

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

FW-HTF Funding (Dollars in Millions)			
	FY 2019 Actual	FY 2020 (TBD)	FY 2021 Request
Stewardship Activities (ENG)	\$29.96	-	\$45.00
Foundational Activities	\$123.52	-	\$116.68
BIO	0.68	-	-
CISE	83.00	-	81.67
EHR	10.36	-	10.30
ENG	16.97	-	13.78
MPS	1.09	-	-
SBE	11.43	-	10.93
Total	\$153.49	-	\$161.68

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 artificial intelligence (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. These changes, while promising benefits to the Nation in the creation of new industries of the future and related occupations, increased productivity, enhanced innovation, and sustained U.S. global leadership, come with risks for workers as technology may substantially alter, and in some cases, eliminate jobs.

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. It is necessary to fund interdisciplinary research at the intersection of computer and information science, engineering, 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. 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. 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.

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 through 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 2021 Investments

Stewardship Activities

FY 2021 activities will leverage the investments made through the FY 2018 and FY 2019 FW-HTF solicitations¹ that support research on advancing cognitive and physical capabilities in the context of human-technology interactions, the evolving symbiosis of human and AI in work, and the understanding and explanation of productivity, innovation, and learning in the workplace. In addition, these activities will leverage new funding opportunities released in FY 2020 that continue to emphasize the four FW-HTF strategic goals listed above. FY 2021 catalytic activities will include standard research grants, workshops, and grants for planning and coordination. These funding opportunities will set the foundation for future integrative activities such as collaboration hubs, center-scale institutes, and larger-scale grants in FY 2021 and beyond. During FY 2020 and 2021, FW-HTF will also develop synergies with other NSF Big Ideas and NSF-wide efforts, including GCR, HDR, Mid-scale RI, NSF INCLUDES, and NRT.

Foundational Activities

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.

¹ www.nsf.gov/pubs/2019/nsf19541/nsf19541.htm

The FW-HTF Track within the NSF Convergence Accelerator (CA)

In FY 2021, although not presented in the table above, the CA seeks to transform how the agency supports the most innovative science, reflecting its commitment to be at the cutting edge, by supporting foundational research while encouraging rapid advances through partnerships between academic and non-academic stakeholders. CA tracks focus on grand challenge themes that would benefit from acceleration. FW-HTF activities within the CA aim to strengthen the U.S. economy, improve worker performance and job satisfaction, and facilitate lifelong learning. Example projects include efforts to match workers with jobs of the future and to develop living laboratories, such as in classrooms and manufacturing environments, where hypotheses about learning and productivity will be tested. FW-HTF activities within the CA will be informed by analysis of emerging foundational advances in FW-HTF research and input from stakeholders. These activities will align with, build upon, and help reshape directorates' foundational research investments. For more information, refer to the CA narrative in this chapter.