

Future of Work at the Human-Technology Frontier

Background

Through its Big Idea initiative, the National Science Foundation (NSF) seeks to understand the future of work at the human-technology frontier and fund useful, convergent research on human-technology partnerships. NSF's work will inform the design of new technologies to augment human performance, illuminate the emerging socio-technological landscape, understand the risks and benefits of new technologies for workers, and foster lifelong learning.

To this end, the Future of Work at the Human-Technology Frontier (FW-HTF) program charged SRI International's Center for Innovation Strategy and Policy (CISP) with designing and implementing a series of virtual workshops that will define current research needs, identify and convene relevant stakeholders, and inform a framework for future collaboration on this topic. Workshop participants will include representatives from industry, academia, non-profits, intergovernmental organizations, and state and federal government agencies.

What are the goals of these workshops?

- Define the challenges and opportunities in the broad area of interests covered by the FW-HTF Big Idea
- Identify and engage stakeholders whose work relates to the FW-HTF Big Idea
- Explore the design of funding opportunities that would encourage collaborative efforts within the FW-HTF Big Idea

What are the main topics of the workshop?

The virtual workshops are structured around four broad topics that will address different dimensions of the future of work at the human-technology frontier:

- Restructuring the physical and virtual workspace
- Exploring the human-technology partnership
- Fostering reskilling, upskilling, and lifelong learning
- Identifying ethical questions and the implications for policy

Restructuring the Physical and Virtual Workspace

Increased use of technology is disrupting work schedules, tasks, business models, even the frontier between work and non-work. Businesses and workers must define new, highly flexible relationships. These new ways of working will spill over into non-work domains of life, with implications for the way households work. The use of technology may reshape the worker's physical presence. Technologies such as alternate, virtual, and mixed realities (AR/VR/MR), telemedicine, and virtual presence will have a dramatic impact on the geography of work, perhaps affecting the growth of superstar urban areas or, at least, reshaping commuting

patterns. These new technologies enable non-traditional work arrangements, such as on-demand and flexible schedules, and allow for more complete oversight of tasks and performance. Even the micro-geographies of the office—also reshaped by COVID-19—may change, with intra-office communication increasingly digital and staff physically isolated. What understanding will employers and employees reach regarding the workplace arrangement and communication under these new circumstances? How will these technologies affect the way firms organize their physical establishments and their employee teams? What will the impact of these technologies be on the spatial distribution of work?

Exploring the Human-Technology Partnership

In the near term and for most jobs, technology will not displace humans but will appear alongside them in factories, offices, stores, hospitals, schools, and other work contexts. While these technologies will contribute to increasing human performance, they will still require critical human input. For example, although artificial intelligence (AI) is increasing its presence from the manufacturing floor to the office suite, humans are still required to fine-tune algorithms and monitor the AI's performance. In return, the presence of AI enables human workers to focus on other, more specialized tasks, augmenting and improving the humans' performance. Over time, therefore, a technology and its human partner must each adapt to the characteristics of the other. What new skills will humans need to acquire? How should the mix of technology and labor be negotiated? What will the interfaces for human-technology collaboration look like in the future?

The increasing role of automated technologies, such as robots, allows greater task specialization for human workers. As a result, industries that once epitomized the American economy, such as manufacturing, will face significant evolutionary changes. Labor- and time-intensive tasks, as well as those with a high level of routineness, are among those most likely to face disruption and automation. Workplaces of all kinds face this disruption, and leaders and workers alike must rethink how they interact with the built environment and their new digitized coworkers. How is the increasing role of data and machines affecting workplace decisions? Will the adoption of these technologies upend the demand for and distribution of workers within a business or organization? What new jobs will emerge for those workers displaced by the growing presence of machines and new technologies?

Fostering Reskilling, Upskilling, and Lifelong Learning

Every discussion of new technologies in the workplace includes, in some way, a reference to the need for new skills, delivered in new ways, with far greater effectiveness than presently achieved. The increased rate of change and diffusion of new technologies places a new imperative on employers to substantially increase investment in worker training. Upskilling, in

concert with technology investments, presents challenges to both the business and the worker. For example, access to discrete training locations is invariably limited and existing credentials tend to be offered based on inflexible curricula. In practice, workers and employers need education and training orientated towards specific knowledge, competencies, and skills, delivered at a time and place that is seamlessly integrated into work schedules (schedules increasingly disrupted by technological change). How will workers identify the correct match between training offerings and employer needs? Can existing workforce institutions adapt? Can businesses and workers successfully negotiate the imperative for new skills given increased technological change? What are the implications for traditional institutions and methods of education and training? What new entities and modes for training are needed? How will credentials, credits, and skills be redefined, mixed, and packaged?

Identifying Ethical Questions and the Implications for Policy

New technologies offer unrivaled opportunities for making decisions, controlling tasks, and assembling goods. Algorithms will be able to judge worker performance and optimize worker assignments. They will help select job candidates, recommend medical therapy, and authorize loans. Robots will be able to take over some of humans' most dangerous, time consuming, and physically demanding jobs. Although these technologies have the potential to provide enormous social benefit, they also carry with them social, ethical, and legal risks. The difficulty of auditing the component parts of an algorithm exposes individuals and society to bias and injustice. The use of robots may displace workers, change the social and economic status of jobs, and affect our perception of self. Can individuals trust decisions supported by smart systems? When mistakes are made, how will liability be assigned? How can we exercise oversight over those in authority, in government or business, so that their decisions, relative to technology, are fair and balanced? What processes and practices should be implemented to ensure ethical design in new technologies? How can society achieve a technology equilibrium that does not systematically disadvantage the individual?