

Partnerships for Innovation: Building Innovation Capacity (PFI: BIC)

PROGRAM SOLICITATION NSF 13-587

REPLACES DOCUMENT(S): NSF 12-578



National Science Foundation
Directorate for Engineering
Industrial Innovation and Partnerships

Letter of Intent Due Date(s) (**required**) (due by 5 p.m. proposer's local time):

November 18, 2013

Full Proposal Deadline(s) (due by 5 p.m. proposer's local time):

January 27, 2014

IMPORTANT INFORMATION AND REVISION NOTES

This program solicitation, Partnerships for Innovation: Building Innovation Capacity (PFI: BIC), is pursuant to program solicitation NSF 12-578, but several important changes have been made.

Topic: "Smart" Service Systems. The program is seeking proposals with a focus on platform technologies to enable "smart" service systems.

Platform technologies [1] are generically defined as a set of technologies that are related; are common to different businesses and product families; are distinctive and can provide competitive advantage and enable and accelerate a broad range of product development (tools, methods, etc.) In the business world, platform technologies are important because they provide a framework for reusing an initial investment in technological know-how in different markets and businesses in order to gain a competitive advantage.

Service systems are socio-technical configurations of people, technologies, organizations, and information designed to deliver services that create and deliver value to customers and other stakeholders by satisfying the needs, wants, and aspirations of customers while achieving positive economic, social, and environmental outcomes [2].

A feature of a service system is the participation and cooperation of the customer in the service and its delivery. A service system then requires an integration of knowledge and technologies from a range of disciplines, often including engineering, computer science, social science, behavioral science, and cognitive science, paired with market knowledge to increase its social benefit.

"Smart" service systems are systems capable of self-detection, self-diagnostic, self-corrective, or self-controlled functions through the incorporation of technologies for sensing, actuation, coordination, communication, control, etc.

PFI:BIC website information. Proposers should review the more comprehensive information provided on the website (<http://www.nsf.gov/eng/iip/pfi/bic.jsp>) before submitting the Letter of Intent.

Limit on number of proposals. An academic institution can submit a maximum of two (2) proposals as a lead institution.

Primary industrial partner(s) requirements have been relaxed. A minimum of one (1) industry partner of any size is required. This partner must be U.S.-based and have commercial revenues including sales, services, and licensing. Grants and government contracts may contribute to its revenues but may not constitute the entirety of its revenues. Note that subawards only can be allocated to business partners defined as a small business concern [3] (<http://www.nsf.gov/eng/iip/sbir/definitions.jsp#sbc>). See the Additional Eligibility Information section for details.

Other partners. Other partners, such as academic institutions, non-profit organizations, public sector organizations, and additional industry partners can be included.

A lead academic institution can participate as a subawardee on any other proposal submitted under this solicitation. Faculty and research scientists affiliated with a proposal submitted by a lead academic institution may participate as consultants on other proposals submitted under this solicitation.

Proposers must demonstrate understanding of potential commercial applications and markets of the platform technology and the "smart" service system or systems to be advanced by the proposed project. See the Full Proposal Preparation and Program Description sections for details.

Mentoring plan for participating students. In addition to the required mentoring plan for postdoctoral researchers, a mentoring plan is required for each graduate and/or undergraduate student receiving support from the project. These mentoring plans should be concise and focus on specifically referencing the role of the student or post-doc on the PFI:BIC academe-industry partnership project.

Additional merit review criteria have been updated. See the "Other Additional Review Criteria" section for details.

Automatic compliance checking. Beginning on March 18, 2013, the NSF FastLane System has begun automated compliance checking for all required sections of full proposals. Please review the following Dear Colleague Letter for more details: <http://www.nsf.gov/pubs/2013/nsf13066/nsf13066.jsp>

[1] Small-Business/ ERC Collaborative Opportunity: (SECO) Funded by the ERC Translational Research Fund and the SBIR Program, PROGRAM SOLICITATION NSF 13-551.

[2] Spohrer J, Maglio PP, Bailey J, Gruhl D (2007). Towards a science of service systems. *Computer* 40(1):71-77. doi:10.1109/MC.2007.33

[3] Small Business Concern (SBC) refers in this solicitation to a business concern that at the time of the submission of the PFI:BIC proposal meets the following criteria: "Is organized for profit, with a place of business located in the United States or which makes a significant contribution to the United States economy through payment of taxes or use of American products, materials, or labor; is in the legal form of an individual proprietorship, partnership, limited liability company, corporation, joint venture, association, trust or cooperative, except that where the form is a joint venture there can be no more than 49 percent participation by foreign business entities in the joint venture; is at least 51 percent owned and controlled by one or more individuals who are citizens of, or permanent resident aliens in, the United States; and has, including its affiliates, not more than 500 employees". See [SBIR/STTR Size Determination](#) for more information.

SUMMARY OF PROGRAM REQUIREMENTS

General Information

Program Title:

Partnerships for Innovation: Building Innovation Capacity (PFI: BIC)

Synopsis of Program:

The Partnerships for Innovation: Building Innovation Capacity (PFI:BIC) program supports academe-industry partnerships, which are led by an interdisciplinary academic research team with a least one industry partner, to collaborate in building technological and human innovation capacity [4]. This innovation capacity is intended to endure beyond the initial award. Partnerships that build the capacity to innovate are expected to be effective at innovating and able to continue to innovate. They are highly intentional about creating an environment that fosters innovation. These partnerships not only develop new technology but also foster the development of human capital that embraces a culture of change, nurtures the generation of new ideas, and considers feedback an integral part of the innovation processes. Partnership members are diverse, representing a spectrum of backgrounds, perspectives, and skills. Partnership activities that drive sustained innovation include the targeted allocation of resources such as capital, time, facilities; and sharing of knowledge in a cross-organizational and interdisciplinary context.

The PFI:BIC partnership team should focus on technological innovations with potential for significant economic/societal impact. The team collaborates on research, focusing on novel applications motivated by existing research discoveries and based on a platform technology with the potential to achieve transformational change in existing service systems or to spur entirely new service systems. To attain this goal, these partnerships, which inherently require interdisciplinary research, must address what is needed to advance this technology so as to enable a "smart" service system or systems to enter into the commercialization process, succeed in the marketplace, and achieve positive economic, social, and environmental outcomes. Such advancement involves not only engineering, computer science, and other fields of science, but also an understanding of the potential interaction of the technology with customers and the broader public affected by the technology, the "socio-technical system." A full understanding of the socio-technical system will require interdisciplinary teams that include social, behavior, and/or cognitive sciences. Finally, the team should demonstrate an understanding of potential commercial applications and markets, which should contribute to guiding the project activities.

Examples [5] of technology applied to service systems include smart healthcare, smart cities, on-demand transportation, precision agriculture, smart infrastructure, and other technologies enabling self-service and customized service solutions.

WEBINARS: Webinars will be held to answer questions about the solicitation. Register on the BIC website where details will be posted (<http://www.nsf.gov/eng/iip/pfi/bic.jsp>). In addition to potential applicants and their partners, Vice Presidents for Research and academic personnel concerned with the review of their institutions' selection of candidates for submission as well as individuals from Sponsored Research Offices are encouraged to attend.

[4] Rockefeller Foundation (n.d.). "Six Factors that Boost an Organization's Capacity to Innovate"

[5] Note that examples have been provided throughout this solicitation to provide a sense of the variety of possibilities across types of service systems and enabling technologies, but by no means are they intended to represent program emphases or priorities.

Cognizant Program Officer(s):

Please note that the following information is current at the time of publishing. See program website for any updates to the points of contact.

- Sara B. Nerlove, PFI:BIC, Program Director, telephone: (703) 292-7077, email: snervlove@nsf.gov

Larry Hornak, ENG, telephone: (703) 292-2678, email: lhornak@nsf.gov

- Alexandra Medina-Borja, ENG/OAD, telephone: (703) 292-7557, email: amedinab@nsf.gov
- Edwin Romeijn, ENG, telephone: (703) 292-2211, email: eromeijn@nsf.gov
- Ralph Wachter, CISE, telephone: (703) 292-8950, email: rwachter@nsf.gov
- Heng Xu, telephone: (703) 292-8643, email: hxu@nsf.gov

Applicable Catalog of Federal Domestic Assistance (CFDA) Number(s):

- 47.041 --- Engineering

Award Information

Anticipated Type of Award: Standard Grant or Continuing Grant

Estimated Number of Awards: 10

Anticipated Funding Amount: \$8,000,000

- Anticipated Funding Amount is subject to the availability of funds and the quality of proposals received.
- Awards may be up to \$800,000 with an award duration of three (3) years.

Eligibility Information

Who May Submit Proposals:

Proposals may only be submitted by the following:

- U.S. universities and two- and four-year colleges (including community and technical colleges) accredited in, and having a campus located in the U.S., acting on behalf of their faculty members. Such organizations also are referred to as academic institutions. The lead (submitting) organization must be an academic institution.

Collaborative proposals between organizations are not permitted. (A collaborative proposal is defined as simultaneous proposal submissions for a joint project from different organizations, with each organization requesting a separate award).

Who May Serve as PI:

The PI cannot concurrently be a PI on more than one active Partnerships for Innovation: Building Innovation Capacity award.

A PI who submits a proposal in response to this program solicitation may not submit a proposal for funding consideration in the same fiscal year to the Partnerships for Innovation: Accelerating Innovation Research program.

Limit on Number of Proposals per Organization: 2

Academic institutions are limited to participation on two (2) proposals as a lead institution. A lead academic institution that has submitted a proposal has the option to participate as a subawardee on any other proposal submitted under this solicitation. Lead academic institutions that have submitted a proposal may also provide consultants to other proposals submitted under this solicitation.

Limit on Number of Proposals per PI or Co-PI: 1

Proposal Preparation and Submission Instructions

A. Proposal Preparation Instructions

- Letters of Intent: Submission of Letters of Intent is required. Please see the full text of this solicitation for further information.
- Preliminary Proposal Submission: Not Applicable
- Full Proposals:
 - Full Proposals submitted via FastLane: NSF Proposal and Award Policies and Procedures Guide, Part I: Grant Proposal Guide (GPG) Guidelines apply. The complete text of the GPG is available electronically on the NSF website at: http://www.nsf.gov/publications/pub_summ.jsp?ods_key=gpg.
 - Full Proposals submitted via Grants.gov: NSF Grants.gov Application Guide: A Guide for the Preparation and Submission of NSF Applications via Grants.gov Guidelines apply (Note: The NSF Grants.gov Application Guide is available on the Grants.gov website and on the NSF website at: http://www.nsf.gov/publications/pub_summ.jsp?ods_key=grantsgovguide)

B. Budgetary Information

- Cost Sharing Requirements: Inclusion of voluntary committed cost sharing is prohibited.
- Indirect Cost (F&A) Limitations: Not Applicable
- Other Budgetary Limitations: Other budgetary limitations apply. Please see the full text of this solicitation for further

information.

C. Due Dates

- Letter of Intent Due Date(s) **(required)** (due by 5 p.m. proposer's local time):
November 18, 2013
- Full Proposal Deadline(s) (due by 5 p.m. proposer's local time):
January 27, 2014

Proposal Review Information Criteria

Merit Review Criteria: National Science Board approved criteria. Additional merit review considerations apply. Please see the full text of this solicitation for further information.

Award Administration Information

Award Conditions: Standard NSF award conditions apply.

Reporting Requirements: Standard NSF reporting requirements apply.

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I. INTRODUCTION

National economic and societal prosperity is increasingly more dependent upon research and technology. Thus, NSF's role of supporting fundamental research across all fields of science and engineering has become ever more relevant to economic competitiveness and value creation. The Partnerships for Innovation: Building Innovation Capacity (PFI:BIC) program establishes and expands partnerships so that existing research discoveries can provide the motivation and foundation to advance technological areas with high potential. These strategic partnerships, which create an academe-industry collaborative culture to build innovation capacity, are in a position to increase the readiness of platform technologies so as to realize and expand their market potential.

Other federal programs also contribute to the goal of innovation. Internal to NSF, there are the following programs: Partnerships for Innovation: Accelerating Innovation Research (PFI: AIR), Innovation Corps (I-Corps), Small Business Innovation Research/Small Business Technology Transfer Research (SBIR/STTR), Grant Opportunities for Academic Liaison with Industry (GOALI), and Industry University Cooperative Research Centers (I/UCRC). For more information on these programs, go to the Division of Industrial Innovation and Partnerships website: <http://www.nsf.gov/div/index.jsp?org=IIP>.

II. PROGRAM DESCRIPTION

The service sector employed approximately 79% of American workers in 2010 [6] and was responsible for 79.7% of the U.S. GDP in 2012, an increase of just under 3% compared to 2010 [7]. Also notable is the increasing role of engineering and value-added services in the manufacturing sector. Given the importance of the service sector and the potential social and economic benefits of "smart" service systems, the Directorate for Engineering of the National Science Foundation invites requests for funding in the area of "smart" service systems under the Partnerships for Innovation: Building Innovation Capacity (PFI:BIC) solicitation. Proposals should focus on platform technology motivated by existing research discoveries that has the potential to achieve transformational change in existing service systems or to spur entirely new systems. The hallmark of PFI:BIC is an academe-industry partnership crafted to collaborate on research to address the central issue of identifying and advancing key platform technologies so as to enable "smart" service systems to enter into the commercialization process and to help insure positive social outcomes that would result from successful commercialization.

The perspectives, competencies, and commitments of both academe and business are needed to address this central issue. Therefore, platform technology advancement should be informed by a deep understanding of potential service systems where the technology could be implemented. A clear understanding of the market need and the competitive landscape should help guide project activities. At least one industry partner is expected to contribute market understanding of one or more promising service applications.

Service systems are socio-technical configurations of people, technologies, organizations, and information designed to deliver services that create and deliver value to customers and other stakeholders by satisfying the needs, wants, and aspirations of customers while achieving positive economic, social, and environmental outcomes [8].

Service systems are becoming increasingly interdependent, often with interconnected configurations of customer-to-customer, provider-to-customer, and provider-to-provider links organized as a large-scale system-of-systems.

Although a service process is performed for the benefit of the customer, the degree of customer involvement in the service process depends on the nature of the process. For example, during a hospital stay, patients will participate in the service process whenever interacting with nurses or physicians. Patients' response to treatment or the way patients provide information could affect the outcome of the service. However, there will be portions of the service that would occur in parallel, independently of patients' direct involvement, such as the processes involved in handing out and reading lab test results by lab technicians and physicians. In the end, the interaction of patients with this system-of-systems will have a single goal: to improve patients' health status. This is why it is said that in order to be considered a service, providers, and recipients co-create value in one or multiple points of their interaction, but sometimes the customer could receive benefits from the sub-systems operating behind the scenes.

Hence, the integration of platform technologies in service systems enabling innovation can occur at different levels of the service system [9] :

- Service concept. Innovations in the service concept or the value proposition facilitated by platform technologies leading to the emergence of novel services never before considered. Examples include the emergence of online auction services in the 1990s or remote conferencing services facilitated by new technologies.
- Customer interface. Innovations in the customer interface or innovations introduced in the service encounter by the use of platform technologies. Examples include self-service technologies, auto-translating technologies, auto-diagnosing technologies, etc.
- Manner of delivery. Innovations in the way the service is delivered and the corresponding interaction with the service recipient. Examples include innovation in mailing logistics, mobile technology and apps, and online services that were initially provided over the phone or in person.
- Processing systems. Innovation in processing systems that feed service systems through the introduction of technologies, thereby creating value in the form of more efficient service systems or higher service quality on the back end but which do not necessarily involve the interface with the customer. Examples include communication technologies to track packages or inventory and algorithms to reduce human error in pharmacies.

Proposals for platform technologies to enable "smart" service systems may address one or more of the levels described above.

Smart cities, on-demand transportation, precision agriculture, smart healthcare, and smart infrastructure are all examples of service systems with the potential to improve quality of life. Solutions to improve government services, including self-service and customized service technologies, are also likely to improve efficiency and quality. Examples of other service systems where smart technologies could make a difference include disaster mitigation and humanitarian services, communication services, utilities, consulting and professional services, and hospitality services, to name a few.

This solicitation seeks proposals that focus on platform technologies to enable "smart" service systems. Examples include, but are not limited to, low-power consumption devices, biodegradable sensors, low-cost sensors, smart phone and tablet platforms, real-time decision making software, customer needs/behavior prediction, self-service and self-customization technologies, machine learning technologies and other intelligent systems, etc.

In addition, with more frequent and ubiquitous use of network linking information, people, processes, and products, a number of sectors, including manufacturing, are increasingly interested in services. This movement, termed "servitization" by Vandermerwe and Rada [10] in 1988, is ever more prevalent [11]. "Servitization", that is, the incorporation of services to increase product value and accessibility, leads to the development of service solutions by manufacturing firms that combine their tangible products with either standardized base services or customized services as an integral part of the value of the product. Servitization examples in manufacturing include but are not limited to changes in the business concept that change the paradigm from selling a product to selling a service. For example, maintenance packages have become more important than the actual product features in many cases. Service packages built into the purchase of a car may include automated emergency rescue services that are activated whenever the vehicle senses a situation of danger. The vehicle's location is communicated to emergency services, even if the driver is unconscious or unable to make a phone call. The European Union [12] recently made it mandatory that all cars manufactured after 2015 have this technology installed. A number of platform technologies are integrated into this system. Once triggered, the system dials the European emergency number, establishes a telephone link to the appropriate emergency call center, and sends details of the accident to the rescue services, including the time of incident, the accurate position of the crashed vehicle, and the direction of travel. These "smart" systems also presuppose a change in the supply chain of services. Emergency monitoring service centers able to communicate with the car and receive all this information had to be created when this technology was introduced.

As technological capabilities advance, there will be many challenging new problems related to the "scale effects" in "smart" service systems. Economies of scale and learning curves are well-known for industrial age economic systems and yet surprisingly are unexplored for the area of "smart" service systems. In fact, for a particular technology level, different scales may be optimal, such as new business models associated with putting solar panels on homes versus providing solar panels for a street, community, district, city, state, or nation. The PFI:BIC research partnership should stimulate considerations of scale that need to be anticipated for successful long-term implementation of "smart" technologies in services. Consider how having all cars on the road being able to communicate with emergency monitoring service centers at once will affect capacity, bandwidth needs, and other technological and human capital requirements.

Often paradigm-shifting innovation in service systems requires having the customer in mind as potential co-creator of the service. Proposals may involve the engagement of potential customers in the research process in any way considered to be effective, from the conceptualization of customer-inspired innovations to exploring a more formal role for customers in the testing of the platform technology application aimed at a specific service system. It is also expected that user-centered research will contribute to the effectiveness of "smart" service systems in meeting important societal needs, such as the need for technologies to better serve the public while delivering essential services. Considerations of how "smart" technology shapes customer behavior (e.g., real-time information on how much energy one household is using relative to neighboring households might modify consumption patterns); and conversely, how customers' cultural differences, socioeconomic and ethnic group identity, age, and other human factors may shape technology development (e.g., "smart" service systems that have customer interfaces that recognize and adapt to different languages, different cultural, gender, and age conventions, etc.) are appropriate.

Academe-Industry Partnerships

The strategic partnerships among academe, industry, and other stakeholders of the PFI:BIC program aim to build innovation capacity in two key ways: 1) technological innovation capacity, by focusing on technological innovations with significant potential for economic and societal impact; and 2) human innovation capacity, by activating academe-industry partnerships that are anticipated to have indelible effects on the partners; and by the participation of students and/or postdoctoral researchers, who are anticipated to develop the skill-sets, capabilities, and motivation to become future innovators in partnership collaborations.

PFI:BIC partnerships must be of high quality, as evidenced by the partners' expertise, experience, and significant measurable commitment to the project, with clear contributions and technical and/or economic "takeaways" [13] for all parties involved. The partnership must enable research accomplishments that would not have been possible without joining the perspectives of academe and industry at a formative stage. Moreover, it should be clear how the partners specifically complement each other in the context of the project.

The primary members of a partnership are an academic research team and at least one industry partner. However, other types of entities may be included (for-profit, non-profit, or public sector) as partners. Other entities also may be included in more peripheral roles as **broader context partners**. The selection of the partners and the blueprint of the partnership should be intended to enable the building of innovation capacity beyond the term of the initial award, generating long-term economic, societal benefits, including the development of human capital. It is expected that academic and industry participants will continue to conduct research and build innovation capacity in a similar collaborative manner in the future, whether or not in the context of this specific project or these specific partners.

Individual projects might require different configurations of partners, depending on the nature of the service system and the position of potential partners in regard to the final users. Therefore, different numbers and kinds of partners are anticipated. Examples follow:

- A project could target a type of service system that requires the integration of several technologies into a device that will be used to improve the user-interface. One primary industrial partner might be the company that has the capability to manufacture the device by integrating this and other technologies into a final product; however, a second industrial partner might be the company or organization that actually provides the service and integrates the device into its service system. For example, imaging platform technologies could be used in devices that facilitate self-service processes in several service systems, such as airlines, banking, etc. The imaging technology also needs to be integrated with other technologies to build the final user-interface. Therefore, in this project, at least two primary partners are essential: one company with the ability to integrate the technology and a second organization that could use it.
- In other cases, the company with the ability to integrate the technology also delivers the service itself. Therefore, advancing the platform technology, the voice of the customer, and an appreciation of the final market could be provided to the project by only one organization. For example, preference prediction algorithms used as personalization technology in e-commerce applications can be integrated into the service system by the same industrial partner that delivers the service.

To facilitate the partners' collaboration in an open innovation context, NSF will require signed written cooperative research agreements (CRAs) between the lead institution and the primary industrial partner(s) and other applicable partners at the time of recommendation for an award. See the Full Proposal Submission Instructions section for more details.

Technological Innovation Capacity

PFI:BIC partnerships should expand the capacity of academe and industry research teams to advance a platform technology so as to enable "smart" service systems, taking post-discovery research from the academic bench to a state of readiness to enter into the commercialization process. The approach should focus on overcoming critical obstacles or barriers, identifying potential market(s) (adding new possibilities as the research progresses), and further understanding of how to meet the needs of those markets.

Human Innovation Capacity

Engaging in the PFI-BIC project activities should provide opportunities for the development and growth of academic faculty and research scientists and industrial participants through cross-organizational collaboration. Over and above the complementarities of the interdisciplinary knowledge of the individual partners are those at the organizational level: the research will benefit in ways that it could not from the involvement of academe or industry alone.

PFI:BIC partnerships will develop the next generation of researchers and entrepreneurs through student and/or post-doctoral researcher participation in and exposure to the academe-industry collaboration. They will simultaneously be linked to: 1) science and technology and 2) real-world challenges and opportunities for identification of commercial applications within the broader market. A defining purpose of PFI:BIC projects is the enculturation of students and/or postdoctoral researchers. These participants should have a role in and receive support from the partnership project, with some opportunity to be immersed in the interaction and collaborate actively with the partners from industry and other organizational entities as well as from academe. The opportunity to engage customers in the development process, which is essential to service systems, can also become a source of unique experiences important in fostering the next generation of innovators.

[6] "Industry employment and output projections to 2020," published in the *January 2012 Monthly Labor Review* of the Bureau of Labor Statistics.

[7] *Field Listing - GDP composition by sector*. CIA World Factbook (2010 and 2012).

[8] See footnote 2

[9] Den Hertog, Pim (2000). Knowledge-Intensive Business Services as Co-Producers of Innovation *International Journal of Innovation Management* Vol. 4, No. 4 (December) pp. 491-528

[10] Vandermerwe, Sandra and Rada, Juan (1988). Servitization of business: Adding value by adding services, *European*

[11] Turunen, T. (2013). Organizing Service Operations in Manufacturing. Aalto University publication series, Doctoral dissertations 4/2013. Permanent link: <http://urn.fi/URN:ISBN:978-952-60-4962-5>

[12] European Commission (2013). eCall: automated emergency call for road accidents mandatory in cars from 2015. IP/13/534 Event Date: June 13, 2013. http://europa.eu/rapid/press-release_IP-13-534_en.htm

[13] "Takeaways"-are defined as capabilities, competencies, or more tangible items that one can take possession of and can move forward with (vs. a benefit that may be merely received and enjoyed). Takeaways are for the primary partners--academe, business, and other--and also include the strategy that has the potential to build the innovation capacity.

III. AWARD INFORMATION

Estimated program budget, number of awards and average award size/duration are subject to the availability of funds.

NSF will make awards subject to the availability of funds and quality of proposals. Awards may be up to \$800,000, with an award duration of three (3) years. *In other words, the total budget request to NSF for the lead institution and all others participating in the project cannot exceed \$800,000.*

As appropriate, awardees have the option to allocate funds for the participation of industrial partners and other primary partners in the project research activities in the form of subawards. Whether or not the option to allocate funds to the partners is exercised, it should be clear how the funds and other resources of the project (e.g., special facilities, equipment, and students) are shared by the partnership.

IV. ELIGIBILITY INFORMATION

Who May Submit Proposals:

Proposals may only be submitted by the following:

- U.S. universities and two- and four-year colleges (including community and technical colleges) accredited in, and having a campus located in the U.S., acting on behalf of their faculty members. Such organizations also are referred to as academic institutions. The lead (submitting) organization must be an academic institution.

Collaborative proposals between organizations are not permitted. (A collaborative proposal is defined as simultaneous proposal submissions for a joint project from different organizations, with each organization requesting a separate award).

Who May Serve as PI:

The PI cannot concurrently be a PI on more than one active Partnerships for Innovation: Building Innovation Capacity award.

A PI who submits a proposal in response to this program solicitation may not submit a proposal for funding consideration in the same fiscal year to the Partnerships for Innovation: Accelerating Innovation Research program.

Limit on Number of Proposals per Organization: 2

Academic institutions are limited to participation on two (2) proposals as a lead institution. A lead academic institution that has submitted a proposal has the option to participate as a subawardee on any other proposal submitted under this solicitation. Lead academic institutions that have submitted a proposal may also provide consultants to other proposals submitted under this solicitation.

Limit on Number of Proposals per PI or Co-PI: 1

Additional Eligibility Info:

Minimum: One (1) U.S.-based industrial partner organization must participate on the BIC proposal.

Revenues: The industrial partner must have commercial revenues including sales, services, and licensing. Grants may contribute to its revenues but may not constitute the entirety of its revenues.

Subawards or Direct Funds from the Grant: Only industrial partners that qualify as a small business per the Small Business Innovation Research (SBIR) program definition [14] can receive subawards.

Project Team and Project Description: Because service systems are socio-technical systems requiring understanding of people, organizations, and information, the team and the project must contain expertise and activity that reflect these requirements. An engineering, a computer science, and a social, behavioral and/or cognitive science component are all needed to develop technology with the appropriate understanding of the implications for the integration of the platform technology with the service system, the usability of the service system, and other human factors. Participation of other scientific fields whenever appropriate is encouraged.

[14] See footnote 3

V. PROPOSAL PREPARATION AND SUBMISSION INSTRUCTIONS

A. Proposal Preparation Instructions

Letters of Intent (**required**):

To submit a proposal for this opportunity, the submission of a Letter of Intent (LOI) by the lead institution (i.e., the applicant institution) is required. LOIs are to be submitted via FastLane at <http://fastlane.nsf.gov/>. More comprehensive information on LOIs is available on the PFI:BIC website: http://www.nsf.gov/eng/iip/pfi/bic/BIC_letterofintent.jsp.

PURPOSE

The LOI is a pre-requisite to proposal submission.

- LOIs are necessary to help NSF prepare and deliver the best review process possible, including assembling panels with appropriate reviewer expertise.
- LOIs provide the NSF with an opportunity to examine proposed projects with respect to eligibility requirements and, in some instances, to identify correctible issues in terms of focus and eligibility.

The LOI will NOT be used as a screening device; that is, it will not be used to disallow full proposals.

In the event that there are changes to the LOI prior to submission of the proposal, it is important to communicate what those changes are to the Program Director.

SUBMISSION. Up to two (2) LOIs per institution can be submitted.

CONTENT/FORMAT

Letters of intent have length limitations. The first two sections are entitled, respectively, Synopsis (2500 characters maximum, including spaces); and Other Comments (2500 characters maximum, including spaces), which can be used wisely to convey important aspects of the project, such as information about the three required components: engineering, computer science, and social, behavioral and/or cognitive science and other scientific components, as applicable. It may also be needed to contain spillover from the Additional Information field, Primary Industrial Partner(s), see below.

Under Additional Information, information in only three (3) data fields is permitted. (Each data field can contain a maximum of 255 characters or approximately 30 words for each section.)

For PFI:BIC, these are as follows:

- For the Platform Technology: Describe briefly the platform technology and its potential to enable a smart service system or systems.
- For the Primary Industrial Partner(s), provide for each: Name, Founding Date, Number of Employees, Location (City & State), Commercial Revenues for the preceding calendar year, and Mission/Technical Foci. Reasonable abbreviations can be used. If you cannot accommodate the information, include the rest of the information under Other Comments (see above).
- For the Activities Advancing Platform Technology that Enables Smart Service System(s): List several major activities proposed as leading to barriers being overcome and/or the identification of new applications.

Letter of Intent Preparation Instructions:

When submitting a Letter of Intent through FastLane in response to this Program Solicitation please note the conditions outlined below:

- Sponsored Projects Office (SPO) Submission is required when submitting Letters of Intent
- A Minimum of 0 and Maximum of 4 Other Senior Project Personnel are allowed
- A Minimum of 0 and Maximum of 4 Other Participating Organizations are allowed
- Platform Technology is required when submitting Letters of Intent
- Primary Industrial Partner(s) is required when submitting Letters of Intent
- Activities Advancing Platform Technology that Enables Smart Service System(s) is required when submitting Letters of Intent
- Submission of multiple Letters of Intent is not allowed

Full Proposal Preparation Instructions: Proposers may opt to submit proposals in response to this Program Solicitation via Grants.gov or via the NSF FastLane system.

- Full proposals submitted via FastLane: Proposals submitted in response to this program solicitation should be prepared and submitted in accordance with the general guidelines contained in the NSF Grant Proposal Guide (GPG). The complete text of the GPG is available electronically on the NSF website at: http://www.nsf.gov/publications/pub_summ.jsp?ods_key=gpg. Paper copies of the GPG may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-7827 or by e-mail from nsfpubs@nsf.gov. Proposers are reminded to identify this program solicitation number in the program solicitation block on the NSF Cover Sheet For Proposal to the National Science Foundation. Compliance with this requirement is critical to determining the relevant proposal processing guidelines. Failure to submit this information may delay processing.
- Full proposals submitted via Grants.gov: Proposals submitted in response to this program solicitation via Grants.gov should be prepared and submitted in accordance with the NSF Grants.gov Application Guide: A Guide for the Preparation and Submission of NSF Applications via Grants.gov. The complete text of the NSF Grants.gov Application Guide is available on the Grants.gov website and on the NSF website at: (http://www.nsf.gov/publications/pub_summ.jsp?ods_key=grantsgovguide). To obtain copies of the Application Guide and Application Forms Package, click on the Apply tab on the Grants.gov site, then click on the Apply Step 1: Download a Grant Application Package and Application Instructions link and enter the funding opportunity number, (the program solicitation number without the NSF prefix) and press the Download Package button. Paper copies of the Grants.gov Application Guide also may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-7827 or by e-mail from nsfpubs@nsf.gov.

Guide to Submission of a Proposal

For program information, contact Dr. Sara Nerlove, Program Director, (703) 292-7077, email: snerlove@nsf.gov

Cognizant Program Officers in the Directorate for Engineering (ENG), the Directorate for Computer & Information Science & Engineering (CISE), the Directorate for Mathematical & Physical Sciences (MPS), and the Directorate for Social, Behavioral & Economic Sciences (SBE)

- Dr. Larry Hornak, ENG, telephone: 703-292-2678, email: lhornak@nsf.gov
- Dr. Alexandra Medina-Borja, ENG/OAD, telephone: 703-292-7977, email: amedinab@nsf.gov
- Dr. Edwin Romeijn, ENG, telephone: 703-292-2211, email: eromeijn@nsf.gov
- Dr. Ralph Wachter, CISE, telephone: 703-8950, email: rwachter@nsf.gov
- Dr. Heng Xu, SBE, telephone: (703) 292-8643, email: hxu@nsf.gov

Note: the submission criteria outlined below are in addition to requirements contained within the NSF Grant Proposal Guide (GPG) or NSF Grants.gov Application Guide.

Full Proposal Preparation Instructions:

Active and early collaboration among the primary project partners is highly encouraged, beginning with the proposal preparation stage.

A. Cover Sheet

The Cover Sheet is automatically generated by FastLane or Grants.gov based on information entered into the "Cover Sheet" module. The title for each project should be preceded by PFI:BIC.

B. Project Summary

Proposals that do not contain the Project Summary, including an **overview** and separate statements on **intellectual merit** and **broader impacts**, will not be accepted by FastLane or will be returned without review. Additional instructions for preparation of the Project Summary are available in FastLane. The Project Summary should be written in the third person and shall begin as follows: "This Partnerships for Innovation: Building Innovation Capacity (PFI:BIC) project...." Provide the title of the proposed BIC project, the name of the PI, and the lead institution.

Box 1: Overview including Naming the Primary Industry Partner(s), and Key Words: A summary paragraph describing the potential outcome(s) of the proposed activity. Provide a statement of objectives and methods to be employed.

Provide a list of key words or phrases that identify the areas of expertise in science or engineering, which are to be invoked in reviewing the proposal. Identify the industry sector(s) to which the "smart" service system or systems innovation is to be initially directed.

Box 2: Intellectual Merit: No proprietary information should be included in the summary. Describe the potential of the proposed activity to enhance scientific and technological understanding both at the level of the platform technology and the "smart" service system.

Box 3: Broader Impacts: Describe the potential of the proposed activity to contribute to economic impact and contribute to the achievement of specific, desired societal outcomes. Information on the potential commercial value can be included in this section.

The aggregate of the three text boxes cannot exceed 4,600 characters.

C. Table of Contents

The table of contents is automatically generated by FastLane or Grants.gov.

D. Project Description

The project description cannot exceed 15 pages and must include the following parts:

Part 1. Narrative Description: Proposers (primary academic and industrial partner(s) and other primary partners, if applicable.) are encouraged to frame the proposal narrative to convey a convincing story. That is, rather than simply describing the potential of the platform technology, the novelty or significance of the proposed "smart" service system or systems and the research plan, proposers should present a compelling story to clearly articulate why this partnership provides the best approach to achieving the greatest impact. This story, while specific to each proposal, should contain at least the following elements: the importance of the research discovery; how the partnership came about; the exciting potential of the discovery to expand what the technology can enable, including market needs that might be addressed; how the partnership might evolve if the project is successful; and how the outcomes of the collaborative research will be greater than the sum of the primary individual (academic and industrial and other, if applicable) partners alone. Include, if applicable, lineage relating to research discoveries in past NSF awards. For each previously funded project, include the directorate name, division name, and award number.

Part 2. Management Plan: Provide a description of the respective roles, responsibilities, and resources of the partnership.

Part 3. Timetable: A table of the research tasks to be conducted, the designated partners to accomplish each task, and the timeline associated with each task.

Part 4. Intellectual Property: Include a discussion of any relevant background intellectual property held by the proposing institution and/or the industry partner, its availability for licensing, and an assessment of how another party might patent or practice around both background and anticipated intellectual property assets.

Part 5. Results from Prior NSF Support: If any PI or Co-PI identified on the project has received NSF funding in the past five years; information on the award(s) is required. Each PI and Co-PI who has received more than one award (excluding amendments) must report on the award most closely related to the proposal. The following information must be provided:

- NSF award number, amount and period of support
- title of the project
- number of publications resulting from the NSF award

E. References Cited

Provide a comprehensive listing of relevant reference sources, including patent citations.

F. Biographical Sketches

All participating personnel from industry and other (types of) primary partners (if applicable) as well as from academe who are not PIs or Co-PIs should be considered as "Non-Co-PI/Senior Personnel". Provide relevant biographical information for the Principal Investigator (PI), Co-Principal Investigators (Co-PIs), and Senior Personnel (including any consultant(s), and/or key member(s) on each subaward). This information should take the form of short "Biographical Sketch" documents (two pages maximum per person). Within each document, include at the top of the first page: the person's name, category of participation (PI, Co-PI, Industry/Other Organization Consultant, Academic Consultant, Industry Subawardee, Academic Subawardee, Industry/Other Organization Participant), and affiliation. Biographical sketches of industry participants need not conform to the standard academic format.

G. Budget, Subaward Budgets, and Consultants

The NSF Summary Proposal Budget is generated in FastLane or Grants.gov. Prepare a budget for each year. The system will automatically generate a cumulative budget for the entire project. All PIs, Co-PIs, and at least one named individual designated as responsible for the leadership of each subaward --this individual(s) must be listed under "A. Senior Personnel" on the subaward budget--and must spend time for which he/she receives salary. The amount of time may be limited, as deemed appropriate; but there must be a formal commitment.

Make clear how many participants there are under each of the categories of "B. Other Personnel" (e.g., 2 students per year cumulates to a total of 6 students on the cumulative budget, which in turn may actually mean that e.g., there are 2 students on the project for 3 years each, or 6 students, for one year each).

Travel costs can be included with careful justification, containing as much specificity as possible regarding the parties, locations/events, and purpose. Foreign travel is allowed.

The NSF does not intend to fund industrial or business research and development. Awarded funds may be allocated in the form of subawards, as appropriate, for participation of the industry in the project research activities, but subawards for industry are optional. The NSF will not provide funds for subawardees to businesses that do not meet the definition of a small business concern [14]. It should be clear in the budget justification and narrative how the NSF funds are shared by the partnership. In the "Facilities, Equipment, and Other Resources" section of the proposal, it should be clear how the other resources of the project (e.g., special facilities, equipment, and students) are shared by the partnership.

If consultants are used, consultant letter(s) must be provided with the number of days and the dollar amount per day, and the role of the consultant; provide an explicit statement that the consultant's role is deemed reasonable and necessary for the project (see below, Section J. Supplementary Documents).

H. Current and Pending Support

The proposal should provide information regarding all research to which the Principal Investigator and other senior personnel either have committed time or have planned to commit time. For all ongoing and proposed projects, the following information should be provided for the Principal Investigator and anyone designated as Senior Personnel in the submitted budget. (Use NSF Form 1239.)

- Name of sponsoring organization and add as a reference the award number;
- Title and performance period of the proposal; and
- Person-months/calendar months (per year) devoted to the project by the Principal Investigator and each of the senior personnel.

The proposal being submitted is considered "pending" (i.e., this proposal) and therefore MUST appear in the Current and Pending Support module.

I. Facilities, Equipment, and Other Resources

Discuss requirements for and the availability of facilities, equipment, and other resources for the proposed work provided by the lead academic institution and each of the partners.

J. Supplementary Documents

Proposals missing any of the required documents outlined below will be returned without review.

The following information must be provided as supplementary documents (unless otherwise indicated) and submitted to the Supplementary Docs module in FastLane or Grants.gov.

1) *Project Framework*. Consider the project framework as the PFI:BIC equivalent of an "elevator" speech. [Please use the template located: [here](#)]. Describe clearly and briefly (using no less than a 11-point font) the following items:

- Maximum 1 page:
 - Problem: Frame the project research as a problem(s)
 - Solution: Describe the path(s) to future impact in service systems
 - Market: Describe the possible markets and commercial applications of the research outcomes. (Detailed market analyses are not necessary-but say what you can about market segment, size, and characteristics). A Letter of Support from a participant(s) in the market may lend credibility to this assessment. "See Letters of Support" also in this section (J. Supplementary Documents).
- Maximum 1 page:
 - Partners: Describe the project partners and why this partnership is the appropriate partnership to carry out this project.
 - Contributions: Describe the specific contributions (facilities, resources, know-how, expertise, etc.) of each partner
 - Objectives: Describe the objectives or takeaway(s) for each partner. If the project is successful, how will these takeaways be implemented following the term of the award?

2) *Partnership List*. Provide a list of all the partner entities and all the participating individuals from those entities, subdivided into the following categories:

- Primary Partners
 - Lead institution
 - Industrial partner(s) , provide founding date, number of employees, location (City & State), financial ties to the lead institution or to any other academic partners, commercial revenues (from the previous year or some other appropriate time period), and mission/technology foci
 - Other partners (if any)
- Broader Context Partners
 - Academic institutions

- Private sector organizations, including for-profit, non-profit businesses, foundations, etc.
- Public sector organizations, including state and local governments, federal government laboratories
- Other broader context partners (if any)

In listing of the personnel from each entity participating in the PFI:BIC, project, provide the individual's title. For each of the individuals from an academic institution, include the department and/or school/college with which the individual is associated.

3) *Organizational/Role Diagram*. Provide an organizational chart that identifies the roles to be played by each of the partners. Note that there is to be an engineering, computer science, and social, behavioral, and/or cognitive science component in each project. There also may be other applicable sciences.

4) *Partnership Letter(s)*

- Primary Partners. Provide partnership letters from the primary industrial partner(s). Each partner should explicitly make a commitment, either financial or in-kind. These letters must be provided on letterhead, signed by the appropriate institution or partner representative and begin with "This letter confirms the partnership between"

The partnership letter should include answers to the following questions:

- What do you stand to gain from participating in this partnership project?
- What do you have to offer to this partnership project? (Commitments: in-kind, cash)
- The following is optional: Briefly make any comments you wish to make about your relationship to any of the partners, how you came to join this partnership, past experience, etc.
- Broader Context Partners (s): Provide letters from all other partners engaged in the proposed project, including the nature of their respective commitments to the partnership.

5) *Cooperative Research Agreements (CRAs)*. A letter (not an official legal document at this point, but signed by an appropriate person at the lead institution) must be submitted with the proposal. The letter should state that CRAs will be provided upon notification that the program is considering a recommendation for award. The lead institution must provide signed written CRAs between the lead institution and the partners in a timely fashion when notification of program consideration for an award recommendation is received.

The CRAs, which are specifically intended for this project and for the benefit and mutual understanding of the primary partners, outline any issues surrounding the intellectual property that each party may bring to the table or intellectual property that could be an outcome of the relationship. CRAs also cover other pertinent matters surrounding the conduct of the partnership. Typical "Articles" in CRAs might include the following: Research, Publication, Intellectual, Property, Term and Termination, Proprietary Information, General, Appendix A (Research Project Title, Research Project Description, Collaborators, Investigators, Scope of Work.) NSF is not responsible for the type or content of agreement reached between the parties. There is no template provided by the program. Should it be useful to adapt a CRA template from another source, please do so.

6) *Preliminary Patent Search*. If appropriate, a preliminary patent search and accompanying discussion to support the feasibility of obtaining needed licenses and/or sufficient protection for the intellectual property developed.

7) *Support Letters*. Begin with "This letter of support....". Each support letter must be distinct. Support letters are one form of providing evidence of market validation, e.g., a signed letter on letterhead from a creditable individual holding a position in recognized entity(ies) in the market (potential future customer, potential licensee, large corporation, etc.) may be included in the supplementary documents to lend credibility to the proposer's assessment of the market and need for an intended application of the platform technology. Make sure support letters are distinct from each other, and note also that they are not to be confused with Partner Letters, which carry a specified commitment.

8) *Student Mentoring Plan*. Provide a mentoring plan for any undergraduate or graduate students receiving support from the budget of this proposal. The mentoring plan should be concise and focus on specifically referencing the role of the student on the PFI:BIC academe-industry partnership project.

Note that the following 2 items for inclusion as Supplementary Documents are NSF-wide requirements:

9) *Data Management Plan*. A Data Management Plan is required for all proposals submitted to NSF. Please reference the data management requirements at this link http://www.nsf.gov/pubs/policydocs/pappguide/nsf11001/gpg_2.jsp#dmp

10) *Postdoctoral Researcher Mentoring Plan (if applicable)*. If more than one postdoctoral researcher is supported on the proposal, the proposer may wish to provide a separate mentoring plan for each researcher. The mentoring plan should contain specific reference to role of the (each particular) postdoctoral researcher on the PFI:BIC academe-industry partnership project.

K. Single Copy Documents

Proposers are encouraged to supply an annotated list (map them onto the key words of the project summary) of suggested reviewers, complete with affiliation and contact information. Proposers are also encouraged to email this information directly to the cognizant Program Director at the time of the submission of the LOI. Choose reviewers, if possible, with breadth--individuals who potentially could serve as panelists suitable for reviewing yours and other proposals as opposed to individuals chosen because there are closely honed to detailed command of knowledge about your project. In addition, the proposal can also designate and label an individual(s) who is a definitive specialist in the areas/technical subtleties of your proposal. If possible, also include a service systems innovation expert. Be particularly mindful about potential conflicts of interest. Avoid selecting any individuals who may have a conflict of interest, or an appearance of a conflict of interest, with the PI, Co-PIs or any of the senior personnel on the project or with the industrial partner(s).

[14] See footnote 3

B. Budgetary Information

Cost Sharing: Inclusion of voluntary committed cost sharing is prohibited

Other Budgetary Limitations:

Limitations:

NSF will not provide salary support for personnel employed by Federal Agencies or Federally Funded Research and Development Centers.

Budget Limitations:

Proposers may request up to \$800,000 from NSF for an award duration of three (3) years.

C. Due Dates

- Letter of Intent Due Date(s) (**required**) (due by 5 p.m. proposer's local time):
November 18, 2013
- Full Proposal Deadline(s) (due by 5 p.m. proposer's local time):
January 27, 2014

D. FastLane/Grants.gov Requirements

For Proposals Submitted Via FastLane:

To prepare and submit a proposal via FastLane, see detailed technical instructions available at: <https://www.fastlane.nsf.gov/a1/newstan.htm>. For FastLane user support, call the FastLane Help Desk at 1-800-673-6188 or e-mail fastlane@nsf.gov. The FastLane Help Desk answers general technical questions related to the use of the FastLane system. Specific questions related to this program solicitation should be referred to the NSF program staff contact(s) listed in Section VIII of this funding opportunity.

For Proposals Submitted Via Grants.gov:

Before using Grants.gov for the first time, each organization must register to create an institutional profile. Once registered, the applicant's organization can then apply for any federal grant on the Grants.gov website. Comprehensive information about using Grants.gov is available on the Grants.gov Applicant Resources webpage: <http://www.grants.gov/web/grants/applicants.html>. In addition, the NSF Grants.gov Application Guide (see link in Section V.A) provides instructions regarding the technical preparation of proposals via Grants.gov. For Grants.gov user support, contact the Grants.gov Contact Center at 1-800-518-4726 or by email: support@grants.gov. The Grants.gov Contact Center answers general technical questions related to the use of Grants.gov. Specific questions related to this program solicitation should be referred to the NSF program staff contact(s) listed in Section VIII of this solicitation.

Submitting the Proposal: Once all documents have been completed, the Authorized Organizational Representative (AOR) must submit the application to Grants.gov and verify the desired funding opportunity and agency to which the application is submitted. The AOR must then sign and submit the application to Grants.gov. The completed application will be transferred to the NSF FastLane system for further processing.

Proposers that submitted via FastLane are strongly encouraged to use FastLane to verify the status of their submission to NSF. For proposers that submitted via Grants.gov, until an application has been received and validated by NSF, the Authorized Organizational Representative may check the status of an application on Grants.gov. After proposers have received an e-mail notification from NSF, Research.gov should be used to check the status of an application.

VI. NSF PROPOSAL PROCESSING AND REVIEW PROCEDURES

Proposals received by NSF are assigned to the appropriate NSF program for acknowledgement and, if they meet NSF requirements, for review. All proposals are carefully reviewed by a scientist, engineer, or educator serving as an NSF Program Officer, and usually by three to ten other persons outside NSF either as *ad hoc* reviewers, panelists, or both, who are experts in the particular fields represented by the proposal. These reviewers are selected by Program Officers charged with oversight of the review process. Proposers are invited to suggest names of persons they believe are especially well qualified to review the proposal and/or persons they would prefer not review the proposal. These suggestions may serve as one source in the reviewer selection process at the Program Officer's discretion. Submission of such names, however, is optional. Care is taken to ensure that reviewers have no conflicts of interest with the proposal. In addition, Program Officers may obtain comments from site visits before recommending final action on proposals. Senior NSF staff further review recommendations for awards. A flowchart that depicts the entire NSF proposal and award process (and associated timeline) is included in the GPG as [Exhibit III-1](#).

A comprehensive description of the Foundation's merit review process is available on the NSF website at: http://nsf.gov/bfa/dias/policy/merit_review/.

Proposers should also be aware of core strategies that are essential to the fulfillment of NSF's mission, as articulated in [Empowering the Nation Through Discovery and Innovation: NSF Strategic Plan for Fiscal Years \(FY\) 2011-2016](#). These strategies are integrated in the program planning and implementation process, of which proposal review is one part. NSF's mission is particularly well-implemented through the integration of research and education and broadening participation in NSF programs, projects, and activities.

One of the core strategies in support of NSF's mission is to foster integration of research and education through the programs, projects and activities it supports at academic and research institutions. These institutions provide abundant opportunities where individuals may concurrently assume responsibilities as researchers, educators, and students, and where all can engage in joint efforts that infuse education with the excitement of discovery and enrich research through the variety of learning perspectives.

Another core strategy in support of NSF's mission is broadening opportunities and expanding participation of groups, institutions, and geographic regions that are underrepresented in STEM disciplines, which is essential to the health and vitality of science and engineering. NSF is committed to this principle of diversity and deems it central to the programs, projects, and activities it considers and supports.

A. Merit Review Principles and Criteria

The National Science Foundation strives to invest in a robust and diverse portfolio of projects that creates new knowledge and enables breakthroughs in understanding across all areas of science and engineering research and education. To identify which projects to support, NSF relies on a merit review process that incorporates consideration of both the technical aspects of a proposed project and its potential to contribute more broadly to advancing NSF's mission "to promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense; and for other purposes." NSF makes every effort to conduct a fair, competitive, transparent merit review process for the selection of projects.

1. Merit Review Principles

These principles are to be given due diligence by PIs and organizations when preparing proposals and managing projects, by reviewers when reading and evaluating proposals, and by NSF program staff when determining whether or not to recommend proposals for funding and while overseeing awards. Given that NSF is the primary federal agency charged with nurturing and supporting excellence in basic research and education, the following three principles apply:

- All NSF projects should be of the highest quality and have the potential to advance, if not transform, the frontiers of knowledge.
- NSF projects, in the aggregate, should contribute more broadly to achieving societal goals. These "Broader Impacts" may be accomplished through the research itself, through activities that are directly related to specific research projects, or through activities that are supported by, but are complementary to, the project. The project activities may be based on previously established and/or innovative methods and approaches, but in either case must be well justified.
- Meaningful assessment and evaluation of NSF funded projects should be based on appropriate metrics, keeping in mind the likely correlation between the effect of broader impacts and the resources provided to implement projects. If the size of the activity is limited, evaluation of that activity in isolation is not likely to be meaningful. Thus, assessing the effectiveness of these activities may best be done at a higher, more aggregated, level than the individual project.

With respect to the third principle, even if assessment of Broader Impacts outcomes for particular projects is done at an aggregated level, PIs are expected to be accountable for carrying out the activities described in the funded project. Thus, individual projects should include clearly stated goals, specific descriptions of the activities that the PI intends to do, and a plan in place to document the outputs of those activities.

These three merit review principles provide the basis for the merit review criteria, as well as a context within which the users of the criteria can better understand their intent.

2. Merit Review Criteria

All NSF proposals are evaluated through use of the two National Science Board approved merit review criteria. In some instances, however, NSF will employ additional criteria as required to highlight the specific objectives of certain programs and activities.

The two merit review criteria are listed below. Both criteria are to be given full consideration during the review and decision-making processes; each criterion is necessary but neither, by itself, is sufficient. Therefore, proposers must fully address both criteria. ([GPG Chapter II.C.2.d.i.](#) contains additional information for use by proposers in development of the Project Description section of the proposal.) Reviewers are strongly encouraged to review the criteria, including [GPG Chapter II.C.2.d.i.](#), prior to the review of a proposal.

When evaluating NSF proposals, reviewers will be asked to consider what the proposers want to do, why they want to do it, how they plan to do it, how they will know if they succeed, and what benefits could accrue if the project is successful. These issues apply both to the technical aspects of the proposal and the way in which the project may make broader contributions. To that end, reviewers will be asked to evaluate all proposals against two criteria:

- Intellectual Merit: The Intellectual Merit criterion encompasses the potential to advance knowledge; and
- Broader Impacts: The Broader Impacts criterion encompasses the potential to benefit society and contribute to the achievement of specific, desired societal outcomes.

The following elements should be considered in the review for both criteria:

1. What is the potential for the proposed activity to
 - a. Advance knowledge and understanding within its own field or across different fields (Intellectual Merit); and
 - b. Benefit society or advance desired societal outcomes (Broader Impacts)?
2. To what extent do the proposed activities suggest and explore creative, original, or potentially transformative concepts?
3. Is the plan for carrying out the proposed activities well-reasoned, well-organized, and based on a sound rationale? Does the plan incorporate a mechanism to assess success?
4. How well qualified is the individual, team, or organization to conduct the proposed activities?
5. Are there adequate resources available to the PI (either at the home organization or through collaborations) to carry out the proposed activities?

Broader impacts may be accomplished through the research itself, through the activities that are directly related to specific research projects, or through activities that are supported by, but are complementary to, the project. NSF values the advancement of scientific knowledge and activities that contribute to achievement of societally relevant outcomes. Such outcomes include, but are not limited to: full participation of women, persons with disabilities, and underrepresented minorities in science, technology, engineering, and mathematics (STEM); improved STEM education and educator development at any level; increased public scientific literacy and public engagement with science and technology; improved well-being of individuals in society; development of a diverse, globally competitive STEM workforce; increased partnerships between academia, industry, and others; improved national security; increased economic competitiveness of the United States; and enhanced infrastructure for research and education.

Proposers are reminded that reviewers will also be asked to review the Data Management Plan and the Postdoctoral Researcher Mentoring Plan, as appropriate.

Additional Solicitation Specific Review Criteria

Other additional review criteria are as follows:

- The promise of the platform technology to enable a "smart" service system or systems, which has the potential for economic/societal impact.
- The value of the activities to be carried out to address the central issue on which the partnership is focused; namely,

identifying and advancing key platform technologies so as to enable "smart" service systems to enter into the commercialization process and to help insure positive social outcomes that would result from successful commercialization.

- The quality of the primary partnership (e.g., expertise, achievements, complementarities, commitment) as integral to the planning and execution of these activities.
- The likelihood that the nature of the participation of students and/or postdoctoral researchers in this culture of collaboration will prepare them to be future innovators.

B. Review and Selection Process

Proposals submitted in response to this program solicitation will be reviewed by Ad hoc Review and/or Panel Review.

Reviewers will be asked to evaluate proposals using two National Science Board approved merit review criteria and, if applicable, additional program specific criteria. A summary rating and accompanying narrative will be completed and submitted by each reviewer. The Program Officer assigned to manage the proposal's review will consider the advice of reviewers and will formulate a recommendation.

After scientific, technical and programmatic review and consideration of appropriate factors, the NSF Program Officer recommends to the cognizant Division Director whether the proposal should be declined or recommended for award. NSF strives to be able to tell applicants whether their proposals have been declined or recommended for funding within six months. Large or particularly complex proposals or proposals from new awardees may require additional review and processing time. The time interval begins on the deadline or target date, or receipt date, whichever is later. The interval ends when the Division Director acts upon the Program Officer's recommendation.

After programmatic approval has been obtained, the proposals recommended for funding will be forwarded to the Division of Grants and Agreements for review of business, financial, and policy implications. After an administrative review has occurred, Grants and Agreements Officers perform the processing and issuance of a grant or other agreement. Proposers are cautioned that only a Grants and Agreements Officer may make commitments, obligations or awards on behalf of NSF or authorize the expenditure of funds. No commitment on the part of NSF should be inferred from technical or budgetary discussions with a NSF Program Officer. A Principal Investigator or organization that makes financial or personnel commitments in the absence of a grant or cooperative agreement signed by the NSF Grants and Agreements Officer does so at their own risk.

Once an award or declination decision has been made, Principal Investigators are provided feedback about their proposals. In all cases, reviews are treated as confidential documents. Verbatim copies of reviews, excluding the names of the reviewers or any reviewer-identifying information, are sent to the Principal Investigator/Project Director by the Program Officer. In addition, the proposer will receive an explanation of the decision to award or decline funding.

VII. AWARD ADMINISTRATION INFORMATION

A. Notification of the Award

Notification of the award is made to *the submitting organization* by a Grants Officer in the Division of Grants and Agreements. Organizations whose proposals are declined will be advised as promptly as possible by the cognizant NSF Program administering the program. Verbatim copies of reviews, not including the identity of the reviewer, will be provided automatically to the Principal Investigator. (See Section VI.B. for additional information on the review process.)

B. Award Conditions

An NSF award consists of: (1) the award notice, which includes any special provisions applicable to the award and any numbered amendments thereto; (2) the budget, which indicates the amounts, by categories of expense, on which NSF has based its support (or otherwise communicates any specific approvals or disapprovals of proposed expenditures); (3) the proposal referenced in the award notice; (4) the applicable award conditions, such as Grant General Conditions (GC-1)*; or Research Terms and Conditions* and (5) any announcement or other NSF issuance that may be incorporated by reference in the award notice. Cooperative agreements also are administered in accordance with NSF Cooperative Agreement Financial and Administrative Terms and Conditions (CA-FATC) and the applicable Programmatic Terms and Conditions. NSF awards are electronically signed by an NSF Grants and Agreements Officer and transmitted electronically to the organization via e-mail.

*These documents may be accessed electronically on NSF's Website at http://www.nsf.gov/awards/managing/award_conditions.jsp?org=NSF. Paper copies may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-7827 or by e-mail from nsfpubs@nsf.gov.

More comprehensive information on NSF Award Conditions and other important information on the administration of NSF awards is contained in the NSF *Award & Administration Guide* (AAG) Chapter II, available electronically on the NSF Website at http://www.nsf.gov/publications/pub_summ.jsp?ods_key=aag.

C. Reporting Requirements

For all multi-year grants (including both standard and continuing grants), the Principal Investigator must submit an annual project report to the cognizant Program Officer at least 90 days prior to the end of the current budget period. (Some programs or awards require submission of more frequent project reports). Within 90 days following expiration of a grant, the PI also is required to submit a final project report, and a project outcomes report for the general public.

Failure to provide the required annual or final project reports, or the project outcomes report, will delay NSF review and processing of any future funding increments as well as any pending proposals for all identified PIs and co-PIs on a given award. PIs should examine the formats of the required reports in advance to assure availability of required data.

PIs are required to use NSF's electronic project-reporting system, available through Research.gov, for preparation and submission of annual and final project reports. Such reports provide information on accomplishments, project participants (individual and

organizational), publications, and other specific products and impacts of the project. Submission of the report via Research.gov constitutes certification by the PI that the contents of the report are accurate and complete. The project outcomes report also must be prepared and submitted using Research.gov. This report serves as a brief summary, prepared specifically for the public, of the nature and outcomes of the project. This report will be posted on the NSF website exactly as it is submitted by the PI.

More comprehensive information on NSF Reporting Requirements and other important information on the administration of NSF awards is contained in the *NSF Award & Administration Guide* (AAG) Chapter II, available electronically on the NSF Website at http://www.nsf.gov/publications/pub_summ.jsp?ods_key=aag.

VIII. AGENCY CONTACTS

Please note that the program contact information is current at the time of publishing. See program website for any updates to the points of contact.

General inquiries regarding this program should be made to:

- Sara B. Nerlove, PFI/BIC, Program Director, telephone: (703) 292-7077, email: snerlove@nsf.gov
- Larry Hornak, ENG, telephone: (703) 292-2678, email: lhornak@nsf.gov
- Alexandra Medina-Borja, ENG/OAD, telephone: (703) 292-7557, email: amedinab@nsf.gov
- Edwin Romeijn, ENG, telephone: (703) 292-2211, email: eromeijn@nsf.gov
- Ralph Wachter, CISE, telephone: (703) 292-8950, email: rwachter@nsf.gov
- Heng Xu, telephone: (703) 292-8643, email: hxu@nsf.gov

For questions related to the use of FastLane, contact:

- FastLane Help Desk, telephone: 1-800-673-6188; e-mail: fastlane@nsf.gov.

For questions relating to Grants.gov contact:

- Grants.gov Contact Center: If the Authorized Organizational Representatives (AOR) has not received a confirmation message from Grants.gov within 48 hours of submission of application, please contact via telephone: 1-800-518-4726; e-mail: support@grants.gov.

IX. OTHER INFORMATION

The NSF website provides the most comprehensive source of information on NSF Directorates (including contact information), programs and funding opportunities. Use of this website by potential proposers is strongly encouraged. In addition, "NSF Update" is an information-delivery system designed to keep potential proposers and other interested parties apprised of new NSF funding opportunities and publications, important changes in proposal and award policies and procedures, and upcoming NSF [Grants Conferences](#). Subscribers are informed through e-mail or the user's Web browser each time new publications are issued that match their identified interests. "NSF Update" also is available on NSF's website at https://public.govdelivery.com/accounts/USNSF/subscriber/new?topic_id=USNSF_179.

Grants.gov provides an additional electronic capability to search for Federal government-wide grant opportunities. NSF funding opportunities may be accessed via this new mechanism. Further information on Grants.gov may be obtained at <http://www.grants.gov>.

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The National Science Foundation (NSF) is an independent Federal agency created by the National Science Foundation Act of 1950, as amended (42 USC 1861-75). The Act states the purpose of the NSF is "to promote the progress of science; [and] to advance the national health, prosperity, and welfare by supporting research and education in all fields of science and engineering."

NSF funds research and education in most fields of science and engineering. It does this through grants and cooperative agreements to more than 2,000 colleges, universities, K-12 school systems, businesses, informal science organizations and other research organizations throughout the US. The Foundation accounts for about one-fourth of Federal support to academic institutions for basic research.

NSF receives approximately 55,000 proposals each year for research, education and training projects, of which approximately 11,000 are funded. In addition, the Foundation receives several thousand applications for graduate and postdoctoral fellowships. The agency operates no laboratories itself but does support National Research Centers, user facilities, certain oceanographic vessels and Arctic and Antarctic research stations. The Foundation also supports cooperative research between universities and industry, US participation in international scientific and engineering efforts, and educational activities at every academic level.

Facilitation Awards for Scientists and Engineers with Disabilities provide funding for special assistance or equipment to enable persons with disabilities to work on NSF-supported projects. See Grant Proposal Guide Chapter II, Section D.2 for instructions regarding preparation of these types of proposals.

The National Science Foundation has Telephonic Device for the Deaf (TDD) and Federal Information Relay Service (FIRS) capabilities that enable individuals with hearing impairments to communicate with the Foundation about NSF programs, employment or general information. TDD may be accessed at (703) 292-5090 and (800) 281-8749, FIRS at (800) 877-8339.

The National Science Foundation Information Center may be reached at (703) 292-5111.

The National Science Foundation promotes and advances scientific progress in the United States by competitively awarding grants and cooperative agreements for research and education in the sciences, mathematics, and engineering.

To get the latest information about program deadlines, to download copies of NSF publications, and to access abstracts of awards, visit the NSF Website at <http://www.nsf.gov>

- Location: 4201 Wilson Blvd. Arlington, VA 22230
- For General Information (NSF Information Center): (703) 292-5111
- TDD (for the hearing-impaired): (703) 292-5090
- To Order Publications or Forms:
 - Send an e-mail to: nspubs@nsf.gov
 - or telephone: (703) 292-7827
- To Locate NSF Employees: (703) 292-5111

PRIVACY ACT AND PUBLIC BURDEN STATEMENTS

The information requested on proposal forms and project reports is solicited under the authority of the National Science Foundation Act of 1950, as amended. The information on proposal forms will be used in connection with the selection of qualified proposals; and project reports submitted by awardees will be used for program evaluation and reporting within the Executive Branch and to Congress. The information requested may be disclosed to qualified reviewers and staff assistants as part of the proposal review process; to proposer institutions/grantees to provide or obtain data regarding the proposal review process, award decisions, or the administration of awards; to government contractors, experts, volunteers and researchers and educators as necessary to complete assigned work; to other government agencies or other entities needing information regarding applicants or nominees as part of a joint application review process, or in order to coordinate programs or policy; and to another Federal agency, court, or party in a court or Federal administrative proceeding if the government is a party. Information about Principal Investigators may be added to the Reviewer file and used to select potential candidates to serve as peer reviewers or advisory committee members. See Systems of Records, [NSF-50](#), "Principal Investigator/Proposal File and Associated Records," 69 Federal Register 26410 (May 12, 2004), and [NSF-51](#), "Reviewer/Proposal File and Associated Records," 69 Federal Register 26410 (May 12, 2004). Submission of the information is voluntary. Failure to provide full and complete information, however, may reduce the possibility of receiving an award.

An agency may not conduct or sponsor, and a person is not required to respond to, an information collection unless it displays a valid Office of Management and Budget (OMB) control number. The OMB control number for this collection is 3145-0058. Public reporting burden for this collection of information is estimated to average 120 hours per response, including the time for reviewing instructions. Send comments regarding the burden estimate and any other aspect of this collection of information, including suggestions for reducing this burden, to:

Suzanne H. Plimpton
Reports Clearance Officer
Office of the General Counsel
National Science Foundation
Arlington, VA 22230

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