Stanford Cyber Initiative: Understanding “Cyber-Social Systems”

Introduction

The Stanford Cyber Initiative (the Initiative) was created in late 2014 with a $15 million grant from The William and Flora Hewlett Foundation (Hewlett). In making this grant, and similar ones to Berkeley and MIT, Hewlett’s goal is to help develop a multidisciplinary cybersecurity field capable of developing thoughtful, long-term solutions to the wide range of complex interdependent technical, social and public policy problems posed by the Internet. Hewlett challenged Stanford to help create and define this new field of research and policy. Stanford has organized its Initiative around the study of “cyber-social systems,” in which cyber-technologies interact with existing social systems. As described in greater length below, social systems comprise the various organizations of human activity, including different markets, political arenas, and other communities. Cyber technologies encompass networked digital technologies – notably, the internet – and extend, for instance, to infrastructure control systems and wireless biomedical devices. Thus, cyber-social systems, both large and small, use embedded digital structures and devices to facilitate, enhance and scale human endeavors.

The study of cyber-social systems will yield a superior policy framework to address immediate cyber-threats and challenges, enhance the social gains from technical innovation and head off longer-term emergent flaws. In pursuing these goals, the Stanford Cyber Initiative will promote expansive research and discussion that combine the University’s expertise in both technology and various social systems. Initially, we will focus on the following four social systems: consumer markets, employment and the workplace, medicine and health care, and democracy and politics. In addition, Stanford has existing hubs that are investigating three other cyber-social systems, with which the Initiative will collaborate: education (through the office of the Vice-Provost of Teaching and Learning), international security (through the Center for International Security and Cooperation), and research (through, for example, the Stanford Data Science Initiative, Institute for Research in the Social Sciences, or the Center for Biomedical Informatics Research).

The Challenge:
How to understand and address the unprecedented scope, scale and rapidity of cyber-technological and associated social change.

Our world has been transformed by a recent wave of technological and social
change. The technological wave began with a succession of ever more powerful computers that ushered in the “information age.” It grew bigger with the introduction of the digital networks — notably the Internet and the World Wide Web — and associated browsers that permitted computer users to visit millions of websites around the world in a matter of seconds. Over the last several years, mobile and wearable devices, cloud storage and countless software applications have invited us to leverage the power of networked information and move a rapidly growing portion of our activities from the three-dimensional, physical world into cyberspace. Today one can, for example, advertise, sell, buy, bank, play, meet friends, share confidences, turn on appliances, argue, steal, and even engage in warfare in cyberspace, with the online activity experienced through the two-dimensional screen of one’s networked digital device.

As a result of recent, widely publicized breaches of private and proprietary information, we have become well aware of looming vulnerabilities that result from this shift to cyberspace. These high-profile threats, that now extend beyond the security of information to our critical physical systems (such as power grids and public transportation), are the focus of frenzied public and private discussion in industry, government and policy circles. Yet, the urgent call for solutions to these threats should not lead us to neglect the more diffuse, gradual and fundamental ways in which our ways of life are being transformed. We need to collect, organize and share quantitative and qualitative data to understand these changes.

Digital technologies have been produced and introduced into markets with little consideration of their short- or long-term social ramifications. In some cases, there is an optimistic premise that market forces or government action will correct for unforeseen problems. The prospect of path dependencies and externalities from market-driven adoption of technologies, however, raise large and complex questions as to their largely unintended impact on social welfare. Moreover, the accretion of technological change over time fundamentally changes who we are and how we interact with each other, whether at work or leisure. The adoption of digital tools, for example, structure thought and action, just as a spoken language influences how one organizes one’s experiences. Our laws, norms and conventions are forced to adapt to each wave of new cyber technology without consciously considering – by protecting or reframing – the respective core values and goals of these social systems.

The “Cyber-Social Systems” Approach

The future cannot be built by technological creators alone, and that awareness brings us to the heart of the Stanford Cyber Initiative: the imperative to build new
bridges across which technology experts and societal system experts can communicate and collaborate to better address the needs of 21st century societies. Many of the societal stresses we experience today illustrate that, to date, such collaborations have been more the exception than the rule. “Cybersecurity” research, for example, has generally been interpreted as correcting the technical flaws and vulnerabilities in digital technologies – flaws and vulnerabilities that have been revealed through use or misuse by humans, of course, but the focus of the research has been more on the technical specifications for the technologies than on the thoughtful, strategic understanding of the interactions between human behavior and the structures of social systems in which the technologies are embedded.

Although the realm of human interaction can be divided in many different ways into social systems, a few illustrative examples may be helpful. At a high level of abstraction, one might think of the market, the democratic state and civil society as systems. More finely partitioned systems involve education, payment mechanisms, insurance, health care, transportation, energy, philanthropy, the workplace, or even the production of knowledge itself.

These social systems predate the digital revolution, and understanding their long-standing values and goals is essential to assessing the impact and prospects of digital technologies. Generally, each system relies on a set of structures and mechanisms that promote stability, fairness, efficiency, reliability and trustworthiness. Ensuring that these values are protected and enhanced during or through the adoption and integration of new technologies requires open, balanced and respectful collaborations between those who build digital products and infrastructures and the social scientists, humanists, educators and legal, medical and management experts who deeply understand how human social systems have operated throughout the history of humankind.

Starting with such an informed view of the needs of a social system offers an opportunity to be more strategic and far-sighted in employing and advocating for effective digital products and structures within that system from the outset. This approach anticipates the interaction of technology and human behavior, providing the opportunity to both avoid emergent flaws and enhance the social gains from technical innovation. Addressing immediate technical flaws and vulnerabilities remains an important part of today’s research, but advocating for a broader, system-wide perspective will also offer longer-term solutions to current problems.

**Cyber-Social System Approach at Stanford**

As noted earlier, Hewlett has challenged Stanford to organize the study of the complex technical and public policy problems posed by the Internet. The cyber-
social system approach responds to this call and it requires multidisciplinary collaboration between experts in digital technologies and experts in the various social systems. Stanford University has accumulated substantial experience in encouraging such cross-disciplinary research -- in areas of the environment, energy and health policy, to name only a few -- and to improving the quality of policy debates, on both national and international stages. The Cyber Initiative has a steering committee that includes faculty from across the University, including computer science, the humanities, the social sciences, management, communications and law.

The Initiative is developing a map of recent and current research activity at Stanford through the lens of cyber-social systems. This will inform further our nascent framing of the set of issues that we have undertaken to help organize. In framing our current solicitation for research funding, we have also taken the first steps to broaden engagement with cyber-social issues at Stanford, by explicitly inviting faculty across the various schools and other units to think about and conduct empirical study of the impact of cyber technologies in the social systems that they study. We are also convening working groups of faculty across the University to identify the game-changing issues that are emerging in four systems mentioned above: consumer markets, employment and the workplace, medicine and health care, and democracy and politics. These groups will later invite the participation of leading figures in industry, government, universities and other policy think tanks. The Stanford Initiative has a two-track objective to contribute to informed responses to the immediate cyber vulnerabilities of the day, while developing an analytical framework and empirical grounding based on cyber-social systems, that will yield resilient policy solutions to the emerging problems five and ten years hence.

**Conclusion**

There is a growing realization in the U.S. and abroad that, as a society, we have much to study and learn if we are to preserve the important values of our collective history while embracing the positive aspects of our new digital future. The vulnerability of our digital information infrastructure to mercenary, political and malicious hacking is but one subset of the broader threat we face. Given the wide range of human activities and social systems that are undergoing fundamental transformation through waves of new digital technologies, with unprecedented and unrelenting speed, the need for better understanding of cyber-social systems is urgent and requires a new analytical approach. With this cyber-social system framework, research and outreach, Stanford will improve the social awareness of technology innovators and contribute to policy debates in the short- and longer-term to ensure these systems are set up to thrive.