**THE FUTURE OF WORK AT THE HUMAN-TECHNOLOGY FRONTIER (FW-HTF)**

**FW-HTF Funding**

(Dollars in Millions)

| | FY 2020 Actual | FY 2021 Estimate | FY 2022 Request |
|---|---|---|---|
| **Stewardship Activities (ENG)** | **$30.00** | **$30.00** | **$30.00** |
| **Foundational Activities** | **$137.63** | **$132.30** | **$143.30** |
| CISE | 83.72 | 81.00 | 81.00 |
| EHR | 10.54 | 10.30 | 10.30 |
| ENG | 14.00 | 12.00 | 18.00 |
| SBE | 11.86 | 11.50 | 11.50 |
| TIP[1] | 17.51 | 17.50 | 22.50 |
| **Total** | **$167.63** | **$162.30** | **$173.30** |

[1] FY 2020 and FY 2021 funding for TIP is shown for comparability across fiscal years.

**Overview**

The FW-HTF Big Idea supports convergence research to develop new human-technology partnerships leading to increased worker productivity and innovation. This research will prepare the workforce for human-technology partnerships by combining the benefits of new technologies, such as green technologies, AI, and virtual environments, with increased understanding of value-based social, economic, and educational opportunities and impacts.

The landscape of jobs and work is changing with unprecedented speed, driven by the development of new technologies that have moved from the factory floor to an expanding array of knowledge and service occupations. The pace of change has been accelerated by new modes of work during the COVID-19 pandemic. While there are promising benefits to the nation in the creation of new industries through increased productivity, enhanced innovation, and sustained U.S. global leadership, there are also risks for workers as technology may substantially alter, and in some cases, eliminate jobs, and more generally as recovery from the pandemic may not be equitable.

The FW-HTF Big Idea started in FY 2018 and responds to the challenges and opportunities associated with the changing landscape of jobs and work. FW-HTF is supporting new convergent research to understand and advance the human-technology partnership, design new technologies to augment human performance, illuminate the emerging socio-technological landscape, and foster lifelong and pervasive learning with technology. Investments in research and development at the human-technology frontier are enabling technologies that amplify and augment human capabilities to learn, adapt, make decisions, and make sense of complex patterns and situations in the work context. FW-HTF funds interdisciplinary research at the intersection of computer and information science, engineering, the social, behavioral, and economic sciences, and education.

Increasing human capabilities is the result of the incorporation of advances in AI, data science, and closely related technologies for sensing, actuation, coordination, communication, and control with humans in the loop; and depends upon understanding human communication, thinking, and action. These advances will underpin the creation of systems that are adaptive, human-centered, and capable of collaborative interactions with humans. By evaluating the aspects of work that humans do most effectively and the complementary aspects of work that emerging technologies can improve, FW-HTF research will support

advances that improve work quality, increase worker productivity, and make work more meaningful. Additionally, these research investments will enable an understanding of how these changes will affect society and what new approaches to education and training will be required for the new jobs created in in emerging industries as well as the adaptation of existing jobs to the new economic landscape. Moreover, NSF investments will explore the ethical and societal implications of emerging technologies, such as AI, and advance the pursuit and adoption of responsible and ethical approaches to using data and furthering data science for work and workers. Likewise, NSF will invest in research on jobs and industries that use environmentally sustainable technologies. These research investments will accelerate progress and enable the Nation's workforce and economy to lead in a future that is increasingly and unavoidably driven by technology and knowledge. The FW-HTF Big Idea will engage research communities to understand how constantly evolving technologies are changing the world of work and the lives of workers, and how people can in turn shape those technologies to human benefit whether it is through the development and creation of new well-paying jobs for the new industries or the training and reskilling of the workforce.

**Goals**

The FW-HTF Big Idea seeks to maximize benefits and minimize risks of the changing technological environment, to foster support of the workforce in increasing productivity and innovation, and to lay the foundation for new knowledge and developments in science and engineering that is informed through ongoing discussions with partners in industry, non-profits, and other government entities, and expressed in the following four strategic goals:

1. *Understand and Build the Human-Technology Partnership*: Research on the future of work will identify how new technologies affect jobs, the workplace, organizations, and society, as well as how these technologies can be designed and built to increase national productivity, job opportunities, and worker satisfaction, while enabling worker creativity.
2. *Design and Develop New Technologies to Augment Human Performance*: By augmenting the physical and mental capabilities of humans, new technology can open new job opportunities. For example, using AI-based, real-time, adaptive physical and cognitive prosthetics can increase job opportunities for those with disabilities and enhance capabilities in all individuals in manufacturing settings.
3. *Illuminate the Emerging Socio-Technological Landscape*: As technology becomes increasingly capable, companies and organizations will be transformed, as will society, the economy, and relevant laws. Research will clarify the benefits and risks of such change and help inform ethical and value-based design of new technology and software in support of a diverse workforce.
4. *Foster Lifelong and Pervasive Learning Through Technology*: Design of training, including novel AI-based approaches, will support both the training and reskilling that the workforce needs to work with new technology and to enable workers to migrate from old jobs to new ones. Adaptive, pervasive training systems will depend on new research in cyberlearning systems, as well as the integration of training into task performance and management.

**FY 2022 Investments**

Stewardship Activities
FY 2022 activities will leverage the investments made through the FY 2018 to FY 2021 FW-HTF solicitations[1] to catalyze interdisciplinary research that understands and builds the human-technology partnership and new job opportunities, designs new technologies to augment human performance and sustain economic competitiveness, illuminates benefits and risk in the emerging socio-technological landscape in ways that benefit quality of life, and fosters lifelong and pervasive learning that drives an innovative and equitable workforce. The FW-HTF strategic goals will be advanced by continued support for standard research grants, workshops, and grants for planning and coordination. In addition, these core

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[1] www.nsf.gov/funding/pgm_summ.jsp?pims_id=505620

activities will leverage new transition-to-scale funding opportunities released in FY 2021; these awards will create a new and extended knowledge base for deployment in future workplaces and contexts, entailing more extensive data collection at different levels, either in different sectors or various geographic locations at regional, national, or international levels. A series of FY 2021 stakeholder workshops bringing together leaders from industry, labor, non-profits, and universities will set the foundation for future integrative activities such as collaboration hubs, center-scale institutes, and larger-scale grants in FY 2022 and beyond. During FY 2022, FW-HTF will also develop synergies with other NSF Big Ideas and NSF-wide efforts, such as GCR, HDR, Mid-scale RI, NSF INCLUDES, and NRT.

<u>Foundational Activities</u>
Foundational activities comprise continued investments by participating directorates and offices in existing (ongoing) NSF programs that have laid the foundation for the FW-HTF Big Idea. Also, FW-HTF tracks within the Convergence Accelerator will continue to be aligned with FW-HTF goals. These foundational programs are currently managed by NSF's directorates and offices and will remain within the directorates and offices with respect to their funding and management.