

Big Data Regional Innovation Hubs: Establishing Spokes to Advance Big Data Applications (BD Spokes)

PROGRAM SOLICITATION

NSF 17-546

REPLACES DOCUMENT(S):

NSF 16-510



National Science Foundation

Directorate for Computer & Information Science & Engineering

Directorate for Education & Human Resources

Directorate for Social, Behavioral & Economic Sciences

Directorate for Mathematical & Physical Sciences
Division of Chemistry

Office of International Science and Engineering

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

September 18, 2017

IMPORTANT INFORMATION AND REVISION NOTES

This solicitation expands upon the BD Hubs network established by the solicitations entitled *Big Data Regional Innovation Hubs (BD Hubs): Accelerating the Big Data Innovation Ecosystem* solicitation (NSF 15-562) and *Big Data Regional Innovation Hubs (BD Spokes): Establishing Spokes to Advance Big Data Applications* (NSF 16-510).

All (SMALL or MEDIUM) BD Spoke proposals submitted in response to this solicitation must include a Letter of Collaboration from a regional BD Hub. Any BD Spoke proposal not including a Letter of Collaboration from a BD Hub will be returned without review. No exceptions will be made.

Salient Changes From Previous BD Spokes Solicitation (NSF 16-510):

Restructuring of award types – NSF 16-510 described two award categories to which proposals could be submitted: Planning awards and BD Spoke awards. This solicitation has discontinued Planning awards and instead establishes two categories of BD Spoke awards: SMALL and MEDIUM.

Letters of Intent are no longer required – NSF 16-510 required potential proposers to submit a Letter of Intent (LOI) before submitting a full proposal. A LOI is no longer required under this solicitation.

Any proposal submitted in response to this solicitation should be submitted in accordance with the revised *NSF Proposal & Award Policies & Procedures Guide* (PAPPG) (NSF 17-1), which is effective for proposals submitted, or due, on or after January 30, 2017.

SUMMARY OF PROGRAM REQUIREMENTS

General Information

Program Title:

Big Data Regional Innovation Hubs: Establishing Spokes to Advance Big Data Applications (BD Spokes)

Synopsis of Program:

NSF's Directorate for Computer and Information Science and Engineering (CISE) initiated the National Network of Big Data Regional Innovation Hubs (BD Hubs) program in FY 2015. Four BD Hubs – *Midwest*, *Northeast*, *South*, and *West* – were established to foster multi-sector collaborations among academia, industry, and government, both nationally and internationally. These BD Hubs are serving a convening and coordinating role by bringing together a

wide range of Big Data stakeholders in order to connect solution seekers with solution providers.

In FY 2016, the *Big Data Regional Innovation Hubs: Establishing Spokes to Advance Big Data Applications (BD Spokes)* solicitation began extending the BD Hubs network by establishing multi-institutional and multi-sector collaborations to focus on topics of specific interest to a given region. The first set of BD Spokes was funded in FY 2016. This solicitation calls for new BD Spoke proposals to be awarded in FY 2018. Collaborating with BD Hubs, each BD Spoke will focus on a particular topic that requires Big Data approaches and solutions. The set of activities managed by a BD Spoke will promote progress towards solutions in the chosen topic area. The regional BD Hub Steering Committee will provide general guidance to each BD Spoke and will assist the BD Spoke in coordinating with the national BD Hub network, with other BD Spokes, and with the broader innovation ecosystem.

The Big Data activities of a BD Spoke will be guided by the following broad themes:

- Accelerating progress towards addressing societal grand challenges relevant to the regional and national priority areas defined by the BD Hubs (information on priority areas can be found on each Hub's website listed in the Introduction section below);
- Helping automate the Big Data lifecycle; and
- Enabling access to and spurring the use of important and valuable available data assets, including international data sets where relevant.

NSF's overall Big Data research and development (R&D) portfolio includes fundamental research, infrastructure development and provisioning, education and workforce development, and community engagement. Not all of these aspects of the overall portfolio are covered by this solicitation. **In particular, this solicitation is not meant to fund proposals in which fundamental research is the primary activity.** If research is a substantial portion of the proposed activities, please consult with a cognizant NSF program officer of this solicitation to help find a more appropriate solicitation. For example, projects focused on foundations and innovative applications related to Big Data may be better suited for submission to the [Critical Techniques and Technologies for Advancing Foundations and Applications of Big Data Science & Engineering \(BIGDATA\)](#) program. Similarly, projects focused primarily on privacy research may be more suited to NSF's [Secure and Trustworthy Cyberspace \(SaTC\)](#) program.

There are two proposal categories covered by this solicitation: SMALL and MEDIUM BD Spokes.

All (SMALL or MEDIUM) BD Spoke proposals submitted in response to this solicitation must include a Letter of Collaboration from a regional BD Hub. Proposals not including a Letter of Collaboration from a BD Hub will be returned without review. No exceptions will be made.

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.

- Fen Zhao, Directorate for Computer and Information Science and Engineering, telephone: (703) 292-7344, email: fzhao@nsf.gov
- Earnestine Psalmonds-Easter, Directorate for Education & Human Resources, telephone: (703) 292-8112, email: epsalmon@nsf.gov
- Cheryl L. Eavey, Directorate for Social, Behavioral, and Economic Sciences, telephone: (703) 292-7269, email: ceavey@nsf.gov
- Lin He, Directorate for Mathematical and Physical Sciences, telephone: (703) 292-4956, email: lhe@nsf.gov
- Seta Bogosyan, Office of International Science and Engineering, telephone: (703) 292-4766, email: sbogosya@nsf.gov
- Deborah Shands, Directorate for Computer and Information Science & Engineering, telephone: (703) 292-4505, email: dshands@nsf.gov
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Applicable Catalog of Federal Domestic Assistance (CFDA) Number(s):

- 47.049 --- Mathematical and Physical Sciences
- 47.070 --- Computer and Information Science and Engineering
- 47.075 --- Social Behavioral and Economic Sciences
- 47.076 --- Education and Human Resources
- 47.079 --- Office of International Science and Engineering

Award Information

Anticipated Type of Award: Standard Grant or Continuing Grant

Estimated Number of Awards: 10 to 20

BD Spoke awards -- Approximately 10 to 20 total awards across both the SMALL and MEDIUM categories are anticipated through this solicitation.

The total number of awards will be subject to the outcome of panel reviews and availability of funds.

Anticipated Funding Amount: \$10,000,000

Each SMALL project will be funded at \$100,000 to \$500,000 total for up to three years, subject to the availability of funds.

Each MEDIUM project will be funded at \$500,001 to \$1,000,000 total for up to three years, subject to the availability of funds.

Eligibility Information

Who May Submit Proposals:

Proposals may only be submitted by the following:

- Universities and Colleges - Universities and two- and four-year colleges (including community colleges) accredited in, and having a campus located in, the US acting on behalf of their faculty members. Such organizations also are referred to as academic institutions.
- Non-profit, non-academic organizations: Independent museums, observatories, research labs, professional societies and similar organizations in the U.S. associated with educational or research activities.
- State and Local Governments: State educational offices or organizations and local school districts.

Who May Serve as PI:

There are no restrictions or limits.

Limit on Number of Proposals per Organization: 1

An organization may participate as submitting organization (or, in the case of collaborative proposals, as the lead organization) for at most one proposal responsive to this solicitation.

Proposal submissions are limited to 1 per organization (except as non-lead in a collaborative proposal) to maintain a balanced geographic representation of the Regional Hubs and Spokes program and to increase diversity of participating institutions.

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

An investigator may participate as PI or Co-PI in no more than one proposal submitted in response to this solicitation, irrespective of proposal category. However, there is no limit on the number of proposals on which an individual may serve as Senior Personnel.

These eligibility constraints will be strictly enforced in order to treat everyone fairly and consistently. In the event that an individual exceeds this limit, proposals received within the limit will be accepted based on earliest date and time of proposal submission (i.e., the first proposal received will be accepted and the remainder will be returned without review). No exceptions will be made.

Proposal Preparation and Submission Instructions

A. Proposal Preparation Instructions

- **Letters of Intent:** Not required
- **Preliminary Proposal Submission:** Not required
- **Full Proposals:**
 - Full Proposals submitted via FastLane: *NSF Proposal and Award Policies and Procedures Guide (PAPPG)* guidelines apply. The complete text of the PAPPG is available electronically on the NSF website at: https://www.nsf.gov/publications/pub_summ.jsp?ods_key=pappg.
 - 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: https://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:**

Not Applicable

C. Due Dates

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

September 18, 2017

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

In 2015, NSF's Directorate for Computer and Information Science and Engineering (CISE) funded a national network of "Big Data Regional Innovation Hubs" (BD Hubs). Interested stakeholders participated in one-day workshops to form collaborations representative of their regions, and to brainstorm on ideas leading toward the preparation of proposals for the BD Hubs within their respective regions.

The BD Hubs and BD Spokes network will serve convening and coordinating roles to help bring together a wide range of regional, national, and international Big Data stakeholders in order to connect solution seekers with solution providers. Such a brain trust is expected to augment and ideate new research efforts via forums, meetings, workshops, challenges, and other convening activities.

The regional breakdowns, coordinating institution(s), and points of contact for each BD Hub follow below (geographical regions adapted from <https://www.census.gov/geo/reference/webatlas/regions.html>).

NORTHEAST: This region includes Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania,

Rhode Island, and Vermont.

- Coordinating Institution: Columbia University
- Point of Contact: contact@nebigdatahub.org
- Website: <http://nebigdatahub.org/>

MIDWEST: This region includes Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin.

- Coordinating Institution: University of Illinois at Urbana-Champaign
- Point of Contact: info@midwestbigdatahub.org
- Website: <http://midwestbigdatahub.org/>

SOUTH: This region includes Alabama, Arkansas, Delaware, District of Columbia, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, and West Virginia.

- Coordinating Institutions: Georgia Institute of Technology, University of North Carolina at Chapel Hill
- Point of Contact: info@southbithub.org
- Website: <http://www.southbithub.org/>

WEST: This region includes Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming.

- Coordinating Institutions: University of California-San Diego, University of Washington, University of California-Berkeley
- Point of Contact: info@westbigdatahub.org
- Website: <http://westbigdatahub.org/>

This solicitation aims to augment the BD Hubs and the existing BD Spokes by establishing a series of additional *BD Spokes*, with each BD Spoke proposing activities on a topic that aligns with the priorities identified by the corresponding BD Hubs. BD Spokes must work in close concert with their corresponding regional BD Hub to formulate their research agendas and plan their activities. BD Spokes are expected to be action-oriented, making measurable progress towards specific goals within their topic area, using Big Data technologies. Please visit the BD Hub webpages listed above to find lists of the current priority areas of the BD Hubs.

II. PROGRAM DESCRIPTION

Overarching Themes

This BD Spokes solicitation supports Big Data activities in a specific topic area of interest to a corresponding regional BD Hub. The activities of a BD Spoke should address one or more of the following Big Data Innovation themes:

- *Accelerating progress towards societal grand challenges relevant to regional and national priority areas.* Due to the pervasiveness of Big Data in virtually all national priority areas, the BD Spokes have the opportunity to bring rapid change in application areas by facilitating the creation of interdisciplinary and multidisciplinary data-intensive teams.
- *Helping to automate the Big Data lifecycle.* Managing the end-to-end lifecycle of Big Data assets can be a tedious and manual task. Steps in the data lifecycle include: ingestion, validation, curation, quality assessment, anonymization, publication, active data management, and analysis (including information extraction, visualization, and annotation). Automated (or semi-automated) techniques are needed in order to keep up with the rapid data rates, large volumes, and immense heterogeneity of Big Data. Automation may also aid the reproducibility of data processing and analysis workflows. The data challenges and lessons learned by a BD Spoke on such automation efforts are expected to be shared with the BD Spoke's stakeholders as well as more broadly across the network of BD Hubs and Spokes.
- *Enabling access to and increasing the use of important and valuable available data assets, including international data sets, where relevant.* Many valuable data sets are underutilized, and results from the analysis of such data are not shared, due to a variety of actual or perceived costs, including cost of curation, cost of data reuse, attribution and intellectual property considerations, etc. One of the desirable roles for a BD Spoke is to act as a catalyst for organizing and sharing data sets and related data services among a larger set of stakeholders, across disciplinary areas, within the geographic region, or across the national community. BD Spokes are expected to play an important role in supporting and promulgating open data and open source software policies within their projects—at the BD Hub level and across BD Spokes—to further facilitate the sharing of data and outcomes of analyses. In addition, issues of data security and privacy are expected to be addressed at the BD Hub level and across BD Spokes.

The results from an individual BD Spoke's activities must also contribute to the education and training missions of the corresponding BD Hub, which is a key component of the BD Hub's activities. For example, efforts could include educating researchers on Big Data tools and techniques used and/or processes followed by the BD Spoke; engaging with or soliciting input from the public (where relevant) in order to facilitate broader impact of the work undertaken by the BD Spoke; and developing education and training modules for widely disseminating Big Data to people at all educational levels from K-12 students to lifelong learners.

Relationship to the National Network of BD Hubs and Spokes

Organizations submitting proposals in response to this solicitation should have past successful experiences engaging in Big Data Innovation activities. Proposals must identify the need to be formally connected to a regional BD Hub and the reasons why accomplishing the proposed activities will not be feasible outside the BD Hubs ecosystem.

It is expected that the PIs of a BD Spoke proposal will have engaged in serious and in-depth discussions with their corresponding BD Hub PIs and Steering Committee prior to submitting their proposal. BD Spoke proposers (for both SMALL and MEDIUM Spokes) must seek formal approval from the regional BD Hub Steering Committee in the form of a Letter of Collaboration (see Proposal Preparation and Submission Instructions). A BD Spoke must choose a single regional BD Hub as its primary BD Hub partner, but may work with other regional BD Hubs as secondary collaborators if appropriate.

If the topic of a proposed SMALL or MEDIUM project is substantively similar to that of a previously funded BD Spoke, even if the activity will take place in a different BD Hub region, the proposal must justify the need to fund the new activity. For example, the proposal can explain how the new activity might expand or augment the previously funded activities or differentiate itself from those other activities. For proposals that expand or augment previously funded BD Spokes, the project team should coordinate in advance with those awarded BD Spoke teams; a Letter of Collaboration is encouraged. Information about previously funded BD Hubs and Spokes can be found at https://www.nsf.gov/funding/pgm_summ.jsp?pims_id=505264.

Missions and Activities

Each BD Spoke proposal must articulate a clear focus within a specific Big Data topic or application area, while highlighting its Big Data innovation theme. All BD Spokes must have clearly defined mission statements with goals and corresponding metrics of success. Some examples that illustrate the specificity and level of detail for missions are:

- Use a specific set of analytical tools to improve the lead time for predictions of certain critical regional indicators by a given percentage;
- Given a specific set of high value data sets that were previously siloed and, therefore, usable only within a single research group or institution, make them available to a broader set of groups, or to the public at large, along with appropriate privacy and access control mechanisms;
- Adapt specific Big Data technologies to automate previously tedious and manual data collection and curation processes for specific types of data in a given field of science; and
- For a specific genre of data, introduce new types of (automated) analytics—which were previously tedious to perform and manual in nature—that can be performed with minimal human intervention.

The examples above are provided for the purpose of illustration only and should not be interpreted as defining or limiting the possible missions or goals of BD Spokes.

BD Spokes can initiate many different kinds of activities in support of their mission goals. BD Spokes are intended to convene stakeholders to augment and spawn new research efforts as opposed to directly carrying out traditional research. Potential activities for BD Spokes include, but are not limited to:

- Accelerating the creation and development of Big Data solutions relevant to its mission by convening stakeholders across sectors (e.g., academic, industry, non-profits, government, etc.) to partner in results-driven programs and projects;
- Driving successful pilot programs by acting as a matchmaker among the various stakeholders;
- Engaging stakeholders across the region—including solution providers and end users—to enable dialogue, share best practices, and/or set standards for data access, data formats, metadata, etc.; or
- Connecting critical data resources to diverse stakeholders that can best utilize them to fulfill the BD Spoke mission.

For the MEDIUM proposals, it is expected that the activities listed above will lead to tangible outcomes by the end of the award period. Examples of outcomes are:

- Explicit results from data-enabled or data-facilitated inquiry in a scientific or engineering field or other domain area, including social science and education research; a general reference to knowledge gained is insufficient; the Project Description must explicitly define the field- or domain-specific questions addressed and which specific researchers would be conducting the research to answer these questions;
- A prototype or proof of concept for a technology platform, data product, data standards, or other data infrastructure; or
- An innovative education or workforce development program with a plan for evaluating the effectiveness of the program. The program could be virtual-, classroom-, or workplace-based and should engage underrepresented groups.

Note that BD Spokes funding from this solicitation is not intended to primarily support research activities. Rather, the goal of the program is to enhance and amplify collaborative efforts focused on achieving specific mission-based goals. BD Spokes funding aims to strengthen current and past research by enabling activities that build on the findings from previously conducted research or catalyzing activities on currently funded research. For example, BD Spokes funding could support staff efforts in maintenance and/or improvement of existing data assets; integration of siloed data sets; analytics using existing high-value data assets, or of data sets made available via the efforts of a given BD Spoke; curation efforts; and workshops, travel, and other activities to support the collaborative and community-building nature of the BD Spokes.

For further clarification on the scope of BD Spoke activities and alignment with proposal categories, please contact the cognizant program officer.

Topics and Application Areas

Proposed BD Spoke projects are expected to focus on their articulated regional challenges and opportunities. In particular, this solicitation welcomes submissions addressing the following areas of emphasis:

- *Education*: Support innovations in software infrastructure and the use of education and learning data sets arising from both administrative data and information collected from interactive learning systems to improve learning outcomes. Projects could also propose to develop innovative education and/or workforce development and training programs that both broaden participation in Big Data research and development activities and enable a workforce for the 21st century. Workforce and training activities will be evaluated on their innovativeness and their ability to be replicated in new environments.
- *Data Intensive Research in the Social, Behavioral, and Economic Sciences*: Accelerate research infrastructure and frameworks that integrate and operate on data from multiple sources including administrative data; scientific instruments from large-scale surveys, brain research, large-scale simulations, etc.; digitally-authored media, including text, images, audio, and

emails; and streaming data from weblogs, videos, and financial/commercial transactions.

- *Data-driven Research in Chemistry*: Encourage innovative partnerships that capitalize on the data revolution (https://www.nsf.gov/publications/pub_summ.jsp?ods_key=nsf17036) and utilize discovery-based science to verify scientific predictions and insights in chemistry. This area of emphasis looks for formation of new alliances to accelerate the discovery of new chemical species with predicted properties and/or new chemical reactions using approaches such as large-scale data analysis, data architectures, or machine learning. Proposal topics must be in alignment with the core research programs within the Division of Chemistry (CHE; <https://www.nsf.gov/div/index.jsp?div=che>).
- *Neuroscience*: Engage questions and opportunities in neuroscience that leverage BD Hub resources, such as enabling large scale, integrative modeling, sharing of diverse data and resources, and other neuroscience and neurotechnology approaches that require very large-scale, complex, or diverse data. Connections to other NSF programs on neuroscience research (<https://www.nsf.gov/brain/>) are welcome.
- *Data Analytics for Security*: Better analytics and detection of security- and privacy-related patterns, anomalies, trends and changes in BD Spoke applications and/or regional data exchanges. Development of statistical, computational and/or interdisciplinary methods for improving BD Spoke security/privacy/trustworthiness through the management, exploration, analytics, mining, and visualization of structured or unstructured BD Spoke data from disparate sources.
- *Replicability and Reproducibility in Data Science*: Facilitate robust and reliable science by improving the replicability and reproducibility of research instruments, procedures, codes and results.

The areas emphasized above in no way preclude submission of proposals concerning other topics. Any topic deemed appropriate and approved by a coordinating BD Hub is welcome.

NSF recognizes that Big Data are global due to the way they are collected and analyzed and hence encourages international collaborations that will enhance the capacity and capabilities of the BD Hubs and Spokes for the proposed Big Data innovation theme. The engagement of underrepresented minorities as students and early-career researchers is particularly encouraged.

Award Types

SMALL: Awards with total budgets (including indirect costs) from \$100,000 to \$500,000 over a period of up to 3 years. These awards are intended for collaborative projects, involving multiple institutions, for establishing BD Spokes on specific topics/themes related to Big Data innovation. *SMALL* proposals should focus on specific topics/themes related to Big Data innovation and be consistent with the regional and national priorities identified by the BD Hubs.

MEDIUM: Awards with total budgets (including indirect costs) from \$500,001 to \$1,000,000 over a period of up to 3 years. *MEDIUM* proposals must deliver tangible outcomes, for example: (1) explicit results from data-enabled or data-facilitated inquiry in a scientific or engineering field or other domain area; (2) a prototype or proof of concept for a technology platform, data product, data standards, or other data infrastructure; or (3) an education or workforce development program with a plan for deployment and sustainment beyond the three-year award period.

For both *SMALL* and *MEDIUM* projects, budgets must be clearly justified and commensurate with the goals of the efforts.

III. AWARD INFORMATION

Estimated number of awards and average award size/duration are subject to the availability of funds. The anticipated program budget will be up to \$10,000,000, also subject to the availability of funds.

IV. ELIGIBILITY INFORMATION

Who May Submit Proposals:

Proposals may only be submitted by the following:

- Universities and Colleges - Universities and two- and four-year colleges (including community colleges) accredited in, and having a campus located in, the US acting on behalf of their faculty members. Such organizations also are referred to as academic institutions.
- Non-profit, non-academic organizations: Independent museums, observatories, research labs, professional societies and similar organizations in the U.S. associated with educational or research activities.
- State and Local Governments: State educational offices or organizations and local school districts.

Who May Serve as PI:

There are no restrictions or limits.

Limit on Number of Proposals per Organization: 1

An organization may participate as submitting organization (or, in the case of collaborative proposals, as the lead

organization) for at most one proposal responsive to this solicitation.

Proposal submissions are limited to 1 per organization (except as non-lead in a collaborative proposal) to maintain a balanced geographic representation of the Regional Hubs and Spokes program and to increase diversity of participating institutions.

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

An investigator may participate as PI or Co-PI in no more than one proposal submitted in response to this solicitation, irrespective of proposal category. However, there is no limit on the number of proposals on which an individual may serve as Senior Personnel.

These eligibility constraints will be strictly enforced in order to treat everyone fairly and consistently. In the event that an individual exceeds this limit, proposals received within the limit will be accepted based on earliest date and time of proposal submission (i.e., the first proposal received will be accepted and the remainder will be returned without review). No exceptions will be made.

Additional Eligibility Info:

NSF welcomes proposals that include for-profit organizations or Federally Funded Research and Development Centers (FFRDCs). **However, such organizations may only participate as subawardees or unfunded collaborators.**

The BD Hubs represent four defined geographic regions, namely the Northeast, Midwest, South, and West, of the United States, as defined in the Introduction. **Organizations involved in a SMALL or MEDIUM BD Spoke proposal need not be physically located within the defined region of a certain BD Hub.** The topic of the BD Spoke and its relevance to the coordinating BD Hub region will be considered, not necessarily the location of the proposing organization. International organizations are also encouraged to participate in BD Spoke projects and to partner with BD Hubs.

V. PROPOSAL PREPARATION AND SUBMISSION INSTRUCTIONS

A. Proposal Preparation Instructions

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 Proposal & Award Policies & Procedures Guide* (PAPPG). The complete text of the PAPPG is available electronically on the NSF website at: https://www.nsf.gov/publications/pub_summ.jsp?ods_key=pappg. Paper copies of the PAPPG 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: (https://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.

In determining which method to utilize in the electronic preparation and submission of the proposal, please note the following:

Collaborative Proposals. All collaborative proposals submitted as separate submissions from multiple organizations must be submitted via the NSF FastLane system. PAPPG Chapter II.D.3 provides additional information on collaborative proposals.

See PAPPG Chapter II.C.2 for guidance on the required sections of a full research proposal submitted to NSF. Please note that the proposal preparation instructions provided in this program solicitation may deviate from the PAPPG instructions.

Cover Sheet:

During completion of the proposal Cover Sheet (see PAPPG Chapter II.C.2.a.), the PI will be prompted to select the applicable response that describes the nature and type of proposal being developed. Though this program does not focus on research as the primary activity, all proposals submitted in response to this solicitation should nevertheless select "Research".

Proposal titles must take the form **Spokes: TYPE: REGION: Title**, where **TYPE** is replaced by the proposal type (SMALL, MEDIUM), and **REGION** is replaced by the region of service for the proposed BD Spoke (NORTHEAST, MIDWEST, SOUTH, WEST). For example, a SMALL proposal for the South region would have the title **Spokes: SMALL: SOUTH: Title**, and a MEDIUM proposal

coordinating with the Midwest BD Hub would have the title **Spokes: MEDIUM: MIDWEST: Title**. Titles of collaborative proposals should be prepared in a similar manner, but should also include "Collaborative" immediately after the region. For example, the title of a SMALL collaborative BD Spoke proposal for the West region would be **Spokes: SMALL: WEST: Collaborative: Title**.

The regional breakdown, coordinating institution(s), and point(s) of contact (POC) for each BD Hub are listed below.

NORTHEAST: This region includes Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont.

- Coordinating Institution: Columbia University
- Point of Contact: contact@nebigdatahub.org
- Website: <http://nebigdatahub.org/>

MIDWEST: This region includes Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin.

- Coordinating Institution: University of Illinois at Urbana-Champaign
- Point of Contact: info@midwestbigdatahub.org
- Website: <http://midwestbigdatahub.org/>

SOUTH: This region includes Alabama, Arkansas, Delaware, District of Columbia, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, and West Virginia.

- Coordinating Institutions: Georgia Institute of Technology, University of North Carolina at Chapel Hill
- Point of Contact: info@southbdhub.org
- Website: <http://www.southbdhub.org/>

WEST: This region includes Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming.

- Coordinating Institutions: University of California-San Diego, University of Washington, University of California-Berkeley
- Point of Contact: info@westbigdatahub.org
- Website: <http://westbigdatahub.org/>

Project Summary (1-page limit): At the top of the Overview text box, enter the title of the BD Spoke project, the name of the PI and the lead institution. Provide a summary description of the project, including a mission statement. In the separate text boxes, provide a succinct summary of the intellectual merit and broader impacts of the proposed project. **Proposals that do not address the intellectual merit and broader impacts of the proposed project in separate statements within the project summary will be returned without review.** All project summaries must include a list of three to six keywords at the end of the broader impacts text box.

Project Description for SMALL and MEDIUM proposals (limited to 15 pages): SMALL and MEDIUM grant proposals must be structured according to the sequence of sections described below, in the order described. Additional sections with pertinent information may be appended to the required sections after the section "Results from Prior NSF Support." The total page limit of required and additional sections cannot exceed 15 pages. **Proposals that do not include the sections listed below, except the Results from Prior NSF Support section, will be returned without review. Proposers should include the Results from Prior NSF Support section, as appropriate.**

All items below apply to both SMALL and MEDIUM proposals unless otherwise indicated. Prospective proposers who are unsure whether their project is more appropriate for a SMALL or MEDIUM proposal should contact one of the cognizant program officers for guidance before submitting a full proposal.

Mission Statement: The Project Description must begin with a concise statement of the project vision. This mission statement should discuss the broader goals of the proposed effort in the context of the current state of Big Data technology, explain how the project outcomes will address the priority topic areas identified by the corresponding BD Hub, and demonstrate the need to perform the proposed activities within the BD Hubs and Spokes ecosystem.

Broader Impacts of the Proposed Work: The Project Description must provide a discussion of the broader impacts of the proposed activities. NSF values the advancement of scientific knowledge and activities that contribute to the 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.

Technical Description: The Project Description must provide a detailed explanation of the science and engineering undergirding the proposed project as it relates to technical aspects of Big Data upon which the project touches. If applicable, the technical description should also include technical aspects of the specific domain or discipline to which Big Data approaches are being applied. The proposal should review and cite appropriate literature pertinent to the technical aspects discussed. Proposals focused on education and workforce development should describe in reasonable technical detail what is being taught and to whom, i.e., technical descriptions of pedagogic theory/methods *per se* are not required but should be included if innovation in pedagogic approaches is a core element of the proposed work.

Project Deliverables (MEDIUM proposals only): Because of the larger investment, Project Descriptions for MEDIUM proposals should delineate clear, specific, substantive, and concrete outcomes that the proposed project will deliver by the end of the award periods. Examples of appropriate deliverables include but are not limited to:

- Explicit results from data-enabled or data-facilitated inquiry in a scientific or engineering field or other domain area, including social science and education research; a general reference to knowledge gained is insufficient; the Project Description must explicitly define the field- or domain-specific questions addressed and which specific researchers would be conducting the

- research to answer these questions;
- A prototype or proof of concept for a technology platform, a data product, data standards, or other data infrastructure;
- An innovative education or workforce development program with a plan for evaluating the effectiveness of the program. The program can be virtual, classroom, or workplace based and should engage underrepresented groups.

Roles and Responsibilities: The Project Description must list the specific roles of the collaborating universities, industry partners, government agencies, non-profits and other organizations involved. International collaboration must be strongly justified in terms of the unique and complementary opportunities offered by the foreign collaborator. International collaborations contributing to data sharing and interoperability of data sets are specifically encouraged.

Collaboration with host BD Hub and other BD Spokes: The Project Description must articulate how the BD Spoke will be managed and integrated into BD Hub activities. Why are the resources and infrastructure of a BD Hub necessary for the proposed activity? The Project Description must also clearly state the proposed BD Spoke's relationship to its BD Hub Steering Committee (i.e., a reporting structure).

If the proposed BD Spoke is on a topic similar to one or more currently funded BD Spokes *in any region*, the Project Description must describe in what sense the proposed work differs substantially from the existing project(s) or how the proposed BD Spoke activities augment or complement that of the existing project(s) when it does not differ substantially. In the latter case, a Letter of Collaboration(s) from the previously funded BD Spoke(s) is (are) encouraged. Information about previously funded BD Hubs and Spokes can be found at https://www.nsf.gov/funding/pgm_summ.jsp?pims_id=505264.

Evaluation plan: The Project Description must include a discussion on how the stated goals of the BD Spoke will be evaluated, including clearly defined metrics of success. This is especially important if the BD Spoke will be deemed "complete" after successful completion of stated goals (see "Long-term sustainability," below).

Long-term sustainability (if applicable): If the proposed BD Spoke is expected to become a long-term resource for its region of service, the Project Description must include a discussion of how the BD Spoke will sustain its efforts beyond the end of the award period.

Education: The Project Description should explicitly state how the BD Spoke will augment the education and training efforts of its BD Hub.

Results from Prior NSF Support: The Project Description should include results from prior NSF support, as specified in the PAPPG Chapter II.C.d.(iii), with broader impacts from the work(s) included.

Supplementary Documents: Supplementary documents are limited to the specific types of documentation listed in the PAPPG, with a few exceptions, as specified below. **Any special information or supplementary documentation that has not been explicitly allowed in the PAPPG or this solicitation, such as article reprints or preprints, or appendices, will not be considered during the review process and may result in the proposal being returned without review.**

1. **Letter of Collaboration from a BD Hub.** Each proposal must be approved by the Steering Committee of a BD Hub, and this approval must be documented by a Letter of Collaboration (see PAPPG Chapter II.C.2.d(iv) for details). This Letter of Collaboration should be signed by the Executive Director(s) of the BD Hub approving the proposal. The letter from the BD Hub organization must describe how the proposed spoke project will reinforce the current Hub priority areas. If the proposed spoke area is not originally listed as a priority by a BD Hub, the Letter of Collaboration must lay out reasons for initiating new priority areas. Any BD Spoke that would require more substantial logistical support from its corresponding BD Hub is urged to include a BD Hub coordinating institution as a collaborative proposal or subawardee so as to set aside funds for that support in the proposal. Proposers should consult the website of the BD Hub with which they intend to collaborate to determine that BD Hub's conditions and requirements for receiving a collaboration letter from them.
2. **Letters of Collaboration.** Any substantial collaboration with individuals not included in the budget should be described in the Facilities, Equipment and Other Resources section of the proposal and documented in a Letter of Collaboration from each collaborator. Such letters should be provided in the supplementary documents section of the proposal and follow the format instructions specified in the PAPPG. Collaborative activities that are identified in the budget should follow the instructions in the PAPPG.

Letters of collaboration should be limited to stating the intent to collaborate and should not contain endorsements or evaluation of the proposed project. The recommended format for letters of collaboration is as follows:

"If the proposal submitted by Dr. [insert the full name of the Principal Investigator] entitled [insert the proposal title] is selected for funding by NSF, it is my intent to collaborate and/or commit resources as detailed in the Project Description or the Facilities, Equipment or Other Resources section of the proposal."

3. **Data Management Plan.** Proposals must include as a supplementary document a Data Management Plan of no more than two pages. This supplement is provided in full by the lead institution. The Data Management Plan should describe how the project will manage its data and software and share its research results (including software). The Data Management Plan will be evaluated using NSF review criteria. Data management requirements and plans specific to the Directorate, Office, Division, Program, or other NSF unit, relevant to a proposal are available at <https://www.nsf.gov/bfa/dias/policy/dmp.jsp>.

Proposals that focus on the "Data Intensive Research in the Social, Behavioral, and Economic Sciences" topic area should consider the guidance for Data Management plans for the Social, Behavioral, and Economics Directorate, available at https://www.nsf.gov/sbe/sbe_data_management_plan.jsp. Proposals that focus on the "Education" topic area should consider the guidance for Data Management Plans for the Education and Human Resources Directorate, available at <https://www.nsf.gov/bfa/dias/policy/dmpdocs/ehr.pdf>. Proposals that focus on the "Chemistry" topic area should consider the guidance for Data management plans from the Mathematical and Physical Sciences Directorate, available at <https://www.nsf.gov/bfa/dias/policy/dmpdocs/mps.pdf>. All other proposals should follow the guidance for the Computer and Information Science and Engineering Directorate, available at https://www.nsf.gov/cise/cise_dmp.jsp

The plan may include information on:

- a. The types of data, software, curriculum materials, and other materials to be produced in the course of the project;

- b. The standards to be used for data and metadata format and content (where existing standards are absent or deemed inadequate, this should be documented along with any proposed solutions or remedies);
 - c. Policies for access and sharing including provisions for appropriate protection of privacy, confidentiality, security, intellectual property, or other rights or requirements;
 - d. Policies and provisions for re-use, re-distribution, and the production of derivatives; and
 - e. Plans for archiving data, samples, and other research products, and for preservation of access to them.
4. **The Software Sharing Plan** (with appropriate timelines) is an optional 1-2 page addendum to the Data Management Plan. There is no prescribed single license for software produced through awards funded pursuant to this solicitation. However, the program does have goals for software dissemination, and reviewers will be instructed to evaluate the dissemination plan relative to these goals, as appropriate:
- a. The software should be freely available to science and engineering researchers and educators in the non-profit sector, such as institutions of education, research institutions, and government laboratories;
 - b. The terms of software availability should permit the dissemination and commercialization of enhanced or customized versions of the software, or incorporation of the software or pieces of it into other software packages;
 - c. To preserve utility to the community, the software should be transferable so that another individual or team can continue development in the event that the original investigators are unwilling or unable to do so;
 - d. The terms of software availability should include the ability of researchers to modify the source code and to share modifications with other colleagues. An applicant should take responsibility for creating the original and subsequent official versions of a piece of software;
 - e. To further enhance the potential impact of their software, applicants may consider proposing a plan to manage and disseminate the improvements or customizations of their tools and resources by others, proposals may include a plan to incorporate the enhancements into the official core software, may involve the creation of an infrastructure for plug-ins, or may describe some other solution; and
 - f. If a particular license is selected for the software distribution, it should be specified in the proposal. If an open-source license is not selected, the proposal should explain why this decision was made.
5. **Postdoctoral Mentoring Plan.** This one-page supplementary document, describing how postdoctoral researchers will be mentored, **is required of all proposals that will provide funding to postdocs.** The lead institution provides this mentoring plan for the entire project. Reviewers will be asked to review the mentoring plan, as appropriate.
6. **Project Personnel and Partner Institutions** (required for all proposal categories) Provide current, accurate information for all personnel and institutions involved in the project. NSF staff will use this information in the merit review process to manage reviewer conflicts of interest. The list must include all PIs, Co-PIs, Senior Personnel, paid/unpaid Consultants or Collaborators, Subawardees, Postdocs, project-level advisory committee members, and writers of letters of support. This list should be numbered and include (in this order) Full name, Organization(s), and Role in the project, with each item separated by a semi-colon. Each person listed should start a new numbered line. For example:
- 1. Mary Smith; XYZ University; PI
 - 2. John Jones; University of PQR; Senior Personnel
 - 3. Jane Brown; XYZ University; Postdoc
 - 4. Bob Adams; ABC Inc.; Paid Consultant
 - 5. Mary White; Welldone Institution; Unpaid Collaborator
 - 6. Tim Green; ZZZ University; Subawardee
7. **Human Subjects Protection** Proposals involving human subjects should include a supplementary document of no more than two pages in length summarizing potential risks to human subjects; plans for recruitment and informed consent; inclusion of women, minorities, and children; and planned procedures to protect against or minimize potential risks.

Proposals that are missing required supplementary documents as specified above will be returned without review.

Single Copy Documents:

Collaborators and Other Affiliations Information:

For this solicitation, the *Collaborators & Other Affiliations* information specified in the PAPPG should be submitted using the spreadsheet template found at <https://www.nsf.gov/cise/collab/>. For each proposal, a completed spreadsheet for each PI, co-PI, or senior personnel must be uploaded directly into Fastlane in .xls or .xlsx format as a "Collaborator and Other Affiliations" Single Copy Document. NSF staff use this information in the merit review process to help manage reviewer selection; the spreadsheet will ensure the Collaborator and Other Affiliations information has a common, searchable format.

Note the distinction to (6) above under Supplementary Documents: the listing of all project participants is collected by the project lead and entered as a Supplementary Document, which is then automatically included with all proposals in a project. The Collaborators and Other Affiliations are entered for each participant within each proposal and, as Single Copy Documents, are available only to NSF staff. Collaborators and Other Affiliations due to participants listed on (6) that are not PIs, co-PIs, or senior personnel can be uploaded under Additional Single Copy Documents using Transfer File.

B. Budgetary Information

Cost Sharing:

Inclusion of voluntary committed cost sharing is prohibited.

Budget Preparation Instructions:

It is expected that appropriate senior personnel (including PI and co-PIs as appropriate) from each funded project will coordinate with

their respective BD Hub to attend an annual national meeting of all BD Hubs and present their activities and outcomes. Proposals should budget for these individuals to attend this annual meeting, including funds for travel and subsistence for this event.

C. Due Dates

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

September 18, 2017

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 PAPPG Exhibit III-1.

A comprehensive description of the Foundation's merit review process is available on the NSF website at: https://www.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 *Investing in Science, Engineering, and Education for the Nation's Future: NSF Strategic Plan for 2014-2018*. 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 strategic objectives 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 must recruit, train, and prepare a diverse STEM workforce to advance the frontiers of science and participate in the U.S. technology-based economy. NSF's contribution to the national innovation ecosystem is to provide cutting-edge research under the guidance of the Nation's most creative scientists and engineers. NSF also supports development of a strong science, technology, engineering, and mathematics (STEM) workforce by investing in building the knowledge that informs improvements in STEM teaching and learning.

NSF's mission calls for the broadening of 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. (PAPPG 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 PAPPG 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

NSF reviewers will address the degree to which the proposed BD Spoke:

- Needs the support and infrastructure of the BD Hub network to carry out its mission;
- Effectively coordinates with its corresponding regional BD Hub and augments the capacity of the existing National Network of BD Hubs and Spokes;
- Will contribute to the education and training plan of the regional BD Hub, including its efforts to educate and train not only the Big Data workforce but also related external groups such as end users, students, or managers; and
- For MEDIUM proposals: Has a feasible set of outcomes that can be delivered given the activities planned.

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 generally be completed and submitted by each reviewer and/or panel. 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 https://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 Proposal & Award Policies & Procedures Guide* (PAPPG) Chapter VII, available electronically on the NSF Website at https://www.nsf.gov/publications/pub_summ.jsp?ods_key=papppg.

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 no later than 90 days prior to the end of the current budget period. (Some programs or awards require submission of more frequent project reports). No later than 120 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 Proposal & Award Policies & Procedures Guide* (PAPPG) Chapter VII, available electronically on the NSF Website at https://www.nsf.gov/publications/pub_summ.jsp?ods_key=papppg.

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:

- Fen Zhao, Directorate for Computer and Information Science and Engineering, telephone: (703) 292-7344, email: fzhao@nsf.gov
- Earnestine Psalmonds-Easter, Directorate for Education & Human Resources, telephone: (703) 292-8112, email: epsalmon@nsf.gov
- Cheryl L. Eavey, Directorate for Social, Behavioral, and Economic Sciences, telephone: (703) 292-7269, email: ceavey@nsf.gov
- Lin He, Directorate for Mathematical and Physical Sciences, telephone: (703) 292-4956, email: lhe@nsf.gov
- Seta Bogosyan, Office of International Science and Engineering, telephone: (703) 292-4766, email: sbogosya@nsf.gov
- Deborah Shands, Directorate for Computer and Information Science & Engineering, telephone: (703) 292-4505, email: dshands@nsf.gov
- Kenneth Whang, Directorate for Computer and Information Science and Engineering, telephone: (703) 292-5149, email: kwhang@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](#).

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

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