientific and technological, institutional, financial, and business model innovations)?
- What information and knowledge exists that should inform the design of approaches for the development and effective use of societally-beneficial ICT?

Successful proposals will integrate insights from researchers and practitioners with relevant expertise [e.g., fundamental advances in computer science (and closely related fields); the design of behavioral science approaches and policy development; domain expertise in a particular societal challenge such as education or workforce development; analysis of socio-technical systems such as K-12 school systems and labor markets] and multiple sectors (government, industry, academia, and civil society).

Conference and EAGER proposals that fail to address concepts described in this DCL will be returned without review. A principal investigator may submit at most one conference or EAGER proposal pursuant to this DCL. The deadline for submission of conference proposals is September 30, 2016, but earlier submissions are encouraged. Submissions should follow the NSF's Grant Proposal Guide (GPG), including GPG Chapter II.D.9 for conference proposals and GPG Chapter II.D.2 for EAGER proposals (see http://www.nsf.gov/publications/pub_summ.jsp?ods_key=gpg).

Principal investigators interested in submitting conference or EAGER proposals (or with other questions pertaining to this DCL) must first contact the program director most closely aligned with the research activities to be proposed:

- William (Bill) Bainbridge, Program Director, CISE Division of Information and Intelligent Systems (IIS), wbainbri@nsf.gov, (703) 292-7470; and
- Heng Xu, Program Director, SBE Division of Social and Economic Sciences (SES), hxu@nsf.gov, (703) 292-8643.

Sincerely,

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