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Technology and Global Change

How Is Technology Changing the World, and How Should the World Change Technology?

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Technologies are becoming increasingly complicated and increasingly interconnected. Cars, airplanes, medical devices, financial transactions, and electricity systems all rely on more computer software than they ever have before, making them seem both harder to understand and, in some cases, harder to control. Government and corporate surveillance of individuals and information processing relies largely on digital technologies and artificial intelligence, and therefore involves less human-to-human contact than ever before and more opportunities for biases to be embedded and codified in our technological systems in ways we may not even be able to identify or recognize. Bioengineering advances are opening up new terrain for challenging philosophical, political, and economic questions regarding human-natural relations. Additionally, the management of these large and small devices and systems is increasingly done through the cloud, so that control over them is both very remote and removed from direct human or social control. The study of how to make technologies like artificial intelligence or the Internet of Things "explainable" has become its own area of research because it is so difficult to understand how they work or what is at fault when something goes wrong (Gunning and Aha 2019).

This growing complexity makes it more difficult than ever—and more imperative than ever—for scholars to probe how technological advancements are altering life around the world in both positive and negative ways and what social, political, and legal tools are needed to help shape the development and design of technology in beneficial directions. This can seem like an impossible task in light of the rapid pace of technological change and the sense that its continued advancement is inevitable, but many countries around the world are only just beginning to take significant steps toward regulating computer technologies and are still in the process of radically rethinking the rules governing global data flows and exchange of technology across borders.

These are exciting times not just for technological development but also for technology policy—our technologies may be more advanced and complicated than ever but so, too, are our understandings of how they can best be leveraged, protected, and even constrained. The structures of technological systems as determined largely by government and institutional policies and those structures have tremendous implications for social organization and agency, ranging from open source, open systems that are highly distributed and decentralized, to those that are tightly controlled and closed, structured according to stricter and more hierarchical models. And just as our understanding of the governance of technology is developing in new and interesting ways, so, too, is our understanding of the social, cultural, environmental, and political dimensions of emerging technologies. We are realizing both the challenges and the importance of mapping out the full range of ways that technology is changing our society, what we want those changes to look like, and what tools we have to try to influence and guide those shifts.

PROMISES AND PITFALLS OF TECHNOLOGY

Technology can be a source of tremendous optimism. It can help overcome some of the greatest challenges our society faces, including climate change, famine, and disease. For those who believe in the power of innovation and the promise of creative destruction to advance economic development and lead to better quality of life, technology is a vital economic driver (Schumpeter 1942). But it can also be a tool of tremendous fear and oppression, embedding biases in automated decision-making processes and information-processing algorithms, exacerbating economic and social inequalities within and between countries to a staggering degree, or creating new weapons and avenues for attack unlike any we have had to face in the past. Scholars have even contended that the emergence of the term *technology* in the nineteenth and twentieth centuries marked a shift from viewing individual pieces of machinery as a means to achieving political and social progress to the more dangerous, or hazardous, view that larger-scale, more complex technological systems were a semiautonomous form of progress in and of themselves (Marx 2010). More recently, technologists have sharply criticized what they view as a wave of new Luddites, people intent on slowing the development of technology and turning back the clock on innovation as a means of mitigating the societal impacts of tech-

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nological change (Marlowe 1970).

At the heart of fights over new technologies and their resulting global changes are often two conflicting visions of technology: a fundamentally optimistic one that believes humans use it as a tool to achieve greater goals, and a fundamentally pessimistic one that holds that technological systems have reached a point beyond our control. Technology philosophers have argued that neither of these views is wholly accurate and that a purely optimistic or pessimistic view of technology is insufficient to capture the nuances and complexity of our relationship to technology (Oberdiek and Tiles 1995). Understanding technology and how we can make better decisions about designing, deploying, and refining it requires capturing that nuance and complexity through in-depth analysis of the impacts of different technological advancements and the ways they have played out in all their complicated and controversial messiness across the world.

These impacts are often unpredictable as technologies are adopted in new contexts and come to be used in ways that sometimes diverge significantly from the use cases envisioned by their designers. The internet, designed to help transmit information between computer networks, became a crucial vehicle for commerce, introducing unexpected avenues for crime and financial fraud. Social media platforms like Facebook and Twitter, designed to connect friends and families through sharing photographs and life updates, became focal points of election controversies and political influence. Cryptocurrencies, originally intended as a means of decentralized digital cash, have become a significant environmental hazard as more and more computing resources are devoted to mining these forms of virtual money. One of the crucial challenges in this area is therefore recognizing, documenting, and even anticipating some of these unexpected consequences and providing mechanisms to technologists for how to think through the impacts of their work, as well as possible other paths to different outcomes (Verbeek 2006). And just as technological innovations can cause unexpected harm, they can also bring about extraordinary benefits—new vaccines and medicines to address global pandemics and save thousands of lives, new sources of energy that can drastically reduce emissions and help combat climate change, new modes of education that can reach people who would otherwise have no access to schooling. Regulating technology therefore requires a careful balance of mitigating risks without overly restricting potentially beneficial innovations.

POLITICS AND PRIVACY

Nations around the world have taken very different approaches to governing emerging technologies and have adopted a range of different technologies themselves in pursuit of more modern governance structures and processes (Braman 2009). In Europe, the precautionary principle has guided much more anticipatory regulation aimed at addressing the risks presented by technologies even before they are fully realized. For instance, the European Union's General Data Protection Regulation focuses on the responsibilities of data controllers and processors to provide individuals with access to their data and information about how that data is being used not just as a means of addressing existing security and privacy threats, such as data breaches, but also to protect against future developments and uses of that data for artificial intelligence and automated decision-making purposes. In Germany, Technische Überwachungsvereine, or TÜVs, perform regular tests and inspections of technological systems to assess and minimize risks over time, as the tech landscape evolves. In the United States, by contrast, there is much greater reliance on litigation and liability regimes to address safety and security failings after-the-fact. These different approaches reflect not just the different legal and regulatory mechanisms and philosophies of different nations but also the different ways those nations prioritize rapid development of the technology industry versus safety, security, and individual control. Typically, governance innovations move much more slowly than technological innovations, and regulations can lag years, or even decades, behind the technologies they aim to govern.

In addition to this varied set of national regulatory approaches, a variety of international and nongovernmental organizations also contribute to the process of developing standards, rules, and norms for new technologies, including the International Organization for Standardization and the International Telecommunication Union. These multilateral and NGO actors play an especially important role in trying to define appropriate boundaries for the use of new technologies by governments as instruments of control for the state.

At the same time that policymakers are under scrutiny both for their decisions about how to regulate technology as well as their decisions about how and when to adopt technologies like facial recognition themselves, technology firms and designers have also come under increasing criticism. Growing recognition that the design of technologies can have far-reaching social and political implications means that there is more pressure on technologists to take into consideration the consequences of their decisions early on in the design process (Vincenti 1993; Winner 1980). The question of how technologists should incorporate these social dimensions into their design and development processes is an old one, and debate on these issues dates back to the 1970s, but it remains an urgent and often overlooked part of the puzzle because so many of the supposedly systematic mechanisms for assessing the impacts of new technologies in both the private and public sectors are primarily bureaucratic, symbolic processes rather than carrying any real weight or influence.

PRIVATE-SECTOR INFLUENCE AND BIG TECH

Technologists are often ill-equipped or unwilling to respond to the sorts of social problems that their creations have—often unwittingly—exacerbated, and instead point to governments and lawmakers to address those problems (Zuckerberg 2019). But governments often have few incentives to engage in this area. This is because setting clear standards and rules for an ever-evolving technological landscape can be extremely challenging, because enforcement of those rules can be a significant undertaking requiring considerable expertise, and because the tech sector is a ma-

jor source of jobs and revenue for many countries that may fear losing those benefits if they constrain companies too much. This indicates not just a need for clearer incentives and better policies for both private- and public-sector entities but also a need for new mechanisms whereby the technology development and design process can be influenced and assessed by people with a wider range of experiences and expertise. If we want technologies to be designed with an eye to their impacts, who is responsible for predicting, measuring, and mitigating those impacts throughout the design process? Involving policymakers in that process in a more meaningful way will also require training them to have the analytic and technical capacity to more fully engage with technologists and understand more fully the implications of their decisions.

At the same time that tech companies seem unwilling or unable to rein in their creations, many also fear they wield too much power, in some cases all but replacing governments and international organizations in their ability to make decisions that affect millions of people worldwide and control access to information, platforms, and audiences (Kilovaty 2020). Regulators around the world have begun considering whether some of these companies have become so powerful that they violate the tenets of antitrust laws, but it can be difficult for governments to identify exactly what those violations are, especially in the context of an industry where the largest players often provide their customers with free services. And the platforms and services developed by tech companies are often wielded most powerfully and dangerously not directly by their private-sector creators and operators but instead by states themselves for widespread misinformation campaigns that serve political purposes (Nye 2018).

Since the largest private entities in the tech sector operate in many countries, they are often better poised to implement global changes to the technological ecosystem than individual states or regulatory bodies, creating new challenges to existing governance structures and hierarchies. Just as it can be challenging to provide oversight for government use of technologies, so, too, oversight of the biggest tech companies, which have more resources, reach, and power than many nations, can prove to be a daunting task. The rise of network forms of organization and the growing gig economy have added to these challenges, making it even harder for regulators to fully address the breadth of these companies' operations (Powell 1990). The private-public partnerships that have emerged around energy, transportation, medical, and cyber technologies further complicate this picture, blurring the line between the public and private sectors and raising critical questions about the role of each in providing critical infrastructure, health care, and security. How can and should private tech companies operating in these different sectors be governed, and what types of influence do they exert over regulators? How feasible are different policy proposals aimed at technological innovation, and what potential unintended consequences might they have?

STATE COMPETITION AND CONFLICT

Conflict between countries has also spilled over significantly into the private sector in recent years, most notably in the case of tensions between the United States and China over which technologies developed in each country will be permitted by the other and which will be purchased by other customers, outside those two countries. Countries competing to develop the best technology is not a new phenomenon, but the current conflicts have major international ramifications and will influence the infrastructure that is installed and used around the world for years to come. Untangling the different factors that feed into these tussles as well as whom they benefit and whom they leave at a disadvantage is crucial for understanding how governments can most effectively foster technological innovation and invention domestically as well as the global consequences of those efforts. As much of the world is forced to choose between buying technology from the United States or from China, how should we understand the long-term impacts of those choices and the options available to people in countries without robust domestic tech industries? Does the global spread of technologies help fuel further innovation in countries with smaller tech markets, or does it reinforce the dominance of the states that are already most prominent in this sector? How can research universities maintain global collaborations and research communities in light of these national competitions, and what role does government research and development spending play in fostering innovation within its own borders and worldwide? How should intellectual property protections evolve to meet the demands of the technology industry, and how can those protections be enforced globally?

These conflicts between countries sometimes appear to challenge the feasibility of truly global technologies and networks that operate across all countries through standardized protocols and design features. Organizations like the International Organization for Standardization, the World Intellectual Property Organization, the United Nations Industrial Development Organization, and many others have tried to harmonize these policies and protocols across different countries for years, but have met with limited success when it comes to resolving the issues of greatest tension and disagreement among nations. For technology to operate in a global environment, there is a need for a much greater degree of coordination among countries and the development of common standards and norms, but governments continue to struggle to agree not just on those norms themselves but even the appropriate venue and processes for developing them. Without greater global cooperation, is it possible to maintain a global network like the internet or to promote the spread of new technologies around the world to address challenges of sustainability? What might help incentivize that cooperation moving forward, and what could new structures and process for governance of global technologies look like? Why has the tech industry's self-regulation culture persisted? Do the same traditional drivers for public policy, such as politics of harmonization and path dependency in policy-making, still sufficiently explain policy outcomes in this space? As new technologies and their applications spread across the globe in uneven ways, how and when do they create forces of change from unexpected places?

These are some of the questions that we hope to address

in the Technology and Global Change section through articles that tackle new dimensions of the global landscape of designing, developing, deploying, and assessing new technologies to address major challenges the world faces. Understanding these processes requires synthesizing knowledge from a range of different fields, including sociology, political science, economics, and history, as well as technical fields such as engineering, climate science, and computer science. A crucial part of understanding how technology has created global change and, in turn, how global changes have influenced the development of new technologies is understanding the technologies themselves in all their richness and complexity—how they work, the limits of what they can do, what they were designed to do, how they are actually used. Just as technologies themselves are becoming more complicated, so are their embeddings and relationships to the larger social, political, and legal contexts in which they exist. Scholars across all disciplines are encouraged to join us in untangling those complexities.

AUTHOR BIOGRAPHY

Josephine Wolff is an associate professor of cybersecurity policy at the Fletcher School of Law and Diplomacy at Tufts University. Her book *You'll See This Message When It Is Too Late: The Legal and Economic Aftermath of Cybersecurity Breaches* was published by MIT Press in 2018.

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