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C. Suzanne Iacono, Ph.D.
Head of the Office of Integrative Activities
National Science Foundation
4201 Wilson Boulevard
Arlington, VA 22230

Re: Request for Feedback on the Vision, Core Values, Strategic Goals and Strategic Objectives in NSF's Current Strategic Plan (Submitted online at https://www.nsf.gov/od/oia/strategicplan/feedback.jsp)

Dear Dr. Iacono,

Nexight Group appreciates the opportunity to comment on the National Science Foundation (NSF) Strategic Plan for 2014-2018.

Nexight Group is a management and technical consulting firm specializing in materials and manufacturing innovation, energy, infrastructure security and resilience, cyber security, climate change, and public health. We understand the challenges faced in these fields, and we apply proven facilitation methods and diverse strategic planning techniques to help our clients and the broader science and engineering (S&E) community to more quickly meet their goals. We support a number of government agencies, academic institutions, and technical professional societies. Please visit here for more information about what we do.

Nexight Group believes that NSF's new Strategic Plan will enable NSF to make an impactful case to Congress and the Administration to obtain additional investments. To this end, we believe NSF should consider synergy of data management and infrastructure across the existing research programs at NSF; the need for a transdisciplinary approach; and the merit of coordinated, concerted approaches across academia, industry, and government agencies to successfully develop, execute, and manage its new plan. Our comments on these aspects related to NSF's next Strategic Plan covering FY 2019-2023 are included below.

Aspect 1: Data management and infrastructure should always be a central component in NSF's new Strategic Plan for integrated approaches to research, education, and management

The S&E community has struggled to maximize the value of data for many years [2]. Technological advances in basic S&E are increasingly dependent on our ability to effectively generate, manage, and share scientific data. Big, open data is a crosscutting issue impacting the ability to meet and enhance NSF's current strategic goals. Important aspects of data are specifically stated in the current NSF Strategic Plan: *"Strategic Objective 3: Provide world-class research infrastructure to enable major scientific advances,"* and *"Priority Goal 2: Improve the nation's capacity in data science by investing in the development of human capital and infrastructure."* Therefore, data and infrastructure are indispensable components for synergistic activities between NSF and the S&E community.

Data Management: While NSF funds and supports a wide range of research that produces highly complex, different sets of data, it is unique among government agencies for its pioneering role in the Data Management Plan (DMP) and cyberinfrastructure programs [3]. Since NSF began requiring a DMP with

grant applications in 2011, its movement toward data management has been emulated by other government agencies—for example, more than 10 federal funding agencies reinforced DMP requirements [4]. NSF has noted that there is a wide range of data results from different research communities, each of which have their own data management practices with variations for different data types [5].

Although DMPs are critical to accelerating scientific progress, the S&E community is seeking ways to make DMP requirements more flexible, community-accepted, and adaptable for future research activities [6]. For example, the physics/materials community has ambiguous DMP requirements for its research due to a lack of DMP best practices and standards for materials research—particularly with respect to the complexity of materials data and big data in materials research—and a lack of formal training in materials data. As NSF-funded research projects grow larger and more complex, current NSF DMP requirements are no longer suitable. For example, NSF needs to add a requirement to its data infrastructure policy for big data management review in large facilities for its Materials Research Science and Engineering Centers (MRSEC) or the Laser Interferometer Gravitational-wave Observatory (LIGO) programs. The latest publicly visible effort aimed at assisting materials researchers in understanding the elements of the DMP was the "DMP-Insights from Program Manager" joint event held by NSF and two other agencies at the 2015 Materials Research Society (MRS) Fall Meeting [6].

Data Infrastructure: The S&E community appreciates NSF's ongoing support to enhance S&E infrastructure through various programs such as "Cyber-enabled Materials, Manufacturing, and Smart Systems (CEMMSS)," "Computational and Data-enabled Science and Engineering (CDS&E)," "Data Infrastructure Building Blocks (DIBBs)", and/or "Smart & Connected Communities (S&CC)" programs. We recommend that NSF further address the agenda in terms of NSF's continued, but stronger, support plan for infrastructure activities facilitating open data movement.

Data Sharing: As reflected in NSF's Public Access Plan [7], Open Government Plan 4.0 [8], and the 10 big ideas for future NSF investments [1], we recommend that NSF continue to address issues in data sharing and open data by clearly stating that its overarching goal is to enhance the current requirements in DMP. NSF should construct various data infrastructures and determine adaptable parameters for policies to help balance practical constraints with data sharing benefits for the S&E communities [3, 6].

Aspect 2: The NSF Plan should promote a transdisciplinary approach

Tomorrow's big S&E questions will increasingly require transdisciplinary approaches to generate new insights. NSF's recent announcements, such as the "10 big ideas for future investments [1]," support this observation. Nearly all of the ideas cited involve integrating a wide range of disciplines and scales of research and development (R&D) to transform fundamental sciences and meet critical societal needs, leading to transdisciplinary research from interdisciplinary and multidisciplinary research settings.

The success of system/network biology (the Human Genome Project in Biotechnology) is mainly from integrated approaches combining biology, computer science, and data science for complex systems. Such approaches to biological science have received increasing attention in the materials community through programs such as the White House's Materials Genome Initiative, which is supported in part by NSF's "Designing Materials to Revolutionize and Engineer our Future (DMREF)" program. We also recognize the importance of the "Design of Engineering Material Systems (DEMS) program, which integrates theory, processing/manufacturing, data/informatics, experimental, and/or computational approaches.

Armed with these existing interdisciplinary programs, we urge NSF to apply such transdisciplinary approaches to its 10 big ideas for future investments in its new Strategic Plan. The plan should build on NSF's current strategic goal 1: "*transform the frontiers of science and engineering and its corresponding strategic objective: integrate education and research to support development of a diverse STEM workforce with cutting-edge capabilities*"; and strategic goal 2: "*stimulate innovation and address societal needs through research and education and its corresponding objective: strengthen the links between fundamental research and societal needs through investments and partnerships."*

Nexight Group strongly supports transdisciplinary approaches. We believe this plan for facilitating transdisciplinary R&D will help the S&E community build the strong, integrated capabilities needed to solve the difficult problems that the S&E community faces. Close collaboration between NSF and the S&E community is critical to identify the best potential areas and applications of integrative, convergent approaches. When establishing S&E research ecosystems, NSF should consider the encompassing structure, scientific merit, impacts, and policies of transdisciplinary programs.

Aspect 3: Intermediary experts who represent a cross-section of academia, industry, and government agencies are needed for the coordinated development, management, and execution of NSF programs

Coordinated, concerted approaches with NSF leadership—including the National Science Board, NSF's directorates, and staff—and numerous stakeholders are required to successfully develop, execute, and manage NSF's new Strategic Plan. Though the Office of International and Integrative Activities at NSF supports joint activities such as partnership development, expert engagement, communications, social impact studies, special types of analyses, open innovation, and project and program management, it is not easy to harness NSF's diverse expertise to pursue the best solutions for the S&E community. To this end, we suggest NSF consider strengthening its collaborations with intermediary subject matter experts (SME) from professional organizations, technical consultancies, or supply chains. Though the roles of intermediary experts are becoming more crucial in other government agencies such as the Department of Energy and Department of Homeland Security, we recognize that NSF's two major open funding mechanisms—Cooperative Agreements and Grants—often do not allow some of these SMEs to participate in NSF's joint efforts. For example, intermediary experts are often limited in their ability to submit typical proposals in response to NSF funding opportunity announcements (FOA).

We appreciate this opportunity to provide our comments on the NSF Strategic Plan and look forward to the opportunity to collaborate with NSF in the development of its new Strategic Plan. Please contact Ross Brindle, Chief Executive Officer, or me if we can be of assistance.

Sincerely,

Changwon Suh, Ph.D.
Technical Program Manager
Nexight Group

Reference

[1] https://www.nsf.gov/about/congress/reports/nsf_big_ideas.pdf
[2] Glazman J.S.; Rumble J.R. Editors (1989) Computerization and networking of materials databases, Proc. 1st Intl. Symp., Philadelphia Nov. 2–3 1987. ASTM STP 1017
[3] http://www.nsf.gov/bfa/dias/policy/dmp.jsp
[4] https://library.osu.edu/researchcommons/2015/04/27/3610/
[5] A good example of data management is EarthCube that is a joint effort by the NSF Directorate for Geosciences and the Directorate for Computer and Information Science and Engineering (CISE)
[6] http://materials.typepad.com/mrs_meeting_scene/2015/12/program-managers-provide-insights-on-data-management-plans.html
[7] NSF's Public Access Plan: Todays' Data, Tomorrow's Discoveries, March 2015
[8] https://www.nsf.gov/pubs/2016/nsf16131/nsf16131.pdf