FUTURE WORK

Jeffrey M. Hirsch[*]

The Industrial Revolution. The Digital Age. These revolutions radically altered the workplace and society. We may be on the cusp of a new era—one that will rival or even surpass these historical disruptions. Technology such as artificial intelligence, robotics, virtual reality, and cutting-edge monitoring devices are developing at a rapid pace. These technologies have already begun to infiltrate the workplace and will continue to do so at ever increasing speed and breadth.

This Article addresses the impact of these emerging technologies on the workplace of the present and the future. Drawing upon interviews with leading technologists, the Article explains the basics of these technologies, describes their current applications in the workplace, and predicts how they are likely to develop in the future. It then examines the legal and policy issues implicated by the adoption of technology in the workplace—most notably job losses, employee classification, privacy intrusions, discrimination, safety and health, and impacts on disabled workers. These changes will surely strain a workplace regulatory system that is ill-equipped to handle them. What is unclear is whether the strain will be so great that the system breaks, resulting in a new paradigm of work.

Whether or not we are on the brink of a workplace revolution or a more modest evolution, emerging technology will exacerbate the inadequacies of our current workplace laws. This Article discusses possible legislative and judicial reforms designed to ameliorate these problems and stave off the possibility of a collapse that would leave a critical mass of workers without any meaningful protection, power, or voice. The most far-reaching of these options is a proposed "Law of Work" that would address the wide-ranging and interrelated issues posed by these new technologies via a centralized regulatory scheme. This proposal, as well as other more narrowly focused reforms, highlight the major impacts of technology on our workplace laws, underscore both the current and future shortcomings of those

* Geneva Yeargan Rand Distinguished Professor of Law, University of North Carolina School of Law. I would like to thank John Coyle, Andy Hessick, Carissa Hessick, Richard Myers, and Kathleen Thomas for their helpful input on this Article, as well as participants at the 12th Annual Colloquium on Scholarship in Labor & Employment Law, Reshaping Work Conference 2018, and University of North Carolina School of Law speaker series. This Article also benefitted from the extraordinary research assistance of Veronica Barkley and Hailey Klabo. Finally, I owe a great deal of debt to the following technologists who graciously provided their time and patience in assisting me with this project: Stanley Ahalt, Jay Aikat, Ron Alterovitz, Blake Boyd, Karen Chen, Lawrence Carin, Michael Clamann, Kris Hauser, Jason Jerald, Regis Kopper, Edgar Lobaton, Collin Lynch, Bryan Moynihan, Junier Oliva, and Ron Parr.

laws, and serve as a foundation for further research and discussion on the future of work.

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I. INTRODUCTION

The workplace is never static. From the time of specialized craft workers, to the Industrial Revolution, and more recently the onset of the Digital Age, the workplace has been in constant flux.[1] Some of these changes evolved slowly; others were revolutions. Presently, we are on the cusp of another era of work, one in which emerging technologies such as artificial intelligence, automation, and virtual reality have the potential to equal or even surpass the shocks caused by previous revolutions in the workplace.[2]

1. KATHERINE V.W. STONE, FROM WIDGETS TO DIGITS: EMPLOYMENT REGULATION FOR THE CHANGING WORKPLACE 4–6 (2004).

2. *Cf.* ALVIN TOFFLER, FUTURE SHOCK 4 (1970) (arguing that rapid changes over short period of time can cause serious societal harms).

The changes wrought by emerging technology will likely take several forms. Major changes in how certain types of work are performed—caused by innovations such as robotics and self-driving vehicles—can be expected to cause significant job losses that will aggravate preexisting cultural, social, and geographic conflicts.[3] New technology will also transform the role of many human workers and their relationship with employers. For instance, innovations in artificial intelligence and other types of computing will interject themselves into the employer-employee relationship in ways that our current workplace laws are incapable of handling.[4] Moreover, advances in monitoring technology increasingly allow employers to gather and use information about workers, oftentimes of a highly personal nature, raising a multitude of questions about privacy and workers' dependency on employers. And, in the future, developments in virtual reality and related technology are expected to emulate the complexity of in-person communications, which will tear down many of the barriers that currently tie most jobs to specific locations. This could dramatically alter how and where jobs are performed, converting a substantially larger portion of the labor force into gig workers and perhaps even leading to a time when there are few "workplaces" as traditionally conceived. These technologies will also place enormous strains on our system of workplace laws, which are often so old and rigid that telecommuting seems like science fiction.[5] This Article will explore these trends and others, discuss the challenges they pose to the existing workplace regulatory regime, and propose new policies to address them.

The frightening aspect of this emerging technology is not that it will change how we work—what's more alarming is the degree to which it may do so. Law in the United States is often quite adaptable, providing judges and regulators leeway to modify their approach to various legal issues. But only to a point. At times, social changes are so great that they are unable to fit tolerably within the current legal regime. When that happens, a threshold is breached, much like the widespread labor unrest and violence that, in combination with judicial hostility to workers' rights, ultimately spurred the creation of federal labor law.[6] New technology's potential to disrupt the labor market, in combination with workplace

3. These conflicts contributed to the surprising 2016 United States presidential election and the growing political divides in this country and elsewhere. *See also infra* Section III.A (discussing job losses, as well as job gains and changes likely to result from new technology); JAMES MANYIKA ET AL., JOBS LOST, JOBS GAINED: WORKFORCE TRANSITIONS IN A TIME OF AUTOMATION 33–34, 46–47 (2017) (noting the major economic changes, including decades of wage stagnation, following the Industrial Revolution despite productivity growth during much of that period), https://www.mckinsey.com/~/media/mckinsey/featured%20insights/future%20of%20organizations/what%20the%20future%20of%20work%20will%20mean%20for%20jobs%20skills%20and%20wages/mgi%20jobs%20lost-jobs%20gained_report_december%202017.ashx.

4. I use the term "workplace laws" to encompass the wide variety of labor and employment laws that regulate the workplace, including those prohibiting employment discrimination, mandating the minimum wage and overtime, and providing for employees' safety and health.

5. *See, e.g.*, *infra* note 13 and Section III.B.

6. William E. Forbath, *The Shaping of the American Labor Movement*, 102 HARV. L. REV. 1109, 1111 (1989).

laws' current problems and limitations, make this tipping point a genuine possibility. For example, technology is creating a "blended workplace"[7] in which human workers constantly interact with technology. In this blended workplace, technology is also increasingly automating various jobs and work tasks, while simultaneously providing employers more tools to monitor and control workers—thereby shifting the balance of power further toward business and away from labor.[8] And if workplace laws are unable to address this shift[9] (or if they exacerbate it, as seems the case now), then we could easily see massive disruptions that shake not only the workplace, but society at large.[10] It is impossible to predict with certainty whether this will happen or, if so, when. Yet this Article's aim, in part, is to explore this possibility and its ramifications for work and workplace regulation.

Society has long had to grapple with emerging technology and its impact on a wide range of areas, such as crime, education, finance, and the environment. There is much literature addressing these areas, but relatively less on technology's impact on the workplace.[11] To be sure, some literature has delved into technology's impact on work, but that scholarship is typically directed to specific and current applications of particular technologies.[12] Such research is valuable, but largely ignores the magnitude and breadth of changes to work that these technologies may bring about. This Article fills that gap by addressing the broader landscape—a landscape in which new technology has already begun to change the workplace and will continue to do so on a much grander scale in the future.

Because of its more expansive focus, this Article differs from the current literature in several important aspects. First, it examines several major emerging technologies, rather than a single one. Although a deep dive into a narrow issue is important, technology's far-reaching impact on the workplace demands an

7. Credit for this term is owed to Professor Richard Myers. This concept could be analogized as a workplace version of the "Internet of Things," in which interconnected networks of "smart" technology become a pervasive part of individuals' lives. Andrew Guthrie Ferguson, *The Internet of Things and the Fourth Amendment of Effects*, 104 CALIF. L. REV. 805, 812–13 (2016).

8. Technology can also provide workers with additional tools to seek better working conditions, such as better ways to monitor and share information about employers, but those tools will almost certainly be a mere drop in the bucket compared to the larger trends working against them.

9. Technology will also likely create new extra-legal responses, although unlikely to a degree that would begin to offset the negative effects of this problem. *See infra* note 264.

10. We are already seeing some evidence of this with the rise of populism in the United States and elsewhere in the world. Work issues aren't the only reason for this development, but it is a major one. MICHAEL COX, LONDON SCHOOL OF ECONOMICS, UNDERSTANDING THE GLOBAL RISE OF POPULISM 10–12 (2018).

11. *See, e.g.*, Jordan Diamond, *Environmental Law and the Changing Data Paradigm*, 44 ECOLOGY L.Q. 1 (2017) (introduction to special journal issue on environment and technology); Mark Fenwick et al., *Legal Education in the Blockchain Revolution*, 20 VAND. J. ENT. & TECH. L. 351 (2017); Tom C.W. Lin, *Compliance, Technology, and Modern Finance*, 11 BROOK. J. CORP. FIN. & COM. L. 159 (2016); Ric Simmons, *Big Data, Machine Judges, and the Legitimacy of the Criminal Justice System*, 52 U.C. DAVIS L. REV. 1067 (2018).

12. *See, e.g.*, Ioefma Ajunwa et al., *Limitless Worker Surveillance*, 105 CALIF. L. REV. 735 (2017); *infra* Section III.D (discussing potential for artificial intelligence to produce discriminatory results in hiring and other personnel decisions). Professor Stone's valuable book, *From Widgets to Digits*, provided a broad look at the effect of computers, among other things, on the workplace. STONE, *supra* note 1; *see also*, Estlund, *infra* note 195. This Article moves beyond that era of change to a new one brought on by more recent technologies.

equally extensive appraisal. In addition, most modern technology does not operate in isolation. For instance, many vehicles on the road today marry technologies as varied as artificial intelligence, automation, and a variety of monitoring devices. Thus, to understand how an autonomous vehicle—or any number of other innovations—will affect the way humans work requires an understanding of the ways in which numerous developing technologies work together.

This Article's second contribution is to provide the scientific backdrop for these technologies. Through information gathered via interviews with numerous experts, it explains the basic principles underlying these technologies, as well as many types of cutting-edge research that are pushing science in countless directions. The purpose of this background is not to provide any rigorous scientific claim. Rather, the aim is to provide key information about how the technologies operate and how they are likely to affect the workplace. Although well known in the scientific world, much of this information has not made its way to the legal one.

Knowledge of how these technologies work is also key to the third contribution of this Article: predicting how technology will impact work in the future. Most of the experts I interviewed were understandably hesitant to make specific predictions about future technological developments, and I make no claim to have additional insights. That said, one can predict likely trends and how they will influence the manner in which we engage in work. These trends, in turn, either create or exacerbate legal and policy issues that society will be forced to contend with.

After Part II of the Article provides the scientific backdrop, Part III sets out these issues and raises various options for addressing them. A comprehensive set of proposals to tackle the myriad challenges posed by emerging technology is beyond the scope of the Article. Whether or not new technology will prompt a true revolution in work, however, changes are coming that will stress an already outmoded workplace regulatory scheme. Thus, by exploring these issues and numerous possible solutions, my aim is both to raise the alarm for policymakers and others invested in the regulation of work and to help spur further discussion for the best path forward. In addition, I explore ways to address more fundamental problems with workplace law that the advance of technology will further highlight. Part IV briefly discusses the most ambitious of these options, a proposed "Law of Work" that would provide a consistent and comprehensible body of law that lowers the cost of compliance for employers and promises better enforcement for all workers, whether or not they are formally considered "employees." Although such a dramatic reshaping of workplace law is unlikely to happen, this proposal helps to illustrate more discrete ways to lower structural barriers to reform, some of which may be politically feasible. Finally, by shining a light on issues that are on the horizon, the Article will hopefully prompt policymakers and judicial actors to take into account how their decisions will impact society in years to come.

It is imperative that we consider and prepare for the future. Although innovation can produce many benefits, without a suitable policy response, advances

in the workplace are expected to impose substantial and long-lasting harms. By examining the likely trajectory of these developments and how they will impact the workplace, I aim to promote efforts to address the impending harms and reform an already outdated workplace regulatory regime.

II. EMERGING TECHNOLOGY TRENDS

At the crux of this Article lies a great tension. On one hand is a focus on cutting-edge technology that is developing at lightning speed. On the other is an area of law that often makes Rip Van Winkle seem like a go-getter.[13] That tension, however, is major impetus for the Article itself, which aspires not only to highlight the stress that new technology will place on an already outmoded system of workplace laws, but also to spur policy and legal changes in a way that has rarely occurred in the past. That is a tall order, and not at all likely to happen. But the degree to which technology is evolving, as well as the enormity of its potential impact on the workplace and society at large, offer some prospect for reform.

To appreciate the nature and scope of technology's impact on work, one must first understand the technology itself. Accordingly, as a supplement to more traditional research of relevant literature, I interviewed fifteen experts in robotics, Artificial Intelligence ("AI"), virtual and augmented reality, and monitoring-related technologies—most of whom work as faculty members or related roles at major research universities.[14] These interviews were not intended to represent a comprehensive scientific consensus on any point. Rather, they provided a superior method for learning about the scientific foundations for these technologies, an opportunity to question experts on legal issues that most scientific literature does not grapple with, and a means to explore possible avenues for future research and application of these technologies.[15]

What follows is a description of these emerging technologies. Based on these interviews and other research, I explore not only the current capabilities of these technologies—including applications in the workplace—but pioneering research that will help shape how the technology will develop in the future.

13. As has frequently been described, labor and employment law changes very slowly, if at all, and as a result often appears seriously outdated. *See, e.g.*, Cynthia L. Estlund, *The Ossification of American Labor Law*, 102 COLUM. L. REV. 1527, 1531 (2002).

14. Two interviewees worked in the private sector, focused both on research and real-world applications of technology. *See infra* notes 86 and 101. Some of the university-associated experts were also involved in commercial applications of research. *See, e.g.*, *infra* note 40.

15. *See supra* note 14 and accompanying text.

A. Artificial Intelligence

Although AI has been in the public consciousness for decades, it has had an evolving and often imprecise meaning.[16] Traditionally, AI referred to what it sounds like: technology that exhibits actual "intelligence."[17] There is no universally accepted definition of intelligence, but it typically refers to some semblance of self-awareness, emotion, or sentience.[18] This "true intelligence" has been the goal of some researchers for decades, with no end in sight. Indeed, because of frustration over the lack of progress, the government froze funding for this research in what is referred to as the "AI Winter."[19] As a result, modern AI research has moved in a different direction, one in which the tools used for true intelligence research have become the new face of AI.

The basic tools of AI research involve technology that uses data to "learn"—that is, recognize patterns and make predictions.[20] As a result, "machine learning," "deep learning," "data mining," "data analytics," and other related terminology more accurately describe today's AI technology.[21] This technology can be separated into two broad categories. "Supervised AI" is a means to label a certain input, such as analyzing a data set to identify a specific image like a tumor in a medical scan[22] or an individual in a crowd.[23] "Unsupervised AI" also analyzes data but does so to identify certain patterns or core characteristics.[24] The burgeoning area of AI legal research illustrates both categories. AI programs can analyze data such as a large set of contracts to either identify contracts with certain characteristics, like a choice of law provision (supervised AI),

16. The term "artificial intelligence" was first coined in 1956, at an academic conference. Tanya Lewis, *A Brief History of Artificial Intelligence*, LIVE SCIENCE (Dec. 4, 2014), https://www.livescience.com/49007-history-of-artificial-intelligence.html.

17. Interview with Junier Oliva, Assistant Professor, Department of Computer Science, University of North Carolina, in Chapel Hill, N.C. (Aug. 28, 2018).

18. CHRIS SMITH ET AL., U. WASH., THE HISTORY OF ARTIFICIAL INTELLIGENCE 4–9 (2006), https://courses.cs.washington.edu/courses/csep590/06au/projects/history-ai.pdf (discussing Turing Test and alternatives).

19. *Id.* at 17–22 (describing freeze caused by frustration with lack of progress).

20. Interview with Junier Oliva, *supra* note 17 (describing machine learning as a combination of computer science and statistics).

21. I will use "artificial intelligence" or "AI" for the sake of clarity and because that is still the term most people associate with this technology.

22. Fei Jiang et al., *Artificial Intelligence in Healthcare Past, Present, and Future*, 2 STROKE & VASCULAR NEUROLOGY 230, 230 (2017) (discussing general methods and examples of AI uses in health care); Interview with Brian Moynihan, Head of Health Technology and Informatics, University of North Carolina, in Chapel Hill, N.C. (Aug. 29, 2018); Dave Fornell, *Examples of How Artificial Intelligence Will Improve Medical Imaging*, IMAGING TECHNOLOGY NEWS (Dec. 21, 2017), https://www.itnonline.com/videos/video-examples-how-artificial-intelligence-will-improve-medical-imaging (video demonstrating uses of AI for medical imaging).

23. Interview with Junier Oliva, *supra* note 17; Paul Mozur, *Inside China's Dystopian Dreams: A.I., Shame, and Lots of Cameras*, N.Y. TIMES (July 8, 2018), https://www.nytimes.com/2018/07/08/business/china-surveillance-technology.html.

24. Interview with Junier Oliva, *supra* note 17; Bernard Marr, *Supervised v. Unsupervised Machine Learning—What's the Difference?*, FORBES (Mar. 16, 2017, 3:13 AM), https://www.forbes.com/sites/bernardmarr/2017/03/16/supervised-v-unsupervised-machine-learning-whats-the-difference/#7acb2f9b485d.

or to determine patterns that help to describe or group the contracts (unsupervised AI).[25]

In addition to the many standalone uses of AI, it is increasingly becoming an integral part of other emerging technologies. Robotics,[26] autonomous vehicles,[27] virtual reality,[28] monitoring devices,[29] and numerous other applications and research rely on AI. But even relatively simple devices are beginning to incorporate AI. For instance, if you do not like to vacuum or sweep, you may own an autonomous vacuum from a company such as Roomba. What you may not realize is that these vacuums have vastly improved in recent years thanks to AI. Early Roomba models randomly traveled around a room, vacuuming and avoiding hazards. More recent versions, however, move randomly at first, but collect data along the way.[30] The vacuums then use that data to develop travel patterns that avoid learned hazards and more efficiently clean a room. Customers can even use an app to view maps of their house that their Roombas have created.[31]

AI applications like these are already being used widely and will likely grow exponentially for many years. But there are limits and pitfalls to AI. Most broadly, the original conception of true AI is very far off in the horizon, if achievable at all.[32] A central problem in achieving genuine artificial intelligence is the difficulty in emulating the human mind, particularly its innate ability to make connections among various pieces of information and use those connections to make generalizations.[33] Although AI can be trained to identify images—often better and more effectively than humans[34]—it takes a tremendous amount of data and processing power to achieve accurate results. But this same generalization

25. *See* Dana Remus & Frank Levy, *Can Robots Be Lawyers? Computers, Lawyers, and the Practice of Law*, 30 GEO. J. LEGAL ETHICS 501, 515–16 (2017). Several companies now sell AI legal software and it is increasing its presence in law schools. *See, e.g.*, *Students Win AI Contest*, U.N.C. SCHOOL OF L. (Dec. 26, 2018), https://law.unc.edu/news/2018/12/students-win-ai-software-contest/ (describing contest sponsored by Duke Law and SEAL Software).

26. *See infra* Section II.C.

27. *See infra* Section II.C; Matthew Hutson, *How Researchers are Teaching AI to Learn Like a Child*, SCIENCE (May 24, 2018, 10:20 AM), https://www.sciencemag.org/news/2018/05/how-researchers-are-teaching-ai-learn-child (describing research using AI to improve autonomous vehicles to control for uncertainty).

28. *See infra* Section II.B.

29. *See infra* Section II.D.

30. Alex Hern, *Roomba Maker May Share Maps of Users' Homes with Google, Amazon, or Apple*, GUARDIAN (July 25, 2017, 6:47 PM), https://www.theguardian.com/technology/2017/jul/25/roomba-maker-could-share-maps-users-homes-google-amazon-apple-irobot-robot-vacuum.

31. This feature generated controversy when Roomba's CEO publicly noted that the company had access to these maps and might sell them. *Id.*

32. *See supra* notes 18–19.

33. *See* SMITH ET AL., *supra* note 18, at 15.

34. European Soc'y for Med. Oncology, *Man Against Machine: AI is Better than Dermatologists at Diagnosing Skin Cancer*, SCIENCEDAILY (May 28, 2018), https://www.sciencedaily.com/releases/2018/05/180528190839.htm; Mohammad Sadegh Norouzzadeh et al., *Automatically Identifying, Counting, and Describing Wild Animals in Camera-Trap Images with Deep Learning*, CORNELL UNIV. (Nov. 15, 2017), https://arxiv.org/abs/1703.05830 (finding that AI-equipped motion-sensor cameras can identify wild animals cheaply and quickly, with same accuracy as crowd-sourced humans); Samuel Dodge & Lina Karam, *A Study and Comparison of Human and Deep Learning Recognition Performance Under Visual Distortions*, 1 arXiv:1705.02498 (2017) (finding that while AI surpasses humans at some visual recognition tasks, humans are better with distorted images), https://arxiv.org/pdf/1705.02498.pdf.

technique is so natural to humans that we can easily make many predictions and identifications with relatively good accuracy.[35] For instance, a child can quickly learn what an elephant looks like and thereafter identify one quite easily, even recognizing one in a picture with many other animals.[36] In contrast, a computer must be fed thousands or more images of an elephant before it can learn enough patterns to identify an elephant in a new picture—and it still make mistakes at times.[37] Thus, comparisons of humans and AI often boil down to this generalization: humans excel at quickly making connections and generalizations that, on the whole, tend to be fairly accurate, while AI requires far more data and training to perform the same tasks, but when successful, can be highly accurate. That said, in some circumstances, AI can defy expectations, such as its ability to reads lips far better than human experts.[38]

AI's reliance on data is currently the most significant barrier to its real-world application. To learn in a sufficiently accurate manner, AI programs not only require massive amounts of data, but data that is organized in precise ways.[39] This often creates serious problems, because before using AI, an organization must collect a large amount of new data or reorganize previously collected data.[40] For instance, medical images are traditionally managed to allow a health care provider to view one image at a time, rather than allow a computer to analyze thousands of images, which is required for it to learn.[41] As a result, only a minority of typically large organizations are using AI in a significant way and, even then, are not fully leveraging the technology.[42] This will change, of course, as organizations either begin the expensive process of transforming their data or new organizations develop with the knowledge of data management's importance.[43] In the interim, however, a select few entities, such as Google, Amazon, and Facebook, possess substantially more data than anyone else, giving

35. Hutson, *supra* note 27.

36. Tom Simonite, *Algorithms that Learn with Less Data Could Expand AI's Power*, MIT TECH. REV. (May 24, 2016), https://www.technologyreview.com/s/601551/algorithms-that-learn-with-less-data-could-expand-ais-power/ (explaining that children can recognize images of animal after one example, but image-recognition software by Google and Microsoft each use 1.2 million labeled examples; also noting research to decrease demand for examples).

37. *Id.*; Katyanna Quach, *AI Image Recognition Systems can be Tricked by Copying and Pasting Random Objects*, REGISTER (Aug. 28, 2018, 7:30 AM), https://www.theregister.co.uk/2018/08/28/ai_image_recognition_tricked/ (describing studies showing AI image-recognition software being tricked into mistaking images, especially uncommon groupings).

38. MANYIKA ET AL., *supra* note 3, at 24 (describing Google's DeepMind lip-reading project and others including reading x-rays and using artificial skin to identify textures and objects).

39. Michael Chui, et al., *What AI Can and Can't Do (Yet) for Your Business*, MCKINSEY Q. (Jan. 2018), https://www.mckinsey.com/business-functions/mckinsey-analytics/our-insights/what-ai-can-and-cant-do-yet-for-your-business#.

40. Interview with Lawrence Carin, Co-Founder and Chief Scientist, Infinia ML & Vice Provost for Research and James L. Meriam Professor of Electrical and Computer Engineering, Duke University, in Durham, N.C. (Sept. 20, 2018).

41. *Id.*; Jiang et al., *supra* note 22, at 241.

42. Arthur Cole, *The Crucial Link Between AI and Good Data Management*, TECHOPEDIA (Nov. 21, 2018), https://www.techopedia.com/the-crucial-link-between-ai-and-good-data-management/2/33477.

43. *Id.*

them potentially oligopolistic control over access.[44] This advantage can limit advances in AI technology and prompt questions about data security.[45]

Other challenges to AI use include computer science limitations. Although computing power is not responsible for current bottlenecks,[46] other issues act as roadblocks to current AI applications. For instance, computers are unable to tell if a program "works" or if something is true or false.[47] Moreover, as AI advances, computing power may become more of a challenge, as there are certain types of problems that current computing is unable to solve in a reasonable amount of time.[48] At some point, major advances such as quantum computing could clear these and other hurdles, but this research is still in its infancy.[49]

Another significant shortcoming with AI, especially when considering its application to the workplace and other human endeavors, is the difficulty in coding fairness, empathy, judgment, and other hard-to-define normative concerns.[50] This means that skills requiring these types of characteristics will remain the province of humans for the foreseeable future. But what tasks are better suited for AI?

As AI technology develops, it will influence countless jobs, some significantly.[51] Indeed, it has already begun making inroads in many industries. AI's influence, broadly speaking, is two-fold. One major use is often referred to as "people analytics," which involves using AI to analyze a company's operations and workers, usually to influence or make personnel decisions such as hiring, scheduling, and compensation.[52] The other major use of AI is to replace human workers or change the way they work.[53]

In real world applications, companies currently use AI for people analytics more than as a substitute for human labor.[54] Uber provides a good example of

44. Tom Simonite, *AI and 'Enormous Data' Could Make Tech Giants Harder to Topple*, WIRED (July 13, 2017, 7:00 AM), https://www.wired.com/story/ai-and-enormous-data-could-make-tech-giants-harder-to-topple/.

45. *See, e.g.*, James Sanders & Dan Patterson, *Facebook Data Privacy Scandal: A Cheat Sheet*, TECHREPUBLIC (July 24, 2019, 8:52 AM), https://www.techrepublic.com/article/facebook-data-privacy-scandal-a-cheat-sheet/#googDisableSync.

46. Interview with Lawrence Carin, *supra* note 40 (stating that data management is bigger hurdle).

47. This is referred to as the "halting problem." Aatish Bhatia, *The Questions that Computers Can Never Answer*, WIRED (Feb. 5, 2014, 11:23 PM), https://www.wired.com/2014/02/halting-problem/.

48. This is referred to as "NP Complete," meaning that it is impossible to solve, or "NP Hard," meaning that there is no efficient way for an algorithm to solve the problem. Erica Klarreich, *Computer Scientists Find New Shortcuts for Infamous Traveling Salesman Problem*, WIRED (Jan. 30, 2013, 9:30 AM), https://www.wired.com/2013/01/traveling-salesman-problem/. The existence of this problem is what cryptosecurity systems like blockchain technology is based upon. Jeff John Roberts, *Breaking Bitcoin with a Quantum Computer*, FORTUNE (Jan. 6, 2018), https://fortune.com/2018/01/06/breaking-bitcoin-cybersaturday/.

49. Roberts, *supra* note 48.

50. Interview with Collin Lynch, Assistant Professor, Dep't of Comput. Sci., N.C. State Univ., in Raleigh, N.C. (Sept. 10, 2018); Francesca Rossi & Nicholas Mattei, *Building Ethically Bounded AI*, CORNELL U. (2018), https://arxiv.org/abs/1812.03980.

51. Later, I discuss personnel-related uses of AI in more detail, especially with regard to risk of discrimination. *See infra* Section III.D.

52. Matthew T. Bodie et al., *The Law and Policy of People Analytics*, 88 U. COLO. L. REV. 961, 964–73 (2017) (describing history and development of people analytics); *infra* Section II.A.

53. *See infra* Section III.A.

54. *See infra* Section III.A.

how AI can influence traditional business models. After creating an online platform for traditional taxi services, Uber has used AI to change the transportation industry in other ways. The company employs data mining to monitor drivers and customers, which enables them to price discriminate (through "surge pricing"), and information technology ("IT") uses psychological tools specifically designed to maximize the supply of drivers at a given time and place.[55] Uber, and others, even use AI software to handle most of its interactions with drivers.[56]

Although less developed than people analytics, AI has already begun replacing human workers and that use is expected to grow exponentially as years go by.[57] For instance, AI is already producing published news stories, especially relatively brief and formulaic "wire reporting."[58] Similarly, a Chinese company has even started using robotic news anchors to read AI-produced text.[59] These uses are part of the "natural language" AI field, where there have been major advances in recent years. Machine language still remains a far cry from the complexity and nuance of human speech,[60] but in the future, as more data becomes available, developers will continue to create better programs for tagging and processing words, which will then produce more human-like results.

AI's potential in the language-processing field is a prime illustration of AI's potential to displace human workers or change the way they work. As AI is better able to interpret and use language like a human, it will not only replace humans but alter how workers learn and do their jobs.[61] For instance, one strand of AI research is developing applications that can improve learning.[62] Among its potential uses is to help attorneys better structure legal arguments.[63] More generally,

55. Noam Scheiber, *How Uber Uses Psychological Tricks to Push its Drivers' Buttons*, N.Y. TIMES (Apr. 7, 2017), https://www.nytimes.com/interactive/2017/04/02/technology/uber-drivers-psychological-tricks.html.

56. Alex Rosenblat, *When Your Boss is an Algorithm*, N.Y. TIMES (Oct. 12, 2018), https://www.nytimes.com/2018/10/12/opinion/sunday/uber-driver-life.html.

57. Vishal Marria, *The Future of Artificial Intelligence in the Workplace,* FORBES (Jan. 11, 2019, 2:58 PM), https://www.forbes.com/sites/vishalmarria/2019/01/11/the-future-of-artificial-intelligence-in-the-workplace/#77e7acf273d4.

58. Google recently gave a major gift to the Reporters and Data and Robots (RADAR) news service, which plans to combine the work of journalists, "Natural Language Generation" software, database tools, and "editorial intelligence" to create up to 30,000 local stories a month, as well as automatically generated graphics and video, in the United Kingdom and Ireland. *PA Awarded €706,000 Grant from Google to Fund a Local News Automation Service in Collaboration with Urbs Media*, PA MEDIA (July 6, 2017), https://pamediagroup.com/pa-awarded-e706000-grant-google-fund-local-news-automation-service-collaboration-urbs-media/.

59. Taylor Telford, *These News Anchors are Professional and Efficient. They're Also Not Human*, WASH. POST (Nov. 9, 2018, 10:40 AM), https://www.washingtonpost.com/business/2018/11/09/these-news-anchors-are-professional-efficient-theyre-also-not-human/.

60. MANYIKA ET AL., *supra* note 3, at 24.

61. Michael Chui et al., *Four Fundamentals of Workplace Automation*, MCKINSEY Q. (Nov. 2015), http://www.mckinsey.com/business-functions/digital-mckinsey/our-insights/four-fundamentals-of-workplace-automation (estimating that natural language advances could increase percentage of job tasks that can be automated from current 45% to 58%).

62. Stefan A.D. Popenici & Sharon Kerr, *Exploring the Impact of Artificial Intelligence on Teaching and Learning in Higher Education*, 12 RES. & PRACTICE IN TECH. ENHANCED LEARNING 1, 6 (2017).

63. Interview with Collin Lynch, *supra* note 50.

AI tools can determine how students or workers learn and what type of educational or training techniques are likely to work best.[64]

AI is a technology that has amazing potential in the workplace, yet also significant limits. For instance, although some have proposed AI as a replacement for many legal tasks, others doubt that it can replace the judgment and empathy often required of attorneys.[65] Current technology is good at sifting through documents and predicting which will be relevant to a case, but—at this point—AI is unable to successfully advise clients, negotiate, and write legal documents.[66] Consequently, AI will increasingly take over simpler legal tasks that paralegals and more junior attorneys typically perform. Humans, however, will continue to perform higher level functions, both in the legal field and others, for the foreseeable future.[67]

In sum, the promise of AI has been just that: much promise, but with significant limitations.[68] As a result, AI's application in real world situations is still largely a work in progress, which means that there is a great deal of uncertainty surrounding its ultimate effect on the workplace. Nevertheless, AI use in the workplace will almost certainly grow as time goes on, likely in dramatic—and, at times, unexpected—ways.

64. For instance, AI can analyze individuals' use of online tools and how they network with each other in productive, or unproductive, ways. *Id.* (noting that studies of MOOCs show that poor students tend to communicate exclusively with each other while good students tend to communicate exclusively with each other).

65. Steve Lohr, *A.I. Is Doing Legal Work. But It Won't Replace Lawyers, Yet.*, N.Y. TIMES (Mar 19, 2017), https://www.nytimes.com/2017/03/19/technology/lawyers-artificial-intelligence.html (citing software that can provide a list of cases most relevant to clients and another software that can provide two-page memoranda answering legal questions—currently with editing from humans); Remus & Levy, *supra* note 25, at 536 (estimating that AI adoption could, in five years' time, reduce lawyers' work by 2.5% annually); James Manyika et al., *Harnessing Automating for a Future that Works*, MCKINSEY GLOBAL INST. (2017), http://www.mckinsey.com/global-themes/digital-disruption/harnessing-automation-for-a-future-that-works (estimating that 23% of attorney's job could be automated with technology currently in use or being tested).

66. Lohr, *supra* note 65.

67. *Id.*; Remus & Levy, *supra* note 25, at 538. *But see* Chui et al., *supra* note 61 (noting that only 4% of U.S. occupations require creativity at median level of human competency and 29% of occupations require median level of empathy).

68. Gary Marcus, *Artificial Intelligence is Stuck. Here's How to Move it Forward*, N.Y. TIMES (July 29, 2017), https://www.nytimes.com/2017/07/29/opinion/sunday/artificial-intelligence-is-stuck-heres-how-to-move-it-forward.html (describing, among other limitations, broad problems with AI systems' comprehending complex visual scenes and following simple directions).

B. X Reality

"X Reality" or "XR" is a relatively new term that is gaining some acceptance as the most inclusive terminology for altered-reality environments.[69] Most readers will recognize virtual reality ("VR") and augmented reality ("AR") as the two most prominent forms of XR, although they are not the only ones. To understand the difference between these related, but distinct, types of technologies, think of a spectrum of reality. At one end of this continuum is the natural world and at the other is a fully computer-generated immersive experience. VR is at this far end, encompassing more of an immersive experience, while AR (sometimes referred to as "mixed reality") is in the middle.[70]

Because VR technology is still developing rapidly, its experiences lie along a spectrum as well. At one extreme is a "true" VR experience, in which a user is fully immersed in the VR environment; that is, everything sensed by the user is computer generated.[71] But the technology required for that level of experience is far off, with most experiences currently limited to sight and sound.[72] Additionally, a true VR experience would be seamlessly three dimensional, allowing, for instance, users to walk and move their heads with the VR inputs changing accordingly and instantly.[73] Because of limits on eye and body tracking, as well as computing power, this level of experience is beyond the reach of most current technology.[74]

The two primary types of VR systems in use today involve displays that are either head-mounted, covering the users' eyes and ears, or a room set up with projectors.[75] Although these systems are becoming quite adept at providing realistic environments for certain aspects of a users' experience, the technology still has a long way to go. In addition to providing only sight and sound in most instances, processing speed has been a major hurdle. The level of computing required to maintain a realistic experience—one that avoids problems of perception and can seamlessly follow a users' movements without lagging—is immense.[76]

69. *See* Sai Krishna V.K., *Looking Beyond the Screen. X Reality*, MEDIUM: SCAPIC (Nov. 30, 2017), https://medium.com/scapic/looking-beyond-the-screen-x-reality-fbda82e2ebfd.

70. JASON JERALD, THE VR BOOK: HUMAN-CENTERED DESIGN FOR VIRTUAL REALITY 29–30 (M. Tamer Özsu ed. 2016).

71. *See id.* at 9.

72. Telephone interview with Karen Chen, Assistant Professor, Dep't of Indus. and Sys. Eng'g, N.C. State Univ. (Aug. 29, 2018). Aside from seeing and hearing, touch is sense furthest along in development. *See* HELEN PAPAGIANNIS, AUGMENTED HUMAN: HOW TECHNOLOGY IS SHAPING THE NEW REALITY 23–35 (2017).

73. JERALD, *supra* note 70, at 9; Adam Savage's Tested, *Hands-On with VR OmniDirectional Treadmill*, YOUTUBE (Apr. 13, 2018), https://www.youtube.com/watch?v=mi3Uq16_YQg (showing a VR treadmill that approximates spatial movements).

74. JERALD, *supra* note 70, at 48–52 (noting other technological barriers).

75. Interview with Regis Kopper, Assistant Research Professor, Department of Mechanical Engineering and Materials Science & Director of the Duke immersive Virtual Environment (DiVE), Duke University, in Durham, N.C. (Sept. 6, 2018); *see The Duke immersive Virtual Environment (DiVE)*, DUKE U., https://digitalhumanities.duke.edu/space/duke-immersive-virtual-environment-dive (last visited Mar. 30, 2020).

76. JERALD, *supra* note 70, at 184–93 (describing "latency" issues).

Thus, higher quality VR systems today are quite expensive, cumbersome, and often uncomfortable.[77]

Although widespread use of truly immersive VR is still far off, researchers are exploring ways to improve the experience, such as incorporating additional senses, particularly touch ("haptics").[78] Although this research is still at a fairly basic level, there has been progress, including full body exoskeletons that mimic certain types of touch, albeit in a cumbersome and inefficient way.[79] What looks more promising in the near term is "sensory substitution."[80] Because the human brain acts like a pattern-matching machine, it can be trained to associate certain inputs—like a vibration—with another sense.[81] For instance, researchers have enabled deaf users to "hear" a word by associating certain vibrations with a certain object.[82] Sensory substitution might be able to provide the same results for other senses or even phenomena that humans are usually unable to detect like infrared waves, electromagnetic fields, and radiation.[83]

In the middle of the XR spectrum is AR, which superimposes images and sounds, and perhaps other inputs in the future, on top of what the user is experiencing in the real world.[84] It is essentially a mid-point between the real world and true VR. Google Glass and Pokémon Go are the most well-known examples of this technology.[85]

Perhaps counterintuitively, AR technology is much further behind VR, and could take up to a decade before its use becomes widespread.[86] The reason for this discrepancy is that developers can fully control the VR experience, while AR must work with the real, often unpredictable, world. This means that aspects of AR, such as head tracking, require more speed and precision than an artificial VR environment to keep up with users' movements in relation to the physical environment.[87] Similarly, it is difficult to create technology that interacts well with the real world, such as placing a virtual cup on an actual table. Although it

77. Telephone interview with Karen Chen, *supra* note 72; Interview with Regis Kopper, *supra* note 75.

78. PAPAGIANNIS, *supra* note 72, ch. 3. Senses such as taste and smell are extremely difficult to emulated digitally. *Id.* ch. 5; JERALD, *supra* note 70, at 109.

79. The exoskeleton can, for instance, provide resistance to allow the feeling of movements such as shaking another's hand. Telephone interview with Karen Chen, *supra* note 72.

80. Interview with Brian Moynihan, *supra* note 22.

81. *Id.*

82. Kortny Rolston, *Tongue Mapping Research: CSU Device Lets You Hear with Your Tongue*, COLO. ST. U. (Jan. 12, 2015), https://source.colostate.edu/words-mouth-csu-device-lets-hear-tongue/.

83. This is done by repeatedly exposing users to vibrations or other prompts in the presence of these "invisible" substances until users develop something like a "sixth sense." For instance, researchers have been able to train users to sense the direction North. Josie Thaddeus-Johns, *Meet the First Human to Sense Where North Is*, GUARDIAN (Jan. 6, 2017, 2:00 PM), https://www.theguardian.com/technology/2017/jan/06/first-humans-sense-where-north-is-cyborg-gadget.

84. JERALD, *supra* note 70, at 29.

85. Nick Bilton, *Why Google Glass Broke*, N.Y. TIMES (Feb. 4, 2015), https://www.nytimes.com/2015/02/05/style/why-google-glass-broke.html; *Pokémon Go*, POKÉMON: VIDEO GAMES & APPS, https://www.pokemon.com/us/pokemon-video-games/pokemon-go/ (last visited Mar. 22, 2020).

86. Telephone interview with Jason Jerald, CEO and Co-Founder of NextGen Interactions & Adjunct Assistant Professor, Department of Mechanical Engineering and Materials Science, Duke University (Oct. 2, 2018).

87. *Id.*

may seem trivial, this requires technology to accurately and rapidly match a digital object with objects and movements outside of its control.[88]

Although XR technology is still largely in its early stages, its use is quickly gaining traction in some areas and is poised for explosive growth at some point. Some of its original applications were in gaming and other types of entertainment.[89] Meanwhile, until around 2012, most nonentertainment uses of XR were limited to researchers and the military,[90] with only a few niche applications in the private sector, such as the oil and gas industry.[91] Recent funding for XR research has been increasing to the point that one might call it a boom period,[92] but the technology's production levels are still at an early and limited stage.[93] Some of this research, however, demonstrates the technology's potential.

One of the most promising areas for XR technology is the health care field. Some early applications involved therapeutic uses, such as for phobias or pain distraction. For instance, some pediatric hospitals use the technology to allow children to virtually immerse themselves in the hospital setting prior to surgery to lower anxiety.[94] Also, XR has been employed in physical therapy treatments, allowing therapists to treat patients remotely and to provide more effective care by providing visual cues that patients can track with their bodies.[95] Imaging is another potential use for XR, such as allowing a surgeon to "look" inside patients in situations where observation would be otherwise impossible.[96]

Healthcare applications of XR illustrate the technology's potential in the workplace, particularly for education and training. One line of research is exploring ways that XR can improve the way we teach. For instance, an AR program could provide a teacher cues about a student's reactions to material, which would permit more tailoring to individual learning styles.[97] XR can also be particularly useful to better train manufacturing and other technical workers. Indeed, some

88. Interview with Regis Kopper, *supra* note 75.

89. JERALD, *supra* note 70, at 26.

90. XR can be useful for pointing out objects with more precision, such as weapons marksmanship, which is one reason why the military is currently conducting trials on AR training. Interview with Edgar Lobaton, Associate Professor, Department of Electrical and Computer Engineering, N.C. State Univ., in Raleigh, N.C. (Sept. 4, 2018).

91. Telephone Interview with Jason Jerald, *supra* note 86; Interview with Regis Kopper, *supra* note 75.

92. This includes Oculus Rift, which ran a record-setting $2.4 billion Kickstarter campaign in 2012, followed two years later by Facebook's $2 billion purchase of the company. Eric Chevalier, *OSSIC Dethrones Oculus as the Highest Grossing VR Kickstarter Ever*, VR SCOUT (Apr. 21, 2016), https://vrscout.com/news/ossic-beats-oculus-kickstarter/#.

93. Peter Graham, *VR Industry Sees Positive Growth as Q3 Headset Sales Hit 1.9 Million*, VR FOCUS (Dec. 4, 2018), https://www.vrfocus.com/2018/12/vr-industry-sees-positive-growth-as-q3-headset-sales-hit-1-9-million/.

94. Jennifer Marcus, *Virtual Reality in Pediatrics*, CHILD. HOSP. OF L.A., https://www.chla.org/virtual-reality-pediatrics (last visited Mar. 22, 2020).

95. Telephone interview with Karen Chen, *supra* note 72.

96. For example, arthroscopic surgeries, in which the only current means of vision is via a camera on the surgical device. Dustin K. Baker et al., *The Emergence of Augmented Reality in Orthopaedic Surgery and Education*, 16 ORTHOPAEDIC J. HARV. MED. SCH. 8, 9 (2015).

97. Interview with Edgar Lobaton, *supra* note 90.

employers are already using XR for training, such as superimposing visual directions on top of real world objects that workers manipulate.[98] A similar example under development involves using AR-enabled tablets that assembly line workers place in front of a part; the AR system then shows a video of the part moving in its proper place.[99] One recent application of this type of training involves athletes. Stanford's football team, looking for additional practice time that did not count against NCAA limits, began using XR technology to give quarterbacks more decision making experience under game-like conditions—with results positive enough that its use is quickly spreading to other teams.[100]

This application demonstrates XR's potential for training workers to handle hazardous or stressful conditions. For instance, a firefighter I interviewed has been using an XR video game in his department to improve communications under dangerous and stressful situations.[101] Researchers are also developing XR technology that allow firefighters to more realistically and safely train how to enter a burning building, avoid risky areas, and find and recover victims.[102] This technology is at its early stages now, but will eventually provide low-cost, safe, and effective training for dangerous situations.[103] Further, XR might be able to help workers with higher level tasks like cognitive understanding and memorization, particularly under different workload stresses, as well as detecting hazards.[104]

98. *See, e.g.*, Sarah Ritter, *Building the Future: Deere Works to Attract a New Generation of Manufacturing Workers*, QUAD CITY TIMES (Oct. 21, 2018), https://qctimes.com/business/building-the-future-deere-works-to-attract-a-new-generation/article_110aae08-e313-5167-b519-8c5770a5d63e.html (describing John Deere's use of VR); Adi Robertson, *Walmart is Putting 17,000 VR Headsets in its US Stores for Training*, VERGE (Sept. 20, 2018, 2:18 PM), https://www.theverge.com/2018/9/20/17882504/walmart-strivr-vr-oculus-go-headset-training-shipments.

99. Researchers are determining whether and to what extent this type of training improves traditional methods. Telephone interview with Karen Chen, *supra* note 72.

100. Lindsay Schnell, *Unreal: Virtual Reality is Changing How Football Teams Train, Recruit*, SPORTS ILLUSTRATED (Aug. 5, 2015), https://www.si.com/college-football/2015/08/06/college-football-virtual-reality-michigan-stanford-recruiting.

101. Interview with Blake Boyd, Lead Technical Adviser and Data Analyst, Town of Cary, North Carolina Fire Department, in Durham, N.C. (Oct. 11, 2018).

102. Zach Myers, *Virtual Reality Training on Display at Downtown Firefighters Convention*, CBS 4 INDY (Apr. 25, 2018, 4:31 PM), https://cbs4indy.com/2018/04/25/virtual-reality-training-on-display-at-downtown-firefighters-convention/.

103. Interview with Regis Kopper, *supra* note 75. The National Institute of Standards is funding projects to test consistent communications standards for more coordination in the future, and XR research to help test new technologies and interfaces. Kimberly Underwood, *NIST Takes Interoperability to New Heights*, AFCEA SIGNAL (July 1, 2018), https://www.afcea.org/content/nist-takes-interoperability-new-heights.

104. Interview with Regis Kopper, *supra* note 75; Thaddeus-Johns, *supra* note 83.

More cutting-edge research is exploring the use of electroencephalography ("EEG")[105] and eye-tracking[106] to, among other things, improve XR's capabilities and quality of experience.[107] Although many of these techniques are currently quite expensive and not particularly effective, some show promise. In one study, for instance, VR users were able to move objects in a game with only their thoughts.[108] This "biofeedback" technique was difficult to control precisely but proved the concept's potential for application that could increase worker productivity, reduce repetitive motion injuries, and assist disabled workers.[109]

With the promise of XR technology, however, comes some concerns. Primary among them is privacy. XR technology will increasingly capture a significant amount of personal data from workers and other users, including their facial expressions, body movements, and eye reactions. Developers have a legitimate interest in such data, which often is essential to improving the XR experience.[110] But this data can also provide significant personal information about users, including their mental health and likely success at particular tasks.[111] It also raises the specter of increased employer monitoring of workers. Thus far, privacy has not been a major focus of XR researchers, but as the technology's application expands, we will need to find ways to balance workers' privacy interests with the needs of developers.[112]

As XR becomes more prevalent, it will also create issues with the workspace itself. The technology will increasingly allow workers to interact in more meaningful ways with individuals in different geographic locations, thereby making physical location irrelevant for a broader range of jobs.[113] Relatedly, employers will need to create areas that accommodate workers who are interacting

105. Loren Grush, *Those "Mind-Reading" EEG Headsets Definitely Can't Read Your Thoughts*, VERGE (Jan. 12, 2016), https://www.theverge.com/2016/1/12/10754436/commercial-eeg-headsets-video-games-mind-control-technology.

106. Telephone interview with Jason Jerald, *supra* note 86 (predicting that eye-tracking will become standard in all but the cheapest XR systems in a couple of years); Adi Robertson, *I Tried Magic Leap and Saw a Flawed Glimpse of Mixed Reality's Amazing Potential*, VERGE (Aug. 8, 2018), https://www.theverge.com/2018/8/8/17662040/magic-leap-one-creator-edition-preview-mixed-reality-glasses-launch (reviewing $2,295 AR headset with eye-tracking).

107. Simpler uses include controlling a smart phone with your eyes or, later, thoughts. Interview with Brian Moynihan, *supra* note 22.

108. Rachel Metz, *Mind-Controlled VR Game Really Works*, MIT TECHNOLOGY REV.: CONNECTIVITY (Aug. 9, 2017), https://www.technologyreview.com/s/608574/mind-controlled-vr-game-really-works/.

109. *Id.*; Grush, *supra* note 105.

110. Telephone interview with Jason Jerald, *supra* note 86.

111. Tom Ward, *AI and VR Could Completely Transform How Doctors Diagnose and Treat Mental Disorders*, FUTURISM (Aug. 4, 2017), https://futurism.com/neoscope/ai-and-vr-could-completely-transform-how-doctors-diagnose-and-treat-mental-disorders.

112. For instance, one could allow developers access only to users' summary data. *See infra* Section III.C.

113. *See infra* Section III.F. Programs such as Facebook Spaces, already permit users to use VR hardware to interact virtually ("telepresence"). The growth of mobile work arrangements, however, has recently been tempered somewhat as companies increasingly realize the value of workers interacting in person and because labor costs in other countries have been rising. Steve Lohr, *Hot Spot for Tech Outsourcing: The United States*, N.Y. TIMES (July 30, 2017), https://www.nytimes.com/2017/07/30/technology/hot-spot-for-tech-outsourcing-the-united-states.html (stating that offshoring increased at an annual rate of 15% from 2011–2016 but is expected to slow to 8% annually from 2016–2021).

with people and objects in different physical spaces.[114] But XR can help address this problem and other spatial workplace concerns. The technology is already being used for architecture and real estate businesses, which take advantage of immersive, three-dimensional modelling.[115] Businesses could use these tools, along with AI, to visualize and virtually walk through workspaces before they are built to promote designs that reduce conflicts, enhance worker interactions, and provide greater access for workers with disabilities.[116]

Finally, as employers try to integrate XR, they will face some resistance as workers adjust to the significant and unfamiliar ways the technology changes how they perform tasks and interact with their environment. Both VR and AR can be unsettling or confusing to users because they remove or alter the normal physical cues we use to navigate the world, which in turn frequently causes eye strain, dizziness, and nausea.[117] A related hurdle involves ease-of-use issues. When faced with technology that provides a particularly unusual experience, individuals often have a natural reluctance to try the technology or stick with it when things do not go according to plan.[118] The challenge for XR researchers and employers alike will be to develop experiences that are as seamless and natural as possible, while providing incentives to give the technology a chance.

C. Robotics and Other Types of Automation

Automation is the emerging technology that is likely most familiar, and most frightening, to the public. Robots and related applications can greatly improve people's lives, but their potential to replace human workers also creates a justified sense of foreboding. But this technology is not an all-or-nothing proposition. Although it will prove beneficial to some and ruinous to many others, a large number of workers will coexist with automation in a new blended workplace where many tasks will be performed by an amalgamation of human workers and automation.[119]

The basic framework for robotics and other automation is a marriage of hardware and software. The hardware involves a robot's physical properties, such as a base, appendages, and possibly means to move around a physical space, such as wheels.[120] These hardware components can be relatively straightforward

114. There are also potential intellectual property issues. For instance, Snapchat created an augmented reality art project with the artist Jeff Koons, which was subsequently altered by others. Anna Codrea-Rado, *Virtual Vandalism: Jeff Koons's 'Balloon Dog' is Graffiti-Bombed*, N.Y. TIMES (Oct. 10, 2017), https://www.nytimes.com/2017/10/10/arts/design/augmented-reality-jeff-koons.html.

115. Interview with Regis Kopper, *supra* note 75.

116. *See id.*

117. Nausea is especially problematic with VR because the body is stationary while visual cues are in motion (the reverse problem of reading in a moving car). This and other symptoms typically diminish as individuals use the technology more, and researchers are looking into tools, such as software modifications, to mitigate this problem. The level of discomfort also varies considerably among individuals, so VR applications have begun using sensitivity-level ratings. JERALD, *supra* note 70, at 200–03.

118. *See id.* at 277–78 (describing techniques to improve human-centered interaction with VR).

119. *See* Nick Wingfield, *As Amazon Pushes Forward with Robots, Workers Find New Roles*, N.Y. TIMES (Sept. 10, 2017), https://www.nytimes.com/2017/09/10/technology/amazon-robots-workers.html.

120. *Id.*

to develop and use, but others can present significant challenges. For instance, robots currently used in various manufacturing settings are often well-suited to their jobs and need little improvement.[121] On the other hand, uses in other settings remain extremely challenging. By way of example, one of the experts I interviewed is conducting research on robotic surgical tools.[122] These steerable medical instruments, which resemble a flexible and moveable "needle," can allow procedures that are impossible with current technology, such as removing a tumor in the brain via the relatively inobtrusive nasal cavity or taking a biopsy from the lung without piercing it.[123] The biggest issue for this type of automation is that navigating the human body presents serious hurdles, including unpredictable movements by the patient; a complex set of obstacles with vastly different characteristics (*e.g.*, tissue, nerves, and blood vessels); and a high-risk environment in which a single mistake poses severe consequences.[124]

The other major component of automation is software, which is the key to determining a robot's movements, including both locomotion and manipulation of objects.[125] Software, increasingly through AI technology, also allows robots to monitor their surroundings and learn assigned tasks.[126] Although robotics have come a long way, developing software that provides either autonomous or semiautonomous automation often remains extremely problematic—even for tasks that are simple for humans. For instance, programming a robot to spoon sugar from a bowl to a cup has a lot of complexity.[127] The robot must learn how to scoop the sugar, keep the spoon level to avoid spilling, find the cup, avoid obstacles, and rotate the spoon to dump the sugar into the cup. Humans are very good at intuitively figuring out how to navigate these challenges, but robots must learn or be taught every one of these steps.[128] And, although developers can individually program robots for specific tasks like this, it is impractical in real world situations because of the scale involved. As a result, current research is exploring more efficient ways to teach robots or have them able to learn such tasks on their own.[129]

The combination of hardware and software challenges poses significant restraints on automation's application in the workplace and elsewhere. Take a robot's need for perception, such as a home-care robot making a cup of sweetened

121. *See id.*

122. Momen Abayazid et al., *Experimental Evaluation of Co-manipulated Ultrasound-guided Flexible Needle Steering*, 12 INT'L J. MED. ROBOTICS & COMPUTER ASSISTED SURGERY 219 (2015); Interview with Ron Alterovitz, Professor, U.N.C. Dep't of Comput. Sci., in Chapel Hill, N.C. (Aug. 30, 2018).

123. *See Motion Planning for Steerable Needles*, U.N.C. COMPUTATIONAL ROBOTICS, https://robotics.cs.unc.edu/SteerableNeedles/index.html (last visited Mar. 22, 2020).

124. *See* Abayazid et al., *supra* note 122. *See generally* Drew Simshaw et al., *Regulating Healthcare Robots: Maximizing Opportunities While Minimizing Risks*, 22 RICH. J.L. & TECH. 1 (2016).

125. Interview with Kris Hauser, Associate Professor, Duke Univ. Dep't of Elec. & Comput. Eng'g, in Durham, N.C. (Oct. 4, 2018).

126. *See id.*; Hern, *supra* note 30.

127. *See* Gu Ye & Ron Alterovitz, *Demonstration-Guided Motion Planning*, *in* Robotics Research: The 15th Int'l Symposium ISRR (2017), https://robotics.cs.unc.edu/publications/Ye2011_ISRR.pdf.

128. Interview with Ron Alterovitz, *supra* note 122.

129. *Demonstration-Guided Motion Planning for Assistive Robots*, U.N.C. COMPUTATIONAL ROBOTICS, https://robotics.cs.unc.edu/DGMP/index.html (last visited Mar. 22, 2020).

tea. The robot must be able to sense the bowl of sugar, the spoon, the cup, and obstacles and have the physical ability to manipulate or avoid these objects. Similarly, a semiautonomous surgical tool must have the capacity to sense both the controls provided by the physician and obstacles in the patient, while having the appropriate physical properties to maneuver in a human body.[130] These and other robots must be designed with materials that can often be used for different tasks; have sensors to collect information; and software—likely enhanced with AI technology—to process and use the collected data.[131]

As a result of these challenges, we should not expect to see widespread automation of complex tasks for a long time.[132] In contrast, more straightforward and predictable uses of automation, especially in controlled environments like a warehouse or assembly line, have become increasingly widespread.[133] This prevalence, in turn, has led to understandable fears about the displacement of workers.

Automation's threat to human jobs is real, but more complex than often portrayed.[134] In the next Part, I examine the risk of job losses from all types of technology and will not repeat that discussion here. Two illustrations are worth highlighting now, however, as they shed light on the current state of automation technology and provide more context for the discussion of when, if ever, certain jobs and tasks are at risk of being automated.[135] The key driver of this question is understanding the distinction between tasks at which humans excel versus those better suited for automation.

The first example involves what appears to be a simple task. Simple, at least, for a human. Consider Amazon's warehouses, which use both automation and

130. Interview with Ron Alterovitz, *supra* note 122 (analogizing challenge to developing a car that can navigate a three-dimensional space inside a living human). The need for perception means that robots—especially those interacting with humans and our environments—will be able to observe us and gather an incredible amount of personal data. *See infra* Section III.C (discussing monitoring and privacy issues).

131. For example, a robot with multiple appendages, such as multiple joints and sensors, requires a tremendous amount of coordination, long-term planning, and machine-learning skills, which is difficult to design and operate. *See* Interview with Kris Hauser, *supra* note 125.

132. *See* Interview with Ron Alterovitz, *supra* note 122; *see also* Danielle Paquette, *Farmworker vs. Robot*, WASH. POST (Feb. 17, 2019), https://www.washingtonpost.com/news/national/wp/2019/02/17/feature/inside-the-race-to-replace-farmworkers-with-robots/ (describing development of farmworker robots, including challenges).

133. *See*, *e.g.*, Wingfield, *supra* note 119.

134. As discussed in more detail in Section III.A, while automation has the potential to impact a significant number of workers, its biggest impact is likely on the *tasks* that workers perform. For instance, one study estimates that current technology could replace 45% of current paid tasks, which are performed for approximately $2 trillion in annual wages. Chui et al., *supra* note 61 (also estimating that 60% of occupations could have 30% or more of their tasks automated, but only 5% of occupations could be fully automated).

135. Currently, there has not been evidence of significant job displacement outside of select situations, although this could be a more substantial problem in various regions and in the future. Chico Harlan, *Rise of the Machines*, WASH. POST (Aug. 5, 2017), https://www.washingtonpost.com/national/rise-of-the-machines/2017/08/05/631e20ba-76df-11e7-8f39-eeb7d3a2d304_story.html; Noam Scheiber & Nick Wingfield, *Amazon's Job Fairs Sends Clear Message: Now Hiring Thousands*, N.Y. TIMES (Aug. 2, 2017), https://www.nytimes.com/2017/08/02/technology/amazons-jobs-fair-sends-clear-message-now-hiring-thousands.html (stating that Amazon's "aggressive" use of robots thus far has not been replacing workers, although some expect that to change in a decade or more).

human workers. Robots move around a specific area of the warehouse, transporting identically shaped pallets of merchandise.[136] These robots bring the pallets to humans, who then place the merchandise in packages for shipment.[137] Why is not this final step also automated? The answer is that while robots excel at moving consistently shaped objects through predetermined paths, humans are far better at determining how to pack different shaped objects into a larger package.[138] Although this seems like a relatively simple task, the science behind trying to automate it is so difficult that Amazon regularly holds robotics challenges to help solve the problem.[139] Yet, the human Amazon workers remain.

The underlying reason for this division of work at Amazon is the difficulty in developing robots that can efficiently manipulate unexpected objects and perform other similarly complex tasks.[140] Moreover, it is very hard to design robots to operate in more varied or unpredictable environments, such as ones that involve humans.[141] Other hurdles to the adoption of automation include managers' lack of familiarity and trust in technology,[142] humans' ability to more quickly address and anticipate problems,[143] and robots' inability to improve processes.[144] For instance, even in BMW's highly automated South Carolina plant, human workers still play a central role, particularly for manufacturing that is customized or sensitive to how a customer interacts with the product.[145] As a result, automation is developing slowly in most industries, and Amazon workers and others in similar, "low-skill" jobs will likely not be replaced by robots anytime soon.[146] This is true even though automation promises lower labor costs, improved efficiency, and avoidance of labor shortages—all at prices that continue to decline.[147]

136. Wingfield, *supra* note 119.

137. *Id.*

138. *See id.*

139. *See, e.g.*, *Amazon Robotics Challenge 2017 Won by Australian Budget Bot*, BBC NEWS (July 31, 2017), https://www.bbc.com/news/technology-40774385.

140. Interview with Kris Hauser, *supra* note 125.

141. *Id.*

142. Craig Torres, *Why the Robot Takeover of the Economy is Proceeding Slowly*, BLOOMBERG (July 5, 2017, 4:00 AM), https://www.bloomberg.com/news/articles/2017-07-05/why-the-robot-takeover-of-the-economy-is-proceeding-slowly.

143. *Id.*

144. *Id.* (quoting a BMW official: "I have never been inspired to do more by a robot, I have never gotten any ideas on how to improve something on the shop floor from a robot"). Data analytics, however, is an increasingly important tool for humans looking to improve processes. *Id.*

145. *Id.* (noting that "[h]umans are paying close attention to look, feel, smell, and even the sound of these cars to ensure BMW authenticity").

146. *Id.* (stating that the finance industry is an exception, where machine decision-making is taking over human work at a more rapid pace). Other jobs, such as cashiers, however, are likely to be automated in the near future. Claire Cain Miller & Quoctrung Bui, *Switching Careers Doesn't Have to Be Hard: Charting Jobs that Are Similar to Yours*, N.Y. TIMES: THE UPSHOT (July 27, 2017), https://www.nytimes.com/2017/07/27/upshot/switching-careers-is-hard-it-doesnt-have-to-be.html.

147. Harlan, *supra* note 135. Many robots are now available for rent, making them even more affordable. *Id.* (citing a company that leases robots for $15 an hour).

The second example involves an industry in which the fear of automation has captured the public's attention like no other: transportation and the threat posed by autonomous (or "self-driving") vehicles. Autonomous vehicles symbolize many people's fears about automation, particularly given the number of workers who drive for a living. These vehicles also demonstrate many of the incredible ways in which technology has developed, as well as the many limitations to its application.

The potential effect of autonomous vehicles on jobs is substantial, with approximately 1.7 million long-haul truck drivers and 1.7 million drivers of taxis, buses, and other commercial vehicles on the road today.[148] Autonomous vehicles, however, are not limited to the ground. Both shipping and air travel have been at the forefront of using this technology, with the vast majority of sea passages and flights today relying heavily on autopilot.[149] In fact, for most passenger flights, humans actively pilot the plane for only an average of three to seven minutes.[150] And although autonomous ground transportation is not commercially viable today, the level of investment reveals the extent to which the transportation industry sees driverless vehicles as the future.[151]

The reasons why we see ships and planes regularly operating autonomously, but not ground vehicles, demonstrates the complexities involved with certain applications of technology. These complexities involve not only features required for the technology itself, but also the environment in which it is designed to operate. Consider how many different technologies must seamlessly coordinate with each other in an autonomous vehicle. First, of course, is the hardware: the actual vehicle that moves, stops, turns, and performs whatever specific task it is designed for (*e.g.*, hauling cargo). Most current autonomous vehicle prototypes emulate human-driven vehicles, albeit with some design modifications to accommodate new technology. To make the vehicle autonomous or semiautonomous, however, requires other differences. Cameras and sensors are a key feature of autonomous technology, as they place the vehicle in its environment, track its movements, and sense various elements, objects, or conditions—such as pedestrians, other vehicles, and inclement weather.[152] AI and other software process all of the data produced by these monitoring systems, along with preprogrammed algorithms that tell the vehicle what to do under certain conditions or its overall goals, the most important being "don't crash."

148. Kevin Roose, *As Self-Driving Cars Near, Washington Plays Catch-Up*, N.Y. TIMES: THE SHIFT (July 21, 2017), https://www.nytimes.com/2017/07/21/technology/self-driving-cars-washington-congress.html; Mark Scott, *The Future of European Transit: Driverless and Utilitarian*, N.Y. TIMES (May 28, 2017), https://www.nytimes.com/2017/05/28/technology/the-future-of-european-transit-driverless-and-utilitarian.html (describing attempts to introduce on-demand driverless vehicles that connect to existing public transportation systems).

149. Chui et al., *supra* note 61.

150. *Id.*

151. Daisuke Wakabayashi & Mike Isaac, *Uber Executive Invokes Fifth Amendment, Seeking to Avoid Potential Charges*, N.Y. TIMES (Mar. 30, 2017), https://www.nytimes.com/2017/03/30/technology/uber-waymo-levandowski.html (describing suit by Waymo against Uber, alleging theft as part of large investment in driverless technology, including $680 million purchase of self-driving truck company at heart of dispute).

152. Monitoring of human drivers using semi-autonomous vehicles will likely be required as well, to help prevent attention and other safety issues.

By the 1990s, researchers had developed technology that allowed vehicles to drive across the country on highways with almost total autonomy.[153] But we're still a long time away from widespread use of vehicles with even close to this level of autonomy. Why is this? The simplest answer is because most driving environments are not like a controlled highway. Take a typical urban streetscape, with multiple human-driven cars, pedestrians, bicycles, perhaps a squirrel or other animal, street signs, streetlights, a child running after a loose ball, and other potential hazards like rain or snow. Each additional, hard-to-predict factor dramatically multiplies the complexity involved with safely and efficiently navigating the environment.[154]

One issue is simply the need to identify possible hazards. Current vehicles' monitoring systems can capture a substantial amount of information, but not all. Indeed, many real world autonomous vehicle accidents have been caused at least in part by the vehicles' monitoring systems failing to recognize pedestrians, vehicles, or other hazards.[155] A recent insurance company test of this technology vividly shows why this can happen.[156] In the test, the vehicle immediately in front of a Tesla moves to a different lane—a situation that forces designers to make a choice. If the only consideration is avoiding a crash, an autonomous vehicle should stop whenever the preceding vehicle moves because there's a chance that there is an undetected hazard ahead, such as a vehicle that suddenly stopped.[157] This, of course, is impractical in real world conditions.[158] But, allowing the autonomous vehicle to continue moving creates a risk that it will not recognize an unseen hazard in time to avoid a collision—which is precisely what happened in the test as the Tesla plows into a stopped car.[159] Our unwillingness to accept such risks, even if they are less probable than human error in traditional vehicles,[160] erects a substantial barrier to adoption of autonomous vehicles. Thus, improving these vehicles' ability to identify and react to hazards will be critical to their future. But that is no easy task. Even if an autonomous vehicle is able to capture all relevant data about its

153. Kate Gammon, *Future Past: Self-Driving Cars Have Actually Been Around for a While*, CAR & DRIVER (Nov. 15, 2016), https://www.caranddriver.com/news/a15343941/future-past-self-driving-cars-have-actually-been-around-for-a-while/ (describing 1995 trip from Pittsburgh to Los Angeles in which 98.2% of the drive was autonomous, although human driver controlled brakes and hand throttle).

154. Interview with Kris Hauser, *supra* note 125.

155. Stuart Gray, *List of Driverless Vehicle Accidents*, ITGS NEWS (June 2, 2018), http://www.itgsnews.com/list-of-driverless-vehicle-accidents/.

156. Rory Cellan-Jones, *Car Insurers Warn on 'Autonomous' Vehicles*, BBC NEWS (June 12, 2018), https://www.bbc.com/news/technology-44439523.

157. Interview with Michael Clamann, Senior Human Factors Engineer, University of North Carolina Highway Safety Research Center, in Chapel Hill, N.C. (Oct. 10, 2018).

158. For instance, most vehicle autopilot systems are designed to ignore stationary objects, which at times can lead to accidents. Jack Stewart, *Tesla's Autopilot Was Involved in Another Deadly Car Crash*, WIRED (Mar. 30, 2018, 10:34 PM), https://www.wired.com/story/tesla-autopilot-self-driving-crash-california/.

159. The "car" was actually a prop, but watching the test video is still not for the faint at heart. Cellan-Jones, *supra* note 156.

160. Aarian Marshall, *Tesla Bears Some Blame for Self-Driving Crash Death, Feds Say*, WIRED (Sept. 13, 2017, 7:00 AM), https://www.wired.com/story/tesla-ntsb-autopilot-crash-death/ (noting a finding that Teslas with self-driving capabilities crashed 40% less than those without).

surroundings, its computers may not be able process the data quickly enough to avoid a collision. The extraordinary variety and quantity of unexpected situations on the road mean that the amount of machine training required is almost limitless and therefore exceeds current technology.[161]

In addition to issues related to vehicle design, our current infrastructure is poorly suited for autonomous vehicles. Some infrastructure improvements are relatively simple, like painting street lines in a way that is more easily recognized by vehicles' monitoring systems.[162] But more substantial changes would be required to substantively decrease road hazards that autonomous vehicles may not be able to avoid. Moreover, these vehicles are reliant on internal and external communication systems, which require enough redundancies to handle malfunctions without catastrophic results.[163] As a result of these limitations, the vast majority of today's autonomous vehicles have humans monitor the vehicle and take control if necessary.[164] Waymo, the leader in attempts to commercialize self-driving vehicles, follows this practice for most of its tests, including a trial service that allows customers to hail a self-driving taxi.[165] The company has discovered that the human supervisors retain an important role because its vehicles exhibit many quirky driving behaviors as they engage in machine learning on city streets.[166] This behavior, as well as a healthy dose of skepticism about the technology, has even led to a rash of attacks and harassing behavior toward Waymo vehicles in neighborhoods where they have been tested.[167]

In sum, it could be decades before autonomous vehicles are in widespread use. For the near term, we are more likely to see fully autonomous vehicles in less-risky environments, such as slow moving shuttles.[168] In addition, we can expect incremental expansion of semiautonomous features on human-driven ve-

161. In contrast, humans are much better than machines at quickly assessing new situations. Interview with Michael Clamann, *supra* note 157.

162. *See, e.g.*, Damon Arthur, *Stripes on California Highway to Pave Way for Self-Driving Vehicles*, TRANSP. TOPICS (Jan. 22, 2018, 3:00 PM), https://www.ttnews.com/articles/stripes-california-highway-pave-way-self-driving-vehicles.

163. Interview with Michael Clamann, *supra* note 157 (noting that autonomous vehicles would need to rely not only on GPS and its monitoring systems, but also communicate with other nearby vehicles).

164. Geoffrey A. Fowler & Jhaan Elker, *Self-Driving Taxis are Here. This is What it's Like to Ride in One.*, WASH. POST (Nov. 29, 2018), https://www.washingtonpost.com/graphics/2018/business/amp-stories/self-driving-car-waymo-robo-taxi/ (multimedia story describing Waymo's self-driving taxis).

165. Michael Laris, *Waymo Launches Nation's First Commercial Self-Driving Taxi Service in Arizona*, WASH. POST (Dec. 5, 2018, 7:00 AM), https://www.washingtonpost.com/local/trafficandcommuting/waymo-launches-nations-first-commercial-self-driving-taxi-service-in-arizona/2018/12/04/8a8cd58a-f7ba-11e8-8c9a-860ce2a8148f_story.html.

166. *Id.*

167. Simon Romero, *Wielding Rocks and Knives, Arizonans Attack Self-Driving Cars*, N.Y. TIMES (Dec. 31, 2018), https://www.nytimes.com/2018/12/31/us/waymo-self-driving-cars-arizona-attacks.html.

168. Kroger's new grocery delivery service in Arizona uses unmanned self-driving vehicles that travel a maximum of 25mph. Peter Holley, *Tired of Going to the Grocery Store? In Arizona, a Robot-Driven Car Will Deliver Groceries to Your Home*, WASH. POST (Dec. 19, 2018, 11:53 AM), https://www.washingtonpost.com/technology/2018/12/19/tired-going-grocery-store-arizona-robot-driven-car-will-deliver-groceries-your-home/.

hicles, especially those that may enhance safety by stopping or slowing the vehicle when a hazard is sensed.[169] But at some point in the future, technology, infrastructure, and our acceptance of autonomous vehicles will advance enough to threaten the jobs of human drivers.

The experience of autonomous vehicles and Amazon's warehouse robots provide some general lessons about the future of automation in the workplace. In order to safely and effectively use robotic labor, employers will need to provide controlled environments that do not create safety risk for human workers and do not push the technology beyond its current limitations.[170] As a result, robotics will be employed most often in workspaces that can be specially designed for them, with limited human interactions.[171] In contrast, adoption of automation will be slow for businesses that are unable to exert that level of control. That said, researchers are exploring ways to make robots better able to learn tasks and adapt to changing conditions.[172] But the ability of this technology to see widespread adoption in the real world is still far off, as the technological hurdles remain substantial.[173] As a result, employers are most likely to automate tasks that tend to be more discrete, repetitive, and in environments that are easily controllable; in contrast, tasks involving self-awareness, judgment, and manipulation will remain the province of humans for the foreseeable future.[174]

D. Monitoring Technology

Among the technologies explored in this Article, those that allow various types of monitoring are by far the furthest along in development. As I describe in the next Part,[175] numerous applications of this technology already exist in many workplaces and their uses are likely to grow exponentially in the near future.

Unlike AI, automation, and XR, there is no discrete category of research devoted to monitoring.[176] Instead, many different types of technologies either use or focus on tools to monitor and collect information from the surrounding environment. Related research is often driven by potential applications of the technology, with healthcare being an area with potentially large benefits, yet also serious risks.[177]

169. Interview with Michael Clamann, *supra* note 157; Interview with Edgar Lobaton, *supra* note 90 (noting current vehicles with autonomous safety measures like cruise control and collision avoidance).

170. In particular, businesses must be aware of their workplaces' geometry, including the physical space in which a robot operates, as well as workers' and other objects' movement in that space. Interview with Ron Alterovitz, *supra* note 122.

171. Wingfield, *supra* note 119.

172. *See id.*

173. Interview with Ron Alterovitz, *supra* note 122.

174. *See infra* notes 219–28. "Soft robotics" that can better emulate humans behavior and norms, such as personal space, gestures, and expressions are currently being researched, but are still relatively primitive. Interview with Kris Hauser, *supra* note 125 (noting also that this technology must account for cultural differences).

175. *See infra* Section III.C.

176. *See* Interview with Brian Moynihan, *supra* note 22.

177. *See id.*

A wide variety of medical monitoring devices are now relatively inexpensive and widely available, such as heart rate monitors.[178] Devices are also being developed that can combine physiological measurements with environmental data—all of which could provide predictions or warnings of potential health threats for the user.[179] Moreover, monitoring that was previously limited to expensive machines in the healthcare setting are becoming the province of home users, such as watches that measure a user's EKG (electrocardiogram) readings.[180] These promise significant improvements in healthcare,[181] but also risks displacing some health care workers who currently provide such monitoring. In addition, the amount of highly personal data collected by these devices raises serious privacy issues, especially if under the control of third parties, such as employers.[182]

This concern is not hypothetical. As discussed in detail below, employers already engage in highly intrusive monitoring, such as implanting tracking devices into workers' arms.[183] And new technology will only increase the ease with which employers and others can gather personal information. For instance, consumers can purchase EEG headsets that identify areas of users' brains that are most active in response to their environment.[184] Although use of this data is currently limited, it does identify activity in specific parts of the brain that control different physical or mental functions.[185] Other monitoring tools are further developed and can already collect a tremendous amount of information. For example, technology that collects and analyzes heart rate variability can determine whether an individual gets enough sleep or suffers from depression, stress, and other conditions.[186] In addition, facial recognition technology can make similar inferences—which means that, with the right tools, someone can merely analyze a video of an individual to gain a wealth of information about their health and wellbeing, as well as their level of arousal, unconscious desire, and other types of interest.[187] Such capabilities can be useful, but also raise significant privacy

178. Tim Collins et al., *How Reliable is Your Wearable Heart-Rate Monitor?*, CONVERSATION (June 19, 2018, 10:22 AM), https://theconversation.com/how-reliable-is-your-wearable-heart-rate-monitor-98095.

179. For instance, patients could use monitoring technology to warn of an impending risk of an asthma or heart attack, thereby allowing avoidance or other preventative measures. Interview with Edgar Lobaton, *supra* note 90.

180. *See, e.g.*, *KardiaMobile*, ALIVECOR, https://www.alivecor.com/kardiamobile (last visited Mar. 22, 2020).

181. For instance, home monitoring promises significant clinical advantages because the data gathered—such as heart rate or insulin levels—covers a much longer period of time than an isolated visit to a health-care provider. Interview with Brian Moynihan, *supra* note 22.

182. *See id.*

183. *See infra* Section III.C.

184. Grush, *supra* note 105.

185. Interview with Brian Moynihan, *supra* note 22 (noting that current level of specificity is similar to using crowd noise from outside a sports stadium to determine what's happening).

186. *Id.*; Interview with Edgar Lobaton, *supra* note 90. GPS and other data can also be used to identify individuals with depression and a variety of other serious mental illnesses. Saeed Abdullah & Tanzeem Choudhury, *Sensing Technologies for Monitoring Serious Mental Illnesses*, 25 IEEE MULTIMEDIA 61, 63–64 (2018).

187. *Id.* at 66; Interview with Brian Moynihan, *supra* note 22.

concerns, especially if used inappropriately. Not all monitoring technology, however, raises sinister-sounding connotations. Attempts to improve workplace and other types of safety are often reliant on monitoring devices, such as "smart" aerial vehicles, like drones, that can observe construction worksites and flag potential hazards before they cause harm.[188]

Workplace monitoring has been around for as long as there have been workplaces, but technology has already given employers more means to gather information about workers than ever before. As discussed below, technological innovations will provide employers increased opportunities to pry ever more deeply into workers' personal information and thereby further underscore the lack of privacy protections in the workplace.[189]

III. TECHNOLOGY'S IMPACT ON WORK LAW AND POLICY: THE BLENDED WORKPLACE

The wide variety of emerging technologies and the divergent paths of future innovation undermine attempts to make solid predictions about the future of technology and its impact on work. But technology has already created numerous legal and policy workplace problems and promise others that are plausible and serious enough to warrant attention now. Unfortunately, our current workplace regulatory scheme is ill-equipped to handle many of these current issues, much less ones that are on the horizon. As a result, although we cannot know for sure whether we have entered a truly new era of work, emerging technology will clearly exacerbate preexisting shortcomings in work law, perhaps to the point where it ceases to function in any meaningful way.

As a preliminary matter, it is worth keeping in mind that real world applications often involve the combination of various technologies. For instance, "smart" prosthetics will combine robotics, advanced physiological and environmental monitoring, and AI to enhance their functionality.[190] This means that many emergent problems in the workplace will more often than not involve multiple types of technology—technology that, in turn, will often operate in conjunction with human workers in a "blended workplace."[191] As a result, policy and legal responses must address complicated, coordinated technological systems and their interaction with workers. In other words, we will need a coordinated effort to adequately address the impact of technology on work, which is a sharp contrast to our current, fractured workplace regulatory system that is typically very slow to react to new problems.[192]

188. David Sparkman, *OSHA Now Using Drones to Inspect Employer Facilities*, EHS TODAY (Dec. 28, 2018), https://www.ehstoday.com/osha/osha-now-using-drones-inspect-employer-facilities.

189. *See infra* Section III.C.

190. Interview with Edgar Lobaton, *supra* note 90.

191. *See id.*

192. Jeffrey M. Hirsch, *Revolution in Pragmatist Clothing: Nationalizing Workplace Law*, 61 ALA. L. REV. 1025, 1036–49 (2010); *cf.* Roose, *supra* note 148 (describing three states that have begun to address autonomous vehicles and the first congressional bill designed to address the issue).

What follows is an exploration of the current and future issues associated with new technology and discussion of possible means to address them. This exploration is not meant to be an exclusive prediction of what is to come or a comprehensive path forward. Instead, my aim is to identify the most serious and likely problems and highlight the ways in which our current set of workplace laws and policies are inadequate to address these developing issues. Some of these failings are merely exacerbated by technology, while others are new. But both raise an alarm regarding how we currently regulate work and demonstrate the need to significantly rethink how we should regulate in the future.

A. Changing the Who and How of Work

1. Technology's Impact on the Labor Market: Job Losses, Job Gains, and Job Changes

When it comes to the problems associated with emerging technology, the potential for job losses captures the most attention, and for good reason. Not only does this threat seem most acute, but it has already started to a certain degree.[193] Thus, the prospect of rapidly advancing technology causing massive job displacement is a very real concern. But that will not be technology's sole impact on the labor market.

For the past several decades, we have seen a transition from an economy dominated by manufacturing and similar jobs to one in which knowledge-based skills are prominent.[194] New technology will both deepen this trend, as well as alter it. Although much of the discussion regarding technology's impact on the labor market focuses only on job losses, the picture is more complicated. To be sure, job losses will be an important part of the story, as well as job gains from some. But technology will likely impact the greatest number of workers, not by putting them out of work, but by changing *how* they work. The traditional secretary position is a good illustration of this effect. Although typing speed used to be a core component of the job, thanks to advances in computing, the ability to type quickly is barely required, if at all, for secretaries' successor, the administrative assistant.

Technology's impact on the labor market will not be uniform. Overall, we can expect technology to enhance productivity across the economy and produce an overall increase in employment, although that is not certain.[195] Technology will also improve the way work is done in many instances by making it more

193. *See, e.g.*, STONE, *supra* note 1, at 83.

194. *Id.*

195. DAVID AUTOR & ANNA SALOMONS, IS AUTOMATION LABOR-DISPLACING? PRODUCTIVITY, GROWTH, EMPLOYMENT, AND THE LABOR SHARE 2–3 (2018) (finding that employment wages and hours could rise, but that labor's share of overall output could decline); MANYIKA ET AL., *supra* note 3, at 36–38. But just as technology may create a new era of work, it may also defy historical trends by causing a net loss of jobs. Cynthia Estlund, *What Should We Do After Work? Automation and Employment Law*, 128 YALE L.J. 254, 271–74 (2018).

efficient or safe.[196] But these likely benefits will take time to develop and will not be felt evenly across the economy. Moreover, technology will replace or devalue the labor of many, as well as generate numerous other problems for workers in general.[197] In other words, technology is likely to produce widespread pain in the near-term and create long-term winners and losers, with many losers experiencing considerable harm.[198] These effects will strain an already flawed system of workplace laws, perhaps to the breaking point. Indeed, it is possible—albeit far from certain—that the speed and the breadth of technology's impact on the workforce may rival or even surpass the labor market disruptions of the Industrial Revolution.[199]

Accurately predicting the long-term impact of still-evolving technology on the labor market is not possible.[200] That said, even imperfect appraisals can be helpful in appreciating the potential scope of this issue. The McKinsey Global Institute recently produced one of the more thorough estimates of technology's impact on jobs through 2030.[201] Their insights are useful but should be taken with several grains of salt. If there was one common theme throughout my interviews with technology experts, it was an unwillingness to predict the development of technology with any certainty, especially anything beyond a short timeline. McKinsey's own report reflects this hesitation, as it makes clear that it is not providing specific forecasts. That said, the report identifies many general trends that ring true to my research and conversations with experts.

Among the report's most general estimates is that by 2030, automation has the potential to replace 23% of labor hours in the U.S. and force between 75 to 375 million workers worldwide to switch occupations.[202] More specifically, the report estimates that by 2030, between 400 to 800 million workers worldwide and 39 million in the U.S. could face some sort of job displacement as the result of technological advances, although many of those with the right training could move into newly created positions.[203] Even for workers who keep their jobs, a

196. For instance, researchers are currently developing robots that collect and analyze samples from the bottom of the ocean—activities that are extremely time consuming and hazardous. Nathan Hurst, *These Underwater Robots Offer a New Way to Sample Microbes from the Ocean*, SMITHSONIAN.COM (Mar. 28, 2018), https://www.smithsonianmag.com/innovation/these-underwater-robots-offer-new-way-sample-microbes-from-ocean-180968577/.

197. *See infra* Sections III.B–F.

198. MANYIKA ET AL., *supra* note 3, at 87–90 (describing potential for greater income polarization as middle-wage jobs are expected to decline in advanced economies, but significantly grow in emerging economies).

199. *Id.* at 48–50 (noting the possibility but concluding that speed and breadth of technological advancement is not out of line with past periods).

200. In addition to the difficulty in predicting the future, much of the current data on issues related to technology is sparse and often less than useful. Tyrone Richardson, *More Details Needed on Gig Workers, Senate Appropriators Say*, BLOOMBERG L. (July 5, 2018, 8:56 AM), https://news.bloomberglaw.com/daily-labor-report/more-details-needed-on-gig-workers-senate-appropriators-say-1 (also noting senators' demands for more information about AI and automation).

201. *See generally* MANYIKA ET AL., *supra* note 3.

202. *Id.* at 2, 105 (predicting range of outcomes depending on speed of automation, with a midpoint of 15% global labor hours being displaced by 2030; range for U.S. displacement is 3% to 44%).

203. *Id.* at 14. (noting that adoption of technology in lower range of its estimate could result in displacement of less than 10 million workers).

significant number will shed some tasks and have to learn new skills.[204] The speed and degree of such changes will depend on various factors such as future technological developments, costs of applying innovations in the workplace, relevant labor markets, expected financial benefits of replacing human labor, regulation, and social acceptance of technology.[205]

These overall figures mask significant differences among various segments of the workforce. An often-overlooked aspect of the labor market is that it undergoes a constant churn of jobs. Even periods of job expansion are accompanied by significant job losses, just as periods of contraction include many new jobs.[206] Take the historical example of personal computing. Computers caused an estimated 3.5 million lost jobs since 1970, but also created 19.3 million jobs during the same period, for a net 15.8 million more jobs.[207] Although it is impossible to know for certain, it is probable that emerging technology will also end up producing job gains that will outweigh job losses in the long run.[208]

Tech-related job gains will likely result from several factors. One driver is technology's capacity to enhance or create demand for certain types of work. An obvious area of this type of job growth is work directly related to technology. For instance, jobs in the IT industry—only a part of the overall technology industry—could increase by 20 to 50 million jobs worldwide by 2030.[209] In addition, there will be a growing need for software developers, programmers, systems analysts, and others who work with increasingly advanced technology.[210] But another major driver of job growth will be technology's ability to boost productivity and spending, thereby expanding the economy and generating increased demand for labor.[211] Overall, the McKinsey report estimates that general growth in the labor market, as well as an 8–9% increase in demand for occupations that do not currently exist, will result in net gains of around 15 million U.S. jobs by 2030.[212] These estimates, however, do not tell the whole story. A significant number of workers who remain employed throughout this period will see their jobs change in some fashion, as technology becomes increasingly integrated with the workplace.[213] And many of these workers will be harmed by the increased

204. *Id.* at 11 (estimating that up to one-third of workers in U.S and Germany will need new skills, and one-half of workforce in Japan).

205. *Id.* at 27.

206. *See* DEP'T OF LABOR, BUREAU OF LABOR STATISTICS, JOBS OPENINGS AND LABOR TURNOVER—DECEMBER 2018 (2018) (describing monthly hires of 5.9 million and layoffs and discharges of 5.5. million), https://www.bls.gov/news.release/archives/jolts_02122019.pdf.

207. MANYIKA ET AL., *supra* note 3, at 40–41.

208. Although that does not mean that the same people who suffer job losses will benefit from job gains. *See infra* notes 216–22 and accompanying text.

209. MANYIKA ET AL., *supra* note 3, at 7.

210. *Id.* at 64; *see also* Executive Order on Maintaining American Leadership in Artificial Intelligence, Exec. Order No. 13,859, 84 Fed. Reg. 18490 (Feb. 11, 2019) (requiring relevant agencies to treat AI as a priority in education fellowships and service programs).

211. MANYIKA ET AL., *supra* note 3, at 6–7, 25–31, 65 (estimating that automation could increase annual global GDP by 0.8% to 1.45%).

212. *Id.* at 14 n.1. Yet it is hard to isolate the net effect of technology because some portion of general labor-market growth is indirectly influenced by technological innovations.

213. *Id.* at 27 (estimating that 60% of occupations involve at least 30% skills that could be automated).

reliance on technology, which could negatively impact wages for years or even decades,[214] especially for those whose skills face lower demand.[215] Moreover, even if we see overall job gains, technology is still likely to produce substantial job losses, which greatly impact effected workers and the nation as a whole.

Discerning which workers will face job losses or negative consequences largely hinges on technology's potential to make certain tasks obsolete for human workers. Although impossible to predict with certainty, identifying tasks better suited for automation as opposed to those at which humans excel will illustrate the likely future labor displacement trends.

Among the jobs most at risk are those that entail a significant amount of predictability and repetitiveness, particularly in controlled environments, as well as those with severe health and safety risks.[216] Examples include certain types of manufacturing work, as well jobs that require moving certain objects or even putting together simple meals.[217] Similarly, basic data collection and processing will be subject to automation, meaning that workers such as paralegals, office support staff, and cashiers will likely see a significant change in their job duties, major cuts in hours, or a total loss of their jobs.[218]

In contrast, other jobs will likely remain the province of human workers for the foreseeable future. The type of work most likely to be buffered from technological displacement or even see higher demand involve tasks requiring judgment, ethical or moral considerations, and quick adaptations to unknown environmental circumstances.[219] Similarly, jobs that require expertise, significant interactions with other humans, and managing or developing workers are less likely to be automated.[220] Examples of this type of work are as diverse as professionals like attorneys and physicians; skilled laborers such as gardeners, carpenters, and plumbers; and personal service providers in the child and health care industries.[221] But even workers in these jobs will need to gain new skills to adapt to workplaces that increasingly blend humans and technology.[222]

Amazon again provides a good example of the different ways in which technology will, and will not, change work. The company is known for automating tasks wherever possible, but this does not mean that the company is simply replacing workers with machines.[223] Amazon has not released precise figures, but it claims that its overall workforce is still growing substantially.[224] This trend

214. *Id.* at 4 (noting that real wages stagnated for decades during England's Industrial Revolution, despite substantial productivity gains).

215. *Id.* at 17 (noting that wage polarization in advanced economics could increase as current high-wage jobs grow more, while middle-wage jobs face declines).

216. *See* MANYIKA ET AL., *supra* note 3, at 30; *infra* notes 217–18 and accompanying text.

217. MANYIKA ET AL., supra note 3, at 9, 78–79.

218. *Id.*

219. *See* sources cited *supra* note 50.

220. MANYIKA ET AL., *supra* note 3, at 15–16.

221. Interview with Kris Hauser, *supra* note 125; MANYIKA ET AL., *supra* note 3, at 6, 102.

222. See *supra* note 213 and accompanying text.

223. Wingfield, *supra* note 119.

224. *Id.* (noting that since incorporating a certain type of robot in its warehouses, Amazon added 80,000 warehouse workers in the U.S.).

could reverse in the future, especially for certain jobs, but up to this point technology has not caused a net loss of jobs at the company.[225] But this does not mean that workers are unaffected. Take Amazon's decision to automate an increasing percentage of its interactions with vendors who sell and supply merchandise sold on the platform. Amazon's analysis showed that its algorithms are better than humans at handling tedious inventory spreadsheets and more accurately predicting demand for products.[226] This change had a varied impact on workers, some of whom were able to realign their tasks while remaining at roughly the same jobs, while many left or changed positions within the company.[227] At Amazon, therefore, technology has spurred job changes and job losses, which—for now—have been outweighed by new jobs. But as technology becomes less expensive and more efficient, the risk to workers is likely to grow. Thus, mitigating the negative effects of technology will require workers to learn new skills either to keep their current jobs or to seek alternate positions.[228]

2. Possible Responses to Technology's Impact on the Workplace

The dilemma presented by technology is a serious one. On one hand, if AI, robotics, and XR follow historical trends, then the overall labor market will remain strong in the long run and policymakers' central concern will be to cushion the harms faced by "losing" workers. On the other hand, if emerging technology represent a truly new era of work, then there is a risk that it will veer away from historical trends and ultimately decrease overall employment. The difficulties and uncertainties involved in addressing that possibility make the substantial challenges of the traditional outcome seem trivial.

Professor Cynthia Estlund recently explored these and other possible results of automation in the workplace, arguing that we should seek ways to lower the cost to businesses of human labor as a means to slow the tide of automation or even prepare for a world with less work.[229] I have doubts about our ability to delay technological job displacement in any meaningful way, as well as the chance that we will see a world in which humans work far less while still enjoying comparable standards of living. Nevertheless, Estlund's attention to business incentives and her proposals—which focus, among other things, on detaching the social safety from the employment relationship—align well with other strategies to ease the transition to a more blended workplace.[230]

225. *See id.*

226. Spencer Soper, *Amazon's Clever Machines Are Moving from the Warehouse to Headquarters*, BLOOMBERG (June 13, 2018, 5:00 AM), https://www.bloomberg.com/news/articles/2018-06-13/amazon-s-clever-machines-are-moving-from-the-warehouse-to-headquarters.

227. *Id.*

228. For instance, workers who want positions alongside robots will have to learn new skills, as interacting with robots is very different than interacting with humans. Schools are beginning to develop training and education programs to help workers become better qualified to work alongside robotics and other technology. *See, e.g.*, *Collaborative Robotics*, WAKE TECH, https://www.waketech.edu/programs-courses/non-credit/enhance-your-career/advanced-manufacturing/collaborative-robotics (last visited Mar. 22, 2020).

229. Estlund, *supra* note 195, at 301.

230. *Id.* at 305–14 (citing, for example, health care, family leave, and basic income).

Rather than attempting to halt the integration of technology, a better—or at least additional—path is to prepare workers for the workplace of the future. Given the nonpecuniary benefits that accompany work,[231] there is much value in providing workers the tools they need to find quality jobs in a changing environment. Thus, the foremost goal should be an emphasis on providing individuals the tools they need to find and keep good jobs. And, ideally, they should be able to do so in a relatively short time frame, because the longer displaced workers are without jobs, the more significant the harm to both the individual and the entire economy.[232] Although a comprehensive strategy to prepare for the future of work is beyond the scope of this Article, there are some general approaches that can ease the burden of technological change and better prepare workers for what lies ahead.

The principal aim should be to ensure that workers have the education and training to match the jobs of the future. In addition to the practical problems associated with this goal, predicting the direction that technology will take is challenging.[233] As a result, workers will need flexible skills that allow them to obtain often unpredictable new job opportunities as old ones disappear. General education is the key foundation for establishing workers' flexibility, as automation and other technology typically leads to greater demand for higher-educated workers,[234] while jobs requiring less education will likely be displaced at a higher rate.[235] Thus, calls in some quarters to transform higher education into a more trade-based system of education[236] are short-sighted and exactly the opposite strategy of what we should pursue. Instead, we need to deepen our commitment to providing individuals with a solid, broad educational foundation that will better equip them to work in an uncertain future.[237] But we also must find ways to encourage mid-career workers to seek out training and other opportunities to

231. Bette Jacobs et al., *At the Intersection of Health and Justice: How the Health of American Indians and Alaska Natives Is Disproportionately Affected by Disparities in the Criminal Justice System*, 6 BELMONT L. REV. 41, 58–59 (2018).

232. MANYIKA ET AL., *supra* note 3, at 15 (stating that if most displaced workers are able to find new work within a year, the employment rate is likely to remain strong, while a longer period of unemployment can create overall harm to the economy).

233. *See supra* notes 201–12 and accompanying text.

234. MANYIKA ET AL., *supra* note 3, at 15–16, 82–83 (noting also that in advanced economies middle-wage jobs may face net losses, but net gains in emerging economies).

235. *Id.* at 30 (estimating that by 2030 the following types of jobs could have this percentage of tasks automated: 55% of tasks in jobs requiring less than high school (*e.g.*, logging, drivers); 52% in jobs with high school or some experience (*e.g.*, store clerks, travel agents); 44% in jobs with some post-secondary (*e.g.*, nursing assistants, legal secretaries); and 22% in jobs with bachelor's or higher degrees (*e.g.*, attorneys, doctors)).

236. Michael Stoner, *Addressing the Decline in Higher Ed's Reputation*, INSIDE HIGHER ED (Feb. 9, 2017), https://www.insidehighered.com/blogs/call-action-marketing-and-communications-higher-education/addressing-decline-higher-eds.

237. *Cf.* MANYIKA ET AL., *supra* note 3, at 107 (noting success of movement to mandate high school education).

gain new skills.[238] Improving education and training, however, is difficult. Because of higher job turnover, fewer employers are willing to invest in training.[239] Government entities in the U.S. are not much better, especially compared to other developed economies.[240] Accordingly, the government should do far more to assist workers who want or need to learn new skills. Given the magnitude of job disruptions likely to result from emerging technology, we could consider a robust program that emulates the largely successful GI Bill.[241]

Maintaining fluidity in the labor market—which better enables workers to switch jobs—will also be important.[242] Measures such as income support or transitional payments for unemployed workers would both lessen the sting of job losses and provide workers more time to search for desirable new employment.[243] Similarly, we could expand economic adjustment programs to include workers displaced by technology. The Department of Labor already runs such a program for workers who lose jobs because of trade,[244] but the program—and others like it—generally get poor reviews.[245] A more comprehensive adjustment system, especially one that provides meaningful assistance to workers forced to adjust to new jobs or locations, could help workers transition to new jobs.[246] Among the ways that readjustment efforts could be improved include expanding financial investment into readjustment efforts; centralizing the many, disperse readjustment programs; and providing readjustment assistance or training benefits to workers *before* they lose their jobs, especially in regions, industries, or occupations most likely to feel technology's impact.[247] Finally, reducing the

238. Moreover, spending on worker training has been declining or flat in recent years in most advanced economies. *Id.* at 18.

239. Cain Miller & Bui, *supra* note 146 (stating that lack of training investment results from employers' concern that employees may leave and take new skills to competitors, while workers may feel that investing in training will not result in new job prospects).

240. *Id.* (noting that the U.S. spends far less than other countries on job training and workers). The White House has made a renewed push for expansion of apprenticeship programs, which has been a rare public policy initiative garnering bipartisan support. *Id.* But it remains to be seen whether this produces real benefits, especially given the narrow scope of most apprenticeship programs.

241. MANYIKA ET AL., *supra* note 3, at 107 (noting that job training spending has declined since the 1990s and emphasizing success of GI Bill). Other countries have explored national education and training programs. OECD, LEARNING FOR JOBS 163–67 (2010), https://www.oecd-ilibrary.org/docserver/9789264087460-en.pdf?expires=1571351013&id=id&accname=ocid43013819&checksum=5308AE75F876EE4D175C582313F679F6.

242. Matthew Dimick, *Labor Law, New Governance, and the Ghent System*, 90 N.C. L. REV. 319, 364 (2012) (discussing Danish "flexicurity" system); MANYIKA ET AL., *supra* note 3, at 114.

243. Estlund, *supra* note 195, at 313–14; Mike Muro & Joseph Parilla, *Maladjusted: It's Time to Reimagine Economic "Adjustment" Programs*, BROOKINGS: THE AVENUE (Jan. 10, 2017), https://www.brookings.edu/blog/the-avenue/2017/01/10/maladjusted-its-time-to-reimagine-economic-adjustment-programs/.

244. *About Us*, U.S. DEP'T LAB., EMP. & TRAINING ADMIN., https://doleta.gov/tradeact/about-us/ (last updated July 29, 2019); *see also* Muro & Parilla, *supra* note 243.

245. *See* David H. Autor et al., *Trade Adjustment: Worker-Level Evidence*, 129 Q.J. ECON. 1799, 1831–33 (2014) (finding that displaced workers rely on other benefits—primarily Social Security and Medicare—rather than trade adjustment retraining); Muro & Parilla, *supra* note 243.

246. For instance, we could provide relocation grants to help workers move away from areas with fewer jobs to those with more opportunities. Muro & Parilla, *supra* note 243.

247. *Id.* (advocating comprehensive basic set of readjustment benefits and assistance).

costs to workers of switching jobs, such as the current widespread use of non-compete agreements, could ease the transition to the jobs of the future.[248]

Another strategy to increase labor fluidity is making benefits like health coverage more portable so workers are not tied to a specific business.[249] The risk of immediately losing one's benefits can be the difference between seeking what would otherwise be a desirable new opportunity and staying in place, even if the long-term prospects are grim.[250] Thus, programs that provide benefits that are independent of employment could reduce or eliminate this lock-in effect. Federal legislators have taken some recent actions to address this issue, particularly with regard to gig and other contingent workers, but thus far Congress has passed nothing.[251] There does, however, seem to be more bipartisan support for increasing benefit portability, including among advocates for both businesses and workers, so there may be hope that some measure is ultimately enacted.[252]

Reducing disincentives to seek jobs in new locations is also important, as geographic areas with strong labor markets today may be different than the ones in the future. One option is to lower the burden of various licensing and certification requirements which for certain jobs, like nursing, can vary greatly among states and dissuade workers from making geographic moves.[253] Additionally, the mere existence of licensing requirements in certain industries, especially those dominated by low-wage jobs, has come under question as they create significant barriers to employment with questionable benefits.[254] Other strategies, such as promoting more affordable housing options, could make workers more open to moving.[255]

In addition to the foregoing options, policymakers could increase labor fluidity by implementing more job counseling for workers who are displaced or at a risk of losing their jobs;[256] providing grants to allow workers to take time off

248. STONE, *supra* note 1, at 127–56.

249. Estlund, *supra* note 195, at 306–08 (advocating detaching benefits from employment relationship as means of lowering cost of human labor and reducing incentive to automate work).

250. John Ahlquist, *The Future of Work: Risk Bearing and Risk Sharing*, PAC. STANDARD (Sept. 3, 2015), https://psmag.com/economics/the-future-of-work-risk-bearing-and-risk-sharing#.k79d8ylye.

251. For instance, the Portable Benefits for Independent Workers Pilot Program Act, S. 1251, 115th Cong. (2017), would examine tax issues related to gig work and provide grants to explore portable benefit programs for gig workers and independent contractors.

252. Tyrone Richardson, *Gig Bills May Be in Works After Labor Department Report*, BLOOMBERG L.: DAILY LAB. REP. (May 2, 2018, 5:45 AM), https://news.bloomberglaw.com/daily-labor-report/gig-bills-may-be-in-works-after-labor-department-report.

253. Recent federal efforts have attempted to encourage states to address this issue, but such efforts have been limited. Gayle Cinquegrani, *You Can't Take it with You: State Licensing Creates Job Barriers*, BLOOMBERG L.: DAILY LAB. REP. (Aug. 24, 2018, 7:00 AM), https://news.bloomberglaw.com/daily-labor-report/you-cant-take-it-with-you-state-licensing-creates-job-barriers.

254. *Id.* (describing substantial costs of some licenses, some states that have eliminated some requirement, and 2018 federal legislation that encourages states to address this issue).

255. David Schleicher, *Surreply: How and Why We Should Become Un-Stuck!*, 127 YALE L.J.F. 571, 587–88 (2017).

256. Muro & Parilla, *supra* note 243.

from work to take classes;[257] and creating more effective job-matching resources.[258] Other, more controversial, recommendations might also include implementing a higher minimum wage, basic minimum income, or other financial support.[259] Technology, perhaps ironically, could also assist with some of these efforts, such as VR providing opportunities for work located in different geographic areas. Moreover, platform and other gig work provide some needed fluidity to the labor market, allowing firms and workers to more efficiently match up in a rapidly changing economy.[260] This type of work, however, also highlights the risks of technology as it emerges in our current, inadequate workplace regulatory system. For reasons explained in the next Section, gig workers are largely at the mercy of firms and technology threatens to expose many other workers to a similarly toxic mix of low job security, lack of bargaining power, and constant monitoring and control.

None of these strategies are a panacea, even if there was the political will to implement them any time soon (which I very much doubt). Yet, the potential magnitude of technology's impact on the workplace may be so great that policymakers cannot ignore these issues. Whether they react in a manner that is either timely or sufficient remains to be seen. But the hope is that, perhaps more than any previous challenges, the threat of technology spurs much needed changes in workplace law.

B. Worker Classification: Who is an Employee in the Future Economy?

Among the many groups of workers who are at risk of being harmed by emerging technology, none face a more dire outlook than those who are not classified as statutory employees.[261] Workers who are classified as independent contractors or other non-employees are completely excluded from coverage by workplace laws—they have no guaranteed minimum wage, no protection for safety and health, no family and medical leave, no right to organize, no disability accommodations, and no right to be free from discrimination.[262] This is not a new problem by any means; even in the initial days of the earliest workplace legislation, employers attempted to exclude workers by classifying them as independent contractors.[263] But technology has exacerbated this problem, as gig

257. *Id.*

258. Joni Hersch & Jennifer Bennett Shinall, *Something to Talk About: Information Exchange Under Employment Law*, 165 U. PA. L. REV. 49, 88–89 (2016).

259. Estlund, *supra* note 195, at 313–14 (discussing options as means to lower financial burdens on employers).

260. MANYIKA ET AL., *supra* note 3, at 19 (noting Germany's unemployment agency's new focus on job-matching).

261. Jacquie Lee, *Gig Workers Have Scant Protection from Job Bias*, BLOOMBERG L.: DAILY LAB. REP. (Feb. 9, 2018, 5:46 AM), https://news.bloomberglaw.com/daily-labor-report/gig-workers-have-scant-protection-from-job-bias.

262. *Id.* (describing concern of EEOC and others about gig workers' lack of protection against discrimination).

263. For instance, the Supreme Court's decision in *NLRB v. Hearst Publ'ns*, 322 U.S. 111, 131–32 (1944) (holding that "newsboys" were employees under the NLRA), led Congress to amend the NLRA to specifically exclude independent contractors, 29 U.S.C. § 152(3) (2012).

and other "on demand" workers are often an ill-fit with the traditional employee classification analysis.[264]

Workers in these new, tech-dependent industries have discovered that current workplace laws, most of which are many decades old, are based on the workplace of the early to mid-Twentieth Century, a workplace where workers' status was usually clear.[265] To a much greater degree than their predecessors, gig and other workers in tech-related industries lack a physical workplace, possess flexibility in their hours and means of work, and encounter highly variable terms and conditions of work—all of which are important factors in the traditional employee classification tests.[266] Indeed, individuals are increasingly engaging in "virtual work" that challenges our conception of work itself.[267]

In recent decades we have already seen an increase in companies' willingness to classify workers as independent contractors excluded from workplace protections.[268] This growth has been particularly evident in tech-related industries. For instance, in 2016, almost a tenth of respondents in a survey reported participating in the platform economy.[269] But this increase in participation has been accompanied by a decrease in earnings, as another study found that workers who used apps to provide transportation services—such as Lyft or Uber Eats—saw their monthly income from this work decrease 53% from 2013 to 2017.[270]

264. Cotter v. Lyft, Inc., 60 F. Supp. 3d 1067, 1081 (N.D. Cal. 2015) (stating that trying to apply the law to on-demand workers is like being "handed a square peg and asked to choose between two round holes"); Jeffrey M. Hirsch & Joseph A. Seiner, *A Modern Union for the Modern Economy*, 86 FORDHAM L. REV. 1727, 1739–45 (2018) (describing challenges faced by gig and other contingent workers, particularly Uber drivers).

265. *Cotter*, 60 F. Supp. 3d at 1081 ("The test . . . developed over the 20th Century for classifying workers isn't very helpful in addressing this 21st Century problem.").

266. Hirsch & Seiner, *supra* note 264, at 1744. On the other hand, if the enhanced monitoring discussed in Section III.C leads to companies' exerting more control over how workers do their jobs, that would increase the chances of an "employee" classification. *See* Nationwide Mut. Ins. v. Darden, 503 U.S. 318, 323–24 (1992) (establishing common-law "right-to-control" test used for most workplace laws); Sec'y of Labor v. Lauritzen, 835 F.2d 1529, 1534 (7th Cir. 1987) (describing "economic realities" test used for FLSA and FMLA claims).

267. Professor Miriam Cherry has written extensively about virtual work, such as online crowdsourcing, the challenges it presents to our preexisting employment law doctrine, and the vulnerabilities of individuals who engage in it. *See, e.g.*, Miriam A. Cherry, *A Taxonomy of Virtual Work,* 45 GA. L. REV. 951 (2011); Miriam A. Cherry, *The Global Dimensions of Virtual Work*, 54 ST. LOUIS U. L.J. 471 (2010); Miriam A. Cherry, *Working for (Virtually) Minimum Wage: Applying the Fair Labor Standards Act in Cyberspace*, 60 ALA. L. REV. 1077 (2009).

268. U.S. GOV'T ACCOUNTABILITY OFF., GAO-07-859T, EMPLOYEE MISCLASSIFICATION: IMPROVED OUTREACH COULD HELP ENSURE PROPER WORKER CLASSIFICATION 2 (2007), http://www.gao.gov/new.items/d07859t.pdf. In addition to avoiding labor and employment law liability, companies also gain significant tax advantages by using independent contractors rather than employees. Shu-Yi Oei & Diane M. Ring, *Tax Issues in the Sharing Economy: Implications for Workers*, *in* THE CAMBRIDGE HANDBOOK ON THE LAW OF THE SHARING ECONOMY (Nestor M. Davidson, Michele Finck & John J. Infranca, eds. 2018); Katherine V.W. Stone, *Legal Protections for Atypical Employees: Employment Law for Workers Without Workplaces and Employees Without Employers*, 27 BERKELEY J. EMP. & LAB. L. 251, 279 (2006); Kathleen DeLaney Thomas, *Taxing the Gig Economy*, 166 U. PA. L. REV. 1415, 1443 (2018).

269. Aaron Smith, *Gig Work, Online Selling and Home Sharing*, PEW RES. CTR. (Nov. 17, 2016), http://www.pewinternet.org/2016/11/17/gig-work-online-selling-and-home-sharing/ (finding 8% using platform economy for job or task, 18% selling something, and 1% renting out property).

270. Diana Farrell, Fiona Greig & Amar Hamoudi, *The Online Platform Economy in 2018: Drivers, Workers, Sellers, and Lessors*, JPMORGAN CHASE & CO. INST. 1, 13–14 (Sept. 2018), https://institute.jpmorganchase.com/content/dam/jpmc/jpmorgan-chase-and-co/institute/pdf/institute-ope-2018.pdf (finding monthly

And because most of these workers are classified as independent contractors, wage and hour laws do not help.

The most publicized example of this phenomenon is Uber which, like most platform companies, insists that its drivers are independent contractors rather than employees. This stance has prompted a litany of litigation under both state and federal law.[271] It has also prompted innovative approaches to improving drivers' working conditions, including an unofficial drivers' union[272] and municipal actions attempting to provide drivers' the ability to officially unionize.[273] But these alternative measures, while beneficial, mask the reality that gig and many other workers lack any meaningful legal protection. Most of these individuals, particularly those who work for smaller, lower profile companies or otherwise face insurmountable collective-action problems, will have no opportunity to take advantage of alternative half-measures. Thus, absent legislative or judicial action, these workers' fates are largely left to companies' unilateral whim.[274]

But what actions should or could policymakers take? There is no shortage of recommendations. These include additional penalties against employers who misclassify their employees;[275] expanding the current employee-classification tests;[276] creating a third classification, such as "dependent contractors" who receive a portion of the rights to which statutory employees are entitled;[277] and even abandoning employment law approaches entirely and, instead, regulate platform work via the Federal Trade Commission.[278] We could also amend the

income drop from $1,469 to $783, although study did not measure hours worked and found little change in non-transportation earnings).

271. *See, e.g.*, O'Connor v. Uber Techs., Inc., 82 F. Supp. 3d 1133, 1145 (N.D. Cal. 2015) (holding, in denial of summary judgment for Uber, that drivers were presumptively employees under California Labor Code; parties subsequently settled); Miriam A. Cherry, *Beyond Misclassification: The Digital Transformation of Work*, 37 COMP. LAB. L. & POL'Y J. 577, 579–94 (2016) (describing employee classification cases against "on demand" companies); Hirsch & Seiner, *supra* note 264, at 1743 (noting employee classification cases brought against numerous technology companies).

272. Hirsch & Seiner, *supra* note 264, at 1749–53 (describing the Uber Guild and noting ways that technology has helped some of these efforts).

273. Charlotte Garden, *The Seattle Solution: Collective Bargaining by For-Hire Drivers and Prospects for Pro-Labor Federalism*, 12 HARV. L. & POL'Y REV. ONLINE 1, 2–5 (2017) (describing Seattle ordinance).

274. The labor market, particularly in times of high employment, can prompt better working conditions. We are currently seeing compensation for gig work decline, however, during a period of historically low unemployment, JPMORGAN CHASE & CO., *supra* note 270, and conditions are likely to worsen as technology begins to replace human workers.

275. Payroll Fraud Prevention Act of 2017, H.R. 3629, 115th Cong. (2017) (amending FLSA to address misclassification).

276. Miriam A. Cherry & Antonio Aloisi, *"Dependent Contractors" in the Gig Economy: A Comparative Approach*, 66 AM. U. L. REV. 635 (2017) (proposing that gig workers be classified as employees by default, with some exceptions); Guy Davidov, *Who is a Worker?*, 34 INDUS. L.J. 57, 62–63 (2005) (arguing for intermediate category of employees based on their dependence and subordination to a business); Jonathan P. Hiatt, *Policy Issues Concerning the Contingent Work Force*, 52 WASH. & LEE L. REV. 739, 750 (1995) (advocating a test centered on workers' economic dependence on business).

277. St. Joseph News-Press, 345 N.L.R.B. 474, 486 (2005) (Member Liebman, dissenting) (noting classification in Sweden, Canada, and Germany); MARC LINDER, THE EMPLOYMENT RELATIONSHIP IN ANGLO-AMERICAN LAW: A HISTORICAL PERSPECTIVE 240 (1989); Cherry & Aloisi, *Dependent Contractors*, *supra* note 276 (examining the intermediate category used in different countries).

278. Martin H. Malin, *Protecting Platform Workers in the Gig Economy: Look to the FTC*, 51 IND. L. REV. 377 (2018).

tax laws to reduce the incentive of businesses to classify workers as independent contractors.[279] A broader, albeit politically improbable, approach could expand certain workplace protections, such as minimum wage and safety, to all individuals who perform work.[280] The argument for this approach is that no one, even those who are truly independent contractors, should have to work for less than $7.25 an hour[281] or be subjected to unsafe working conditions. Therefore, entities that control pay or the work environment would be required to do so at a minimally acceptable level.

Despite widespread recognition that misclassification is a significant problem, and not just in the tech sector, legislative response has been tepid.[282] Some states have considered bills to ensure that gig and other similarly situated workers are classified as employees.[283] But, in part because of the power of business interests, more states have been pursuing the opposite aim by trying to ensure that these workers are classified as independent contractors.[284] Such efforts are shortsighted, as they trade near-term business interests for the long-term social costs that are associated with a growing percentage of individuals who are dependent on insecure, unpredictable, and low-wage work.

Although the way forward is not obvious, what is clear is that gig and other similarly situated workers' situation is untenable. They exist in a modern economy that is governed as if the last half-century never occurred, much less one that is undergoing rapid changes prompted by technology. In this emerging economy, many workers will continue to rely on a patchwork of gigs that, unless something is done, will leave them in the gaps of our workplace regulatory system. To provide these workers the protections that we have deemed essential for employees, we must alter our approach to workplace regulation and—as is the case for addressing job displacement—consider changes to the social safety

279. *See supra* note 268 and accompanying text.

280. For instance, legislation could mirror Section 1981, which prohibits racial discrimination in contractual relationships. 42 U.S.C. § 1981 (2018); Lee, *supra* note 261; *cf.* Marc Linder, *Dependent and Independent Contractors in Recent U.S. Labor Law: An Ambiguous Dichotomy Rooted in Simulated Statutory Purposelessness*, 21 COMP. LAB. L. & POL'Y J. 187, 223 (1999) (arguing for employment relationship to cover service provider and recipient); Brishen Rogers, *Toward Third-Party Liability for Wage Theft*, 31 BERKELEY J. EMP. & LAB. L. 1, 49–55 (2010) (arguing for liability under FLSA to rely on a firm's duty of reasonable care to ensure compliance throughout its supply chain, rather than workers' status as employees of a firm).

281. This minimum wage could be made more flexible by taking into account other forms of compensation, such as the value of other goods or services exchanged for the work.

282. *See infra* notes 283–84 and accompanying text.

283. S.B. 18-171, 71st Gen. Assemb., Reg. Sess. (Colo. 2018). The California Supreme Court also recently changed its test for employee classification; the new test applies generally but should make it easier for gig workers to argue that they are employees. Dynamex Operations W. Inc. v. Superior Court, 416 P.3d 1 (Cal. 2018) (adopting the "ABC" classification test).

284. Describing efforts by Handy, a platform housecleaning company, to convince state legislators to adopt sample legislation that would classify platform workers as independent contractors; three states have already enacted such legislation, and at least five more are considering it. Sarah Kessler, *Handy is Quietly Lobbying State Lawmakers to Declare its Workers aren't Employees*, QUARTZ (Mar. 30, 2018), https://qz.com/work/1240997/handy-is-trying-to-change-labor-law-in-eight-states/.

net.[285] Neither will be easy or even feasible in the near-term, but the changes generated by emerging technology may prove to be the tipping point.[286]

C. Employer Monitoring and Worker Privacy: Working in a Fishbowl

Among today's emerging technologies, perhaps none are as currently underappreciated by policymakers as those that enhance employers' ability to monitor workers and limit their autonomy. Employers have always desired information about the quality and effort of workers, as well as more personal information, and they have frequently used emerging technologies to obtain it.[287] But past advances like the time clock and aptitude tests pale in comparison to what is already occurring now, which in turn is a far cry from what is on the horizon.[288]

Many employers are already monitoring workers extensively in an attempt to crack down on shirking, protect trade secrets, stop harassment, and other reasons.[289] The existing levels of workplace monitoring are quite alarming, but new innovations will become progressively integrated into a blended workplace which will provide employers with far more dramatic opportunities to watch and control workers.

Among today's more accessible monitoring technologies are computer and smart phone programs that allow companies to scrutinize workers' productivity and actions, as well as communicate with workers even when they are off-duty.[290] Additionally, these devices and other types of equipment with GPS capabilities provide employers with cost-effective means to track workers' locations—many times when they are not at work.[291] These capabilities will strike most as familiar, if not desirable; however, developing technology will allow employers to monitor workers in ways that make GPS seem quaint.

One company has developed a work badge that tracks not only workers' movements, but also captures and allows analysis of the tone and length of workplace conversations.[292] This data can be used to monitor things such as how often

285. *See* sources cited *supra* notes 249–52.

286. *See* sources cited *supra* notes 273, 283.

287. Bradley A. Areheart & Jessica L. Roberts, *GINA, Big Data, and the Future of Employee Privacy*, 128 YALE L.J. 710, 755–57 (2019).

288. William A. Herbert, *No Direction Home: Will the Law Keep Pace with Human Tracking Technology to Protect Individual Privacy and Stop Geoslavery?*, 2 I/S: J.L. & POL'Y FOR INFO. SOC'Y 409, 455 (2006).

289. Pauline T. Kim, *Electronic Privacy and Employee Speech*, 87 CHI.-KENT L. REV. 901, 913 (2012).

290. Ajunwa et al., *supra* note 12, at 742–44, 771–72 (describing recent employer monitoring practices, including productivity apps).

291. *See* David Kravets, *Worker Fired for Disabling GPS App that Tracked Her 24 Hours a Day*, ARS TECHNICA (May 11, 2015, 11:41 AM), http://arstechnica.com/tech-policy/2015/05/worker-fired-for-disabling-gps-app-that-tracked-her-24-hours-a-day; *see also* Arias v. Intermex Wire Transfer, LLC, No. 1:15-CV-01101, at *1 (E.D. Cal. Nov. 23, 2015) (settlement of claims by employee allegedly fired for turning off employer's GPS-capturing app when off-duty).

292. *Smile, You're on Camera: There Will be Little Privacy in the Workplace of the Future*, ECONOMIST (Mar. 28, 2018), https://www.economist.com/special-report/2018/03/28/there-will-be-little-privacy-in-the-work place-of-the-future (describing employer that requires workers to wear devices with a microphone and motion tracker and uses information as part of its people analytics); Richard M. Reice, *Wearables in the Workplace–A*

workers talk to individuals of a particular sex, how long they spend listening versus talking, how much they move around in a day, and what spaces in a building are used and when.[293] Moreover, in 2017, a Wisconsin company held a "chip party," during which employees voluntarily had radio-frequency identification ("RFID") chips implanted in their forearms.[294] These chips were ostensibly intended to make purchases in a break room, open locked doors, log in to computers, and access other types of equipment.[295] But under the U.S.'s default "employment-at-will" rule, [296] employers could require workers to submit to embedded technology or other monitoring devices.

Emerging monitoring technology promises even greater intrusions. For instance, one device under development can track not only where workers are positioned at a given time, but also what their hands are doing.[297] Other devices will help control the amount of time workers spend on tasks, including going to the bathroom.[298] In Japan, technology is already in use that monitors workers' eyelid movements and will lower the room's temperature if the system identifies signs of drowsiness.[299]

As significant as these advances seem, far more disruptive monitoring applications are on the horizon. In particular, the encroachment of other types of technologies into the workplace will greatly expand employers' monitoring capabilities. Consider automation or XR in a blended workplace. Both technologies employ a substantial amount of image capturing, much more than what is occurring now. Companies can aggregate this data with AI systems to delve into highly intimate areas. For instance, by marrying AI with monitoring technology that captures biometric and other subtle behavioral cues, employers will be able to predict workers' moods, energy levels, and whether they are likely to engage in certain behaviors, as well as even diagnose depression or other medical conditions.[300] "Wearables" are an early harbinger of this potential, as employers have

New Frontier, BLOOMBERG L. (May 24, 2018, 5:40 AM), https://news.bloomberglaw.com/daily-labor-report/wearables-in-the-workplacea-new-frontier.

293. *Smile, You're on Camera*, *supra* note 292.

294. Joseph Jerome, *Embedded Chip on Your Shoulder? Some Privacy and Security Considerations*, IAPP PRIVACY PERSPECTIVES (Aug. 1, 2017), https://iapp.org/news/a/embedded-chip-on-your-shoulder-some-privacy-and-security-considerations/ (arguing that employers should clearly disclose their purposes for embedded chips and limitations on the use of information gathered).

295. *Id.*

296. *See* Samuel Estreicher & Jeffrey M. Hirsch, *Comparative Wrongful Dismissal Law: Reassessing American Exceptionalism*, 92 N.C. L. Rev. 343, 347 (2014).

297. Ceylan Yeginsu, *A Wristband to Track Workers' Hand Movements? (Amazon Has Patents for It)*, SEATTLE TIMES (Feb. 1, 2018, 6:28 PM), https://www.seattletimes.com/business/a-wristband-to-track-workers-hand-movements-amazon-has-patents-for-it/.

298. Ifeoma Ajunwa, *Algorithms at Work: Productivity Monitoring Applications and Wearable Technology as the New Data-Centric Research Agenda for Employment and Labor Law*, 63 ST. LOUIS U. L.J. 21, 34–35 (2018) (discussing Amazon patents).

299. Johnny Wood, *Feeling Sleepy in the Office? This Japanese Technology Detects Tired Workers and Blasts Cold Air into the Room*, WORLD ECON. F. (July 31, 2018), https://www.weforum.org/agenda/2018/07/feeling-sleepy-in-the-office-this-japanese-technology-detects-tired-workers-and-blasts-cold-air-into-the-room/.

300. *Smile, You're on Camera*, *supra* note 292; Valentina Zarya, *Employers Are Quietly Using Big Data to Track Employee Pregnancies*, FORTUNE (Feb. 17, 2016), https://fortune.com/2016/02/17/castlight-pregnancy-data/.

begun exploring the use of Fitbits and other devices that can monitor workers' movements, level of exertion, posture, stress levels, fatigue, and other personal details.[301] In short, the integration of technologies like automation, AI, and XR into the workplace will make these intrusive practices cheaper and easier to implement, while spurring novel ways to monitor and control workers.

If one doubts whether employers will take advantage of the ability to intrude into the most private aspects of workers' lives, consider the National Football League's ("NFL") vaunted "combine." At this annual event, teams evaluate former collegiate players who hope to join the NFL.[302] During the combine, teams use various technologies to evaluate not only players' current and predicted athletic performance, but also highly personal physiological and mental health information.[303] To be sure, the amount of money at stake for these high-paid employees is unusual, but as the affordability and effectiveness of monitoring technology increases, the number of employers that take advantage of these capabilities will rise as well. Indeed, if employers remain able to sell personal information about their workers, we should expect this development to expand rapidly.[304]

The future workplace's amalgam of technology and human workers will provide employers the capacity to monitor workers twenty-four hours a day and use that data to access intimate information. Despite these looming horrors, however, it is worth noting that technology can also benefit workers. Some innovations will make work safer by tracking workers' hydration levels, posture, and fatigue; identifying workplace hazards; and, in an example of a merger between automation and monitoring technology, lowering the risk of injury by helping workers lift objects with exoskeletons and other robotic technology.[305] Uber has experimented with analyzing drivers' acceleration and braking data to identify unsafe driving practices.[306] And employers worried about liability for sexual harassment will be tempted to increase monitoring of employees,[307] while wear-

301. Reice, *supra* note 292 (noting that by 2018 employers had used 13 million fitness trackers in company wellness programs).

302. Rick Maese, *The NFL Combine: Pro Football's Intrusive, and Compulsory, Job Interview*, WASH. POST (Feb. 26, 2017), https://www.washingtonpost.com/sports/redskins/the-nfl-combine-pro-footballs-intrusive-and-mandatory-job-interview/2017/02/24/8eeda44c-fad2-11e6-9845-576c69081518_story.html.

303. *Id.* (describing tests including heart and blood testing, X-rays, MRIs, psychological exams, drug testing, neurological testing, cognitive and intelligence exams—some of which is available to potential employers in less than a minute after the test is performed); Dave Siebert, *An Inside Look Into the NFL Medial Exam Process at the Combine*, BLEACHER REP. (Feb. 21, 2014), https://bleacherreport.com/articles/1968230-an-inside-look-into-the-nfl-medical-exam-process-at-the-combine (noting stress tests, orthopedic exams, and evaluation of internal organs and pre-existing conditions).

304. *Cf.* Jennifer Valentino-DeVries et al., *Your Apps Knowns Where You Were Last Night, and They're Not Keeping it Secret*, N.Y. TIMES (Dec. 10, 2018), https://www.nytimes.com/interactive/2018/12/10/business/location-data-privacy-apps.html (describing companies' capturing and selling of smart phone users' locations).

305. *Smile, You're on Camera*, *supra* note 292; Ajunwa, *supra* note 298, at 36, 40–41; Reice, *supra* note 292.

306. Scheiber, *supra* note 55.

307. Ajunwa, *supra* note 298, at 33–34, 48

ables and other devices could, if used correctly, reduce wage and hour violations.[308] But all of those innovations still raise serious privacy questions, as they typically capture a large amount of personal data and can be used to shape workers' behavior, even at home.[309]

Existing privacy laws in the U.S. are woefully inadequate even for current technology, much less the technology of tomorrow. Indeed, with a few limited exceptions, workplace privacy protections are essentially nonexistent in the private sector.[310] As briefly described below, there are a few laws that might provide safeguards in limited instances, but for the most part, the privacy interests of private-sector workers are left to the whims of their employers.[311] Public-sector employees have a layer of protection against some privacy invasions that qualify as searches under the Fourth Amendment.[312] But even if public employers engage in such searches they will not run afoul of the Fourth Amendment if they were motivated by a valid business justification or a court finds that the affected employees lacked a reasonable expectation of privacy.[313]

When employers collect or use their workers' health-related information—like at the NFL combine—the Americans with Disabilities Act ("ADA")[314] or Genetic Information Nondiscrimination Act[315] ("GINA") might provide some protection.[316] But those laws protect only disabled employees and genetic information respectively. In other words, if a worker is not classified as an employee[317] or an employee is not disabled, the ADA is irrelevant, while GINA does nothing to protect against intrusions that do not involve genetic information. Thus, companies can work around both of those statutes with relative ease, permitting, for example, an employer to evaluate all of its nondisabled workers or applicants based on nongenetic personal characteristics and other intimate information. And even when those statutes are applicable, they have limited reach. During the hiring process, the ADA mainly prohibits disability related questions or medical examinations of job applicants.[318] Once an offer of employment is made, employers are generally free to access health records or similar medical

308. Clement L. Tsao et al., *The Rise of Wearable and Smart Technology in the Workplace*, ABA NAT'L SYMP. ON TECH. LAB. & EMP. L. 4 (2017).

309. Moreover, technology, especially when new and unfamiliar, could lead to accidents and other harms. *See supra* note 117 and accompanying text.

310. Bodie et al., *supra* note 52, at 988–89.

311. Burdeau v. McDowell, 256 U.S. 465, 475 (1921) (no right to privacy in private sector); Ajunwa et al., *supra* note 12, at 749. Unionized employees may gain additional privacy protections via collective-bargaining agreements, but like other specialized employment contracts, those agreements require employers' assent.

312. O'Connor v. Ortega, 480 U.S. 709, 725–26 (1987); *cf.* Carpenter v. United States, 138 S. Ct. 2206 (2018) (holding that Fourth Amendment requires police to obtain warrant before retrieving cell-site location information); United States v. Jones, 132 S. Ct. 945 (2012) (holding that police needed warrant to place GPS tracker on suspect's car).

313. NASA v. Nelson, 562 U.S. 134, 149–50 (2011); City of Ontario v. Quon, 560 U.S. 746, 756–57 (2010).

314. 42 U.S.C. §§ 12101–12213 (2018).

315. *Id.* §§ 2000ff–2000ff-11.

316. Bodie et al., *supra* note 52, at 995–96 (discussing possibility that forcing employees to submit to psychological testing not justified by valid business need might violate employees' common-law privacy rights).

317. *See supra* Section III.B.

318. 42 U.S.C. § 12112(d)(3) (2018).

information as long as it is necessary for the business and it is not used to discriminate based on an applicant's or employee's disability.[319] The ADA, however, does not appear to protect medical-related information that employers gather from other sources, such as emerging monitoring technology.[320]

Various privacy laws suggest some protection against monitoring, but they apply in such limited circumstances that they are virtually useless for workers. For instance, the Wiretap Act—as codified under the Electronic Communications Privacy Act ("ECPA")—regulates the intercept of electronic, oral, and wire communications, but not GPS or other types of monitoring.[321] The Wiretap Act also prohibits only the *simultaneous* intercept of electronic communications, meaning that employers are able to capture emails, texts, or other communications and analyze them later.[322] The Stored Communications Act ("SCA"), which is also part of the ECPA, partially fills this gap through its coverage of stored electronic communications.[323] But the SCA's ability to protect workers is severely limited. Among other things, the SCA allows employers to insist that workers authorize access to covered communications,[324] completely neutering the law as it applies to the workplace. And even without workers' consent, employers are allowed to monitor employees' communications for legitimate business purposes if the employer provides the service being monitored.[325] Similarly, merely giving notice of monitoring may be enough to avoid liability under the SCA, which only applies where there is a reasonable expectation of privacy.[326] Most state eavesdropping laws suffer from the same limitations, including employers' ability to condition jobs on workers' consent to monitoring.[327] The same is true of the Computer Fraud and Abuse Act ("CFAA"),[328] which prohibits unauthorized access of a computer, but only when that access causes a loss of at

319. *Id.* § 12112(d)(3)–(d)(4) (2018) (permitting information if it's job-related and business necessity); Areheart & Roberts, *supra* note 287, at 55–56.

320. Areheart & Roberts, *supra* note 287, at 56. Relatedly, the EEOC recently stated that employers could lawfully collect medical-related information as part of wellness programs, as long as employee participation in the program was truly voluntary and the data was disclosed only in aggregate form that does not identify individuals. Regulations Under the Americans with Disabilities Act, EEOC, 29 C.F.R. § 1630.14. The Health Insurance Portability and Accountability Act (HIPAA) suffers from the same shortcomings, as it protects only medical records and applies only to health care providers, plans, and similar entities—not employers. 45 C.F.R. §§ 160, 163.

321. 18 U.S.C. § 2511 (2018).

322. Konop v. Hawaiian Airlines, Inc., 302 F.3d 868, 878 (9th Cir. 2002) (holding that the Wiretap Act applies only when someone intercepts communications as they are occurring).

323. 18 U.S.C. §§ 2702, 2710 (2018); 45 C.F.R. § 160 (2018).

324. 18 U.S.C. § 2701(c)(2) (2018); *Konop*, 302 F.3d at 879–80.

325. 18 U.S.C. § 2701(c)(1) (2018); Garrity v. John Hancock Mut. Life Ins. Co., 2002 U.S. Dist. LEXIS 8343 (D. Mass. 2002).

326. Thygeson v. U.S. Bancorp., CV-03-467-ST, 2004 U.S. Dist. LEXIS 18863, at *72 (D. Or. 2004). *Compare* Cunningham v. New York State Dep't of Labor, 997 N.E.2d 468 (N.Y. 2013) (holding that public employer's installation of GPS tracker on employee's personal vehicle was unlawful search), *with* El-Nahal v. Yassky, 993 F. Supp. 2d 460 (S.D.N.Y. 2014) (approving municipal requirement for GPS tracking of personally owned taxis).

327. All states have legislation that prohibits eavesdropping, which might apply to employers. Sally Brown Richardson, *Privacy and Community Property*, 95 N.C. L. REV. 729, 735 (2017).

328. 18 U.S.C. § 1030 (2018).

least $5000 in one year.[329] The CFAA also covers only certain types of information, such as financial records, information used for fraud, computer passwords, and information protected by certain other laws or policies.[330] Moreover, none of these statutes protect workers' personal data generated through employer monitoring, data mining, or other emerging technology.

More general workplace legislation might provide some privacy protections in limited circumstances. For instance, if collected information is used in a discriminatory fashion, Title VII of the Civil Rights Act could provide a cause of action.[331] Additionally, if an employer uses technology to monitor employees while they are engaging in activity protected by the National Labor Relations Act—for instance, planning a drive for a union or collectively agitating for higher wages—then such surveillance would be unlawful.[332] The agency in charge of enforcing that statute, however, is still struggling to regulate email, so the prospects for it to meaningfully address newer technology is not good.[333] In short, these and other workplace laws do not directly speak to workplace privacy and, as a result, will be relevant only in limited circumstances.

Given the lack of federal privacy protections, states may provide an alternative. Predictably, however, state laws are quite varied and none have the sort of broad-based privacy protection that both current and future technology warrant.[334] That said, unlike the federal government, several states have been incrementally exploring certain aspects of workplace privacy, such as protecting employees' personal social media accounts.[335] Although quite limited, one positive aspect of these social media laws is that—unlike other privacy laws—they generally prohibit an employer from pressuring employees to give up their passwords.[336] Some states, spurred by the rise in wearable devices, have begun to address other privacy intrusions. Connecticut and Delaware, for instance, now require notification if employers collect information about employees' activities and conversations other than by direct observation in the workplace.[337] A few

329. *Id.* §§ 1030(a)(4), 1030(a)(2)(C) (2018) (permitting employers to insist on workers' consent or to freely access company-supplied equipment).

330. *Id.* § 1030(a) (2018).

331. *See infra* Section III.C.

332. Purple Commc'ns, Inc., 361 N.L.R.B. 1050, 1064–65 (2014).

333. NLRB, *Board Invites Briefs Regarding Employee Use of Employer Email*, NAT'L LAB. REL. BOARD (Aug. 1, 2018), https://www.nlrb.gov/news-outreach/news-story/board-invites-briefs-regarding-employee-use-employer-email.

334. RESTATEMENT OF EMPLOYMENT LAW §§ 7.01–7.06; Ajunwa et al., *supra* note 12, at 758–62 (surveying state workplace privacy protections, that largely do only three things: regulate audio only, protect against video in private space; and require notice).

335. Approximately half the states regulate employers' ability to demand access to employees' or applicants' social media accounts. Robert Sprague, *Survey of (Mostly Outdated and Often Ineffective) Laws Affecting Work-Related Monitoring*, 93 CHI.-KENT L. REV. 221, 243 (2018).

336. Nat'l Conf. State Legislators, *State Social Media Privacy Laws*, NAT'L CONF. OF STATE LEGISLATORS (May 22, 2019), http://www.ncsl.org/research/telecommunications-and-information-technology/state-laws-prohibiting-access-to-social-media-usernames-and-passwords.aspx.

337. CONN. GEN. STAT. § 31-48b (2019); DEL. CODE § 19-7-705 (2019). *But see* Gerardi v. City of Bridgeport, 2007 Conn. Super. LEXIS 3446 (Conn. Super. Ct. Dec. 31, 2007) (holding that a company-owned vehicle is part of the employer's "premises" and can therefore be outfitted with GPS tracking, even without employees' knowledge).

states require employee consent before employers can track workplace equipment, like trucks.[338] Other state attempts to limit tracking equipment, however, do not extend to employer-owned vehicles and other equipment.[339] A few states have also prohibited employers from requiring employees to implant RFID devices including, unsurprisingly, Wisconsin.[340] And still others regulate the collection, storage, and use of biometric data.[341]

States also recognize common law claims for privacy intrusions, although they are typically limited to only highly offensive invasions into areas over which employees have a reasonable expectation of privacy—a high bar that excludes most workplaces.[342] Indeed, to the extent that employees have any common law privacy interests, they are generally nullified by employers' implementation of policies that make clear that employees forgo those interests when using employer-owned computers and other equipment.[343] That said, in extreme cases, courts may recognize a violation of privacy that results from an employer's surreptitious monitoring of sensitive employee information.[344]

These privacy laws mirror the shortcoming of our workplace regulatory system as a whole: a patchwork of federal and state legislation that leaves huge gaps in protection for a large swath of workers under numerous legal situations. Strategies to address these problems are similar as well. Continuing to reactively address issues once they become serious enough to demand policymakers' attention may be a good tactic if you're playing whack-a-mole, but it is not sufficient to tackle the myriad issues that affect workers across the economy. This is especially true when the workplace is undergoing the drastic technological changes that are underway.

The depth and breadth of monitoring technology warrants a policy response of similar scope. Ideally, this response would involve a broad federal privacy statute that protects workers, either as a primary or ancillary goal. Up to now,

338. *See, e.g.*, CAL. PENAL CODE § 637.7 (2019). Some bills in Congress, like the Location Privacy Protection Act, S. 2171, 113th Cong. (2013), and the Geolocation Privacy and Surveillance Act, H.R. 1062, 115th Cong. (2017), would accomplish much the same, but have yet to gain much traction.

339. Sprague, *supra* note 335, at 245.

340. Kelsi Loos, *Maryland Lawmaker Takes Aim at Mandatory Microchipping*, GOV'T TECH. (Mar. 15, 2018), https://www.govtech.com/policy/Maryland-Lawmaker-Takes-Aim-at-Mandatory-Microchipping.html (noting prohibitions in California, Missouri, North Dakota, Oklahoma, and Wisconsin).

341. *See* Erin Marine, *Biometric Privacy Laws: Illinois and the Fight Against Intrusive Tech*, FORDHAM J. CORP. & FIN. L. (Mar. 20, 2018), https://news.law.fordham.edu/jcfl/2018/03/20/biometric-privacy-laws-illinois-and-the-fight-against-intrusive-tech/; Paul Shukovsky, *Washington Biometric Privacy Law Lacks Teeth of Illinois Cousin*, BLOOMBERG NEWS (July 18, 2017, 7:26 AM), https://perma.cc/3PQH-92SL.

342. RESTATEMENT OF EMPLOYMENT LAW § 7.01 (AM. LAW INST. 2015); RESTATEMENT (SECOND) OF TORTS § 652B (AM. LAW INST. 1977); Ajunwa et al., *supra* note 12, at 748; Sprague, *supra* note 335, at 225.

343. TBG Ins. Servs. Corp. v. Superior Court, 117 Cal. Rptr. 2d 155, 163 (Cal. Ct. App. 2002); Elizabeth C. Tippett, *The Legal Implications of the MeToo Movement*, 103 MINN. L. REV. 229, 282–83 (discussing computer use policies).

344. For instance, in *Pulla v. Amoco Oil Co.*, 72 F.3d 648 (8th Cir. 1995), an employer reviewed the credit card receipts of an employee, who worked in the employers' credit card department and was allowed to use a company card for personal reasons, to determine if he was abusing sick leave. A jury found that this conduct was a tortious invasion of privacy. *Pulla*, 72 F.3d at 653.

privacy laws have either been broad, while exempting workers from most protections,[345] or been focused on very narrow issues, like employers demanding employees' social media passwords.[346] But this approach will continue to leave workers largely at the mercy of employers' voluntary privacy practices.

The specifics of any future privacy legislation are beyond the purview of this Article, but I will note some general approaches worth pursuing. One is a general privacy statute that is not limited to the workplace, which might be more politically feasible. A robust privacy law that was sensitive to some of the unique issues related to the workplace[347] would go a long way to protect workers. Indeed, calls for such legislation have been rising throughout the world,[348] although thus far with little success. The European Union's General Data Protection Regulation ("GDPR"),[349] however, provides an admittedly flawed model of such comprehensive privacy legislation.

The GDPR is responsible for the millions of emails sent across the world in 2018 to notify users of online companies' privacy policies.[350] Although the GDPR provides some meaningful notice requirements and protections for the use and collection of personal data,[351] those protections are fairly modest compared to the expanding potential of monitoring technology. Moreover, its relevancy to the workplace is extremely limited. In particular, the GDPR allows the use of personal data for "legitimate interests," which appear to cover most valid business concerns.[352] The GDPR also allows waiver of its privacy rights, although it is an open question whether an employer can lawfully pressure an employee to consent under the statute.[353] That said, the general approach of GDPR—a statute that broadly protects certain types of personal information in many different situations—is not only more realistic politically than workplace-focused legislation,

345. *See supra* notes 311–21 and accompanying text.

346. *See supra* note 335.

347. *See supra* notes 341–42.

348. Arjun Kharpal, *Google's Top Policy Chief Calls for 'Common Rules of the Road' Globally for Tech Regulation*, CNBC: TECH (Feb. 10, 2019, 6:20 AM), https://www.cnbc.com/2019/02/10/google-policy-chief-tech-regulation-global-common-rules.html.

349. Regulation 2016/679, of the European Parliament and of the Council of 27 Apr. 2016 on the Protection of Natural Persons with Regard to the Processing of Personal Data and on the Free Movement of Such Data, and Repealing Directive 95/46/EC, art. 99, 2016 O.J. (L 119) 1, 87.

350. Megan Leonhardt & Alix Langone, *You've Probably Received a Ton of Privacy Policy Emails This Week. Here's What's Changing*, MONEY: EVERYDAY MONEY: PRIVACY (May 24, 2018), http://money.com/money/5254754/gdpr-privacy-policy-rules/.

351. In 2019, a French agency issued an almost $57 million GDPR fine against Google for failing to fully disclose to users how the company collected and used personal information, and for failing to obtain consent to show personalized ads. Tony Romm, *France Fines Google Nearly $57 Million for First Major Violation of New European Privacy Regime*, WASH. POST: EUROPE (Jan. 21, 2019, 11:54 AM), https://www.washingtonpost.com/world/europe/france-fines-google-nearly-57-million-for-first-major-violation-of-new-european-privacy-regime/2019/01/21/89e7ee08-1d8f-11e9-a759-2b8541bbbe20_story.html.

352. *See supra* note 349, at 42.

353. *Id.* at 6; Miriam Kullman, Discriminating Job Applicants Through Algorithmic Decision-Making 7–8 (Jan. 1, 2019) (unpublished manuscript) (https://ssrn.com/abstract=3373533).

but can also ensure that all workers are covered, regardless of their employee classification.[354]

If the U.S. were to enact a broad privacy statute, it must define both the type of information being protected and exceptions, as some forms of monitoring will be justified, such as rooting out illegal activity.[355] There is general agreement, however, that basic privacy rights require some level of freedom from regular, unjustified monitoring.[356] But implementing that goal is easier said than done because it requires the identification of the types of personal information that should be entitled to protection and the types that should be excluded. Reasonable minds can differ on this question, but information such as the medical and genetic data that is partly covered by the ADA and GINA is a good starting point.[357] Similarly, a general privacy statute could also prohibit the collection and use of data to make predictions or diagnoses of medical conditions or traits.[358] A closer call would be the use of such information to predict employment-related attributes, such as workers' propensity to follow rules, work hard, and other conduct that is not strictly medical in nature.[359] Off-duty conduct might be another fault line. Although American law currently does virtually nothing to protect the off-duty conduct of private-sector employees,[360] a new privacy statute should consider restrictions on employers' ability to collect information from employees when they are away from work.[361] In addition, any legislation that is to provide meaningful protection for workers must prohibit or

354. *But see* Ajunwa et al., *supra* note 12, at 774 (criticizing broad privacy legislation as failing to provide protections tailored to specific types of data).

355. Alex Horton, *Kellyanne Conway Said Finding Leakers is Easier That Leakers Think. She Might be Right*, WASH. POST: POLITICS (Aug. 5, 2017, 8:09 AM), https://www.washingtonpost.com/news/the-fix/wp/2017/08/05/kellyanne-conway-said-finding-leakers-is-easier-than-leakers-think-she-might-be-right/ (describing how cloud-based software and analytics can sift through digital information to narrow sets of employees who potential leaked information).

356. Julie E. Cohen, *What Privacy is For*, 126 HARV. L. REV. 1904, 1905, 1917–18 (2014).

357. GINA's impact has been limited, with no successful discrimination claims in the ten years since its enactment; it has instead mainly served as a barrier against unlawful requests for genetic information. Areheart & Roberts, *supra* note 287, at 714. Professors Areheart and Roberts, however, argue that GINA could serve as a blueprint for a broader privacy legislation. For instance, GINA's prohibition on acquiring and using genetic information could be applied to information relevant to anti-discrimination laws or could serve as a template for bans on the use of certain employment data, such as employees' off-duty activity, health, or other personal information. *Id.* at 772–74. The Affordable Care Act provides similar, albeit somewhat broader, protection by prohibiting discrimination based on an individual's health status. Mark A. Rothstein, *GINA at Ten and the Future of Genetic Nondiscrimination Law*, HASTINGS CTR. REP. 1, 2 (2018).

358. *See* Abdullah & Choudhury, *supra* note 186.

359. *See, e.g.*, FED. TRADE COMM'N, PRIVACY ONLINE: A REPORT TO CONGRESS 7 (1998) (setting forth "Fair Information Practice Principles": notice/awareness; choice/consent; access/participation; integrity/security; and enforcement/redress), https://www.ftc.gov/sites/default/files/documents/reports/privacy-online-report-congress/priv-23a.pdf; Paul Ohm, *Sensitive Information*, 88 S. CAL. L. REV. 1125, 1170 (2015) (proposing method for determining types of sensitive information, such as many types of health, education, sexual information); OECD, *OECD Guidelines Governing the Protection of Privacy and Transborder Flows of Personal Data* 11, 14 (2013), https://www.oecd.org/sti/ieconomy/2013-oecd-privacy-guidelines.pdf (recommending basic principles for the collection and use of private data).

360. In contrast, countries like France and Germany have begun to regulate employers' ability to demand access to off-duty employees. *See generally* Paul M. Secunda, *The Employee Right to Disconnect*, NOTRE DAME J. INT'L & COMP. L. 1, 13 (2019).

361. Ajunwa et al., *supra* note 12, at 774.

limit employers' ability to demand that workers waive their privacy rights.[362] Additionally,
any work-related exceptions should be narrowly focused on genuine business needs.[363] Finally, procedural requirements such as notifying employees before certain information is collected and used could mitigate some privacy concerns.[364]

A still broader approach would be to enact a just-cause termination law that would require a legitimate business justification for firing workers. Because all but one state in the U.S. uses at-will employment as the default, "consent" means almost nothing for the majority of workers who do not have contractual or statutory job-security protections.[365] Employers can lawfully demand consent from these workers as a prerequisite for their jobs. Therefore, establishing a national just-cause default, as exists in some form in virtually every other country,[366] would go far in removing the problem with consent. If a refusal to waive privacy rights is not considered "just cause," employers would need to entice workers with something more than continued employment to secure privacy waivers. But this is not an insignificant "if." Just-cause protection by itself will fail to protect against the many privacy intrusions that employers could characterize as fulfilling valid business goals.[367] More specific regulation is needed to address those situations, such as making any workplace privacy protections nonwaivable in most instances.

Although some of these options, such as just-cause legislation, may be unattainable in the current political climate, I am optimistic that we will see some attempt to regulate privacy in the near future. In part because of the immediacy of this issue, as well as its significance to a large and diverse set of people, it is likely that the chorus for privacy regulation will continue to grow. Indeed, we have already witnessed enough public concern that even the tech industry has indicated some openness to federal privacy legislation.[368] As a result, I expect a legislative response at some point; the question is whether such legislation will be comprehensive enough to adequately address companies' burgeoning ability to monitor and control its workers.

362. *See infra* note 365.

363. Ajunwa et al., *supra* note 12, at 775.

364. Kate Crawford & Jason Schultz, *Big Data and Due Process: Toward a Framework to Redress Predictive Privacy Harms*, 55 B.C. L. Rev. 93, 126–27 (2014). In 2014, the White House detailed various privacy initiatives, including ensuring access to health, tax, home energy usage, and student loan information; it also described its Consumer Privacy Bill of Rights, which advocated for individual control, transparency, respect for context, security, access and accuracy, focused collection, and accountability. EXEC. OFF. OF THE PRESIDENT, BIG DATA: SEIZING OPPORTUNITIES, PRESERVING VALUES 13–14, 19–20 (2014), https://obamawhitehouse.archives.gov/sites/default/files/docs/big_data_privacy_report_mma_1_2014.pdf.

365. Samuel Estreicher & Jeffrey M. Hirsch, *Comparative Wrongful Dismissal Law: Reassessing American Exceptionalism*, 92 N.C. L. REV. 343, 347–48 (2014) (describing at-will employment which, with some exceptions, allows any party to end the employment relationship for any reason); Daniel J. Solove, *Introduction: Privacy Self-Management and the Consent Dilemma*, 126 HARV. L. REV. 1880, 1880–81 (2013).

366. Estreicher & Hirsch, *supra* note 365, at 445–46.

367. *See supra* notes 289, 305–08.

368. David Shepardson, *Tech Companies Back U.S. Privacy Law if it Preempts California's*, REUTERS (Sept. 26, 2018, 2:35 PM), https://www.reuters.com/article/us-usa-tech-congress-idUSKCN1M62TE.

D. Regulating Automated Personnel Systems: What Happens When Your Computer Acts Like a Bigot?

Emerging technologies, particularly AI, will transform employers' approach to personnel management.[369] Indeed, AI is already making significant inroads at the biggest companies, particularly as the driver of "predictive analytics," which employers use to improve their personnel decisions.[370] One survey found that around half of the organizations use AI for recruiting higher-skilled workers, with over a third of those using the technology for tasks such as selecting, interviewing, and onboarding candidates.[371] Other companies rely extensively on algorithmic "bosses" to handle most communications with workers.[372] Some employers have become adept at using technology to manipulate workers' "free choice" of when to work,[373] such as the psychological nudges that Uber uses to encourage drivers to accept fares at opportune times.[374] Still others employ AI for scheduling and other operational decisions that impact working conditions.[375] These uses of AI raise many legal questions.

Take the recent controversy surrounding employers' increased use of on-time scheduling. Businesses understandably like being able to schedule workers more precisely, which allows them to avoid paying wages when workers are not needed and to increase work during peak times. Currently, data analytics already provides a great degree of scheduling precision—so much so that it causes substantial problems for workers.[376] This is especially true for workers with multiple jobs, as it is hard to juggle different work schedules at the last minute. AI has the potential to make this issue far worse, as it can greatly enhance employers' ability to implement on-demand scheduling, thereby making it even less predictable for workers.[377] On the other hand, AI could also help mitigate this problem if employers are either required or volunteer to do so.[378]

369. Pauline T. Kim, *Data-Driven Discrimination at Work*, 58 WM. & MARY L. REV. 857, 860 (2017).

370. *Id.* at 901.

371. MODERN HIRE, STATE OF AI IN TALENT ACQUISITION, MONTAGE RESEARCH REPORT 1, 5 (2018) (surveying talent acquisition recruiters and decisionmakers, finding that AI is used by 34% of the organizations for selecting candidates, 36% for interviewing, and 37% for onboarding), https://engage.montagetalent.com/resources/artificial-intelligence-in-talent-acquisition.

372. Rosenblat, *supra* note 56.

373. Ryan Calo & Alex Rosenblat, *The Taking Economy: Uber, Information, and Power*, 117 COLUM. L. REV. 1623, 1630 (2017).

374. Scheiber, *supra* note 55.

375. *See* Cherry, *Beyond Misclassification*, *supra* note 271, at 596–97; *supra* notes 376–78 and accompanying text.

376. The problem has become so acute that states and localities have begun restricting employers' use of on-time scheduling. *Shifting Shifts: The Tight Labour Market is Making Unskilled Work More Predictable*, ECONOMIST (Dec. 8, 2018), https://www.economist.com/united-states/2018/12/08/the-tight-labour-market-is-making-unskilled-work-more-predictable.

377. Matthew Lynley, *Legion Raises $10.5M to Roll Out an Automated Employee Scheduling Tool*, TECHCRUNCH (Sept. 27, 2017, 6:00 AM), https://techcrunch.com/2017/09/27/legion-raises-10-5m-to-roll-out-an-automated-employee-scheduling-tool/.

378. *See id.*; Valery Yakubovich, Roman V. Galperin, & Mouna, El Mansouri, *Timing is Money: The Flexibility and Precariousness of Login Employment*, ACAD. MGMT. ANN. MEETING PROC. (2019) (discussing work

One of the more pressing issues related to AI—and therefore the focus of this Section—is employment discrimination, for which AI promises both opportunities and risks. If used properly, AI can help identify and root out irrational and biased decision-making.[379] AI's promise lies in its ability to analyze employment data to look for evidence of bias that may not be readily apparent to humans—a promise that Google and others have been actively selling to employers in recent years.[380] Indeed, the Equal Employment Opportunity Commission ("EEOC"), the agency tasked with enforcing most federal employment discrimination laws, has begun using AI to aid its own anti-discrimination efforts.[381] Yet, there are many hurdles to this use of AI to mitigate discrimination, particularly access to good data and the potential legal or practical disincentives to highlighting existing discrimination.[382] And even if employers have a genuine desire to eradicate discrimination, there are questions whether using AI to do so would be lawful. For example, if an employer trained an AI algorithm to identify applicants who are members of a protected class, such as race or sex, to reduce discrimination it may open itself up to a reverse discrimination suit by other applicants.[383] And even if an employer did not explicitly engage in such labeling, other variables may be so closely linked with membership in a protected class that their use produces the same result.[384] Despite these hurdles, however, many companies are already exploring AI as a means to address diversity and discrimination issues.[385] But what if those attempts go awry? What if, rather than reducing discrimination, the AI algorithm *causes* it? In that case, questions arise regarding the apportionment of liability. In particular, if an AI program is responsible for some or all of a hiring decision, does the employer possess the necessary intent or culpability to establish an employment discrimination claim?

To address this liability question, one must first understand how AI could allow or cause discrimination. Data is the key.[386] AI is only as good as the data it uses to learn, so if an employer has a workforce that is not diverse—whether

systems that allowed workers to commit to a certain schedule in exchange for getting more work), https://journals.aom.org/doi/10.5465/AMBPP.2019.12500abstract.

379. Kim, *supra* note 369, at 872–73 (describing attempts to use data analytics to reduce employment discrimination); Interview with Lawrence Carin, *supra* note 40 (arguing that AI can do a good job inferring biases against certain categories of individual).

380. Bodie et al., *supra* note 52, at 1011–12; Farhad Manjoo, *The Happiness Machine: How Google Became Such a Great Place to Work*, SLATE (Jan. 21, 2013, 5:41 AM), https://slate.com/technology/2013/01/google-people-operations-the-secrets-of-the-worlds-most-scientific-human-resources-department.html (describing Google's use of AI to improve working conditions).

381. Paige Smith, *Machine Learning Deployed to Help EEOC Predict Discrimination*, BLOOMBERG L. (Dec. 26, 2018, 10:17 AM), https://news.bloomberglaw.com/daily-labor-report/machine-learning-deployed-to-help-eeoc-predict-discrimination.

382. Evidence that an employer was aware that a step in its selection process was biased could be used to show intent to discriminate; employers may also be reticent to use or correct AI if it forces them to undertake expensive changes. Kim, *supra* note 369, at 897, 924–25.

383. *See id.* at 867.

384. Solon Barocas & Andrew D. Selbst, *Big Data's Disparate Impact*, 104 CALIF. L. REV. 671, 691–92 (2016).

385. STATE OF AI IN TALENT ACQUISITION, *supra* note 371, at 7 (finding that 38% of surveyed large organizations are trying to us AI to eliminate bias and 35% to meet diversity goals).

386. Bodie et al., *supra* note 52, at 1015–17.

because of past discrimination or simply because certain types of people rarely seek out that type of work—then a program using that data will likely reflect that lack of diversity.[387] In other words, the program will exclude these underrepresented applicants, even if they would have been valuable workers. Another issue is that AI generally looks for patterns but does not question whether those patterns are based on causation—and thus identify factors that are really drivers of better work performance—or random correlation.[388] Finally, merely defining what it means to be a good worker, which is ostensibly the goal, is not easy and involves subjective judgments that can introduce bias into the process.[389]

Amazon's recent experience with AI highlights many of these problems. The company, known for its data-driven personnel policies,[390] recently abandoned a multi-year project to develop AI for hiring decisions because the resulting algorithm was explicitly biased against female applicants.[391] The reason for this bias was that the program trained with a dataset made up of past Amazon applicants, who were predominately men. As a result, the algorithm essentially learned to correlate "male" with "good employee"; it simply did not see enough females to suggest otherwise. Accordingly, the algorithm explicitly rejected any applicant it could identify as female, such as individuals who graduated from women's colleges or were members of female-oriented organizations.[392] A similar problem can also occur if AI overgeneralizes information. For instance, different populations or cultures use distinct facial cues and other signifying expressions.[393] Thus, an AI algorithm that analyzes facial cues from a dataset dominated by one population may misinterpret cues from individuals in other populations.[394] Finally, AI's learning process may not work well with employment. In contrast to analyses of medical scans or financial transactions, there are few opportunities for employers to correct an algorithm's learning process by identifying proper and improper decisions.[395]

387. Barocas & Selbst, *supra* note 384, at 680, 684; Interview with Junier Oliva, *supra* note 17 (analogizing to an AI analysis of a data set that doesn't include someone with umbrella; if so, the program will never choose anyone with umbrella); *cf.* Sandra G. Mayson, *Bias In, Bias Out*, 128 YALE L.J. 2218 (discussing racial bias in predicting crime).

388. Kim, *supra* note 369, at 875, 880–81.

389. Barocas & Selbst, *supra* note at 384, at 679–80, 688.

390. *See* Jodi Kantor & David Streitfeld, *Inside Amazon: Wrestling Big Ideas in a Bruising Workplace*, N.Y. TIMES (Aug. 15, 2015), https://www.nytimes.com/2015/08/16/technology/inside-amazon-wrestling-big-ideas-in-a-bruising-workplace.html?module=inline.

391. Jeffrey Dastin, *Amazon Scraps Secret AI Recruiting Tool that Showed Bias Against Women*, REUTERS (Oct. 9, 2018, 10:12 PM), https://www.reuters.com/article/us-amazon-com-jobs-automation-insight-idUSKCN1MK08G.

392. *Id.*

393. Marianna Pogosyan, *Emotion Perceptions Across Cultures*, PSYCHOL. TODAY (Oct. 9, 2016), https://www.psychologytoday.com/us/blog/between-cultures/201610/emotion-perception-across-cultures.

394. Interview with Collin Lynch, *supra* note 50; *cf.* Joy Buolamwini & Timnit Gebru, *Gender Shades: Intersectional Accuracy Disparities in Commercial Gender Classification*, 81 PROC. MACHINE LEARNING RES. 77 (2018) (finding that three commercially available facial recognition programs incorrectly classified light-skinned men no more than 0.8% of the time, but dark-skinned women 20%-34.7% of the time).

395. Kim, *supra* note 369, at 882 (noting that an employer will not know if a rejected applicant would have been a good employee and employers' biases, whether intentional or not, can inhibit the correction process).

As Amazon's failed experiment demonstrates, an AI program's training is critical to its success or failure. In an ideal world, employers would randomly hire a qualified sample of individuals from the relevant labor market and use AI to analyze the types of workers who produced the best results. This, of course, is completely unrealistic, so responsible employers must seek acceptable second-best solutions. This means, among other things, that employers using AI will need to collect the best data available, avoiding homogenous or biased samples. And to prevent a similar "garbage-in-garbage-out" problem in defining a "good worker,"[396] employers should first use AI to analyze their current personnel practices to identify areas of bias and correct those issues before having an algorithm learn how to make personnel decisions.[397] And, once such a program is in place, its goals should include more than just individual performance. Instead, employers should take advantage of AI's ability to analyze the performance of teams and perhaps identify different types of workers who, in combination with others, are more successful than they appear to be in isolation.[398]

That a company as large and well-versed in technology as Amazon was incapable of developing an unbiased hiring program speaks volumes about the difficulty in using AI for personnel decisions. It should also serve as a strong warning to other companies about the limits of AI. There are right ways and wrong ways to use AI technology and Amazon's experience demonstrates that the right way can be extremely difficult. To its credit, Amazon never implemented the program. But others may not be so careful or responsible. Some companies may be familiar with AI and other technology but are insensitive to discrimination issues.[399] Other companies may be less tech-savvy and become so blinded by the novelty of AI that they fail to realize that, like all tools, it is appropriate for some uses but not others.

The potential for AI to cause discriminatory personnel decisions begs the question whether there are effective legal means to challenge these decision-making processes? The short answer, for now at least, is "not really." Like other emerging technologies, AI is so fundamentally different from traditional employment practices, that our antidiscrimination laws are poorly equipped to handle the challenges it poses.[400]

In exploring this question, I will focus on Title VII of the Civil Rights Act,[401] which is the primary federal employment discrimination statute. Although other statutes differ from Title VII in important ways, for present purposes Title VII adequately represents the field. A traditional Title VII discrimination claim is referred to as "disparate treatment," which involves an adverse employ-

396. *See* Barocas & Selbst, *supra* note 384, at 679–80, 688.

397. Interview with Lawrence Carin, *supra* note 40.

398. Bodie et al., *supra* note 52, at 972–73 (describing Google's "Project Aristotle," a data analysis of work teams); Interview with Lawrence Carin, *supra* note 40.

399. *See, e.g.*, Ifeoma Ajunwa, *Age Discrimination by Platforms*, 40 BERKELEY J. EMP. & LAB. L. 1 (2019) (discussing corporate use of age-based targeting AI recruitment methods).

400. Kim, *supra* note 369, at 865.

401. 42 U.S.C. §§ 2000e–2000e-17 (2018).

ment action that is motivated by the victim's race, sex, religion, or other protected class.[402] The need to find motivation or intent triggers a critical problem in challenging a discriminatory AI program. Unless victims can prove that the employer was aware of the discrimination, they will be unable to win an intent-based disparate treatment claim.[403] The employer can simply, and successfully, argue that it didn't know what the program was doing.

There is an alternative to a disparate treatment claim. Under the "disparate impact" theory of discrimination, an employer can violate Title VII for using a facially neutral employment practice that results in discrimination and is not shown to be job-related and a business necessity.[404] Historically, the disparate impact theory primarily addressed employers' use of testing to predict future employee performance, balancing the desire to eradicate workplace discrimination against properly validated tests that satisfy genuine business needs.[405] Although disparate impact now applies to a variety of policies, employment tests provide an obvious parallel to AI as both selection devices can produce discriminatory results even if implemented in good faith. Consequently, disparate impact appears to be a good fit for discriminatory AI. Even when challenging traditional practices, however, disparate impact claims are notoriously difficult to win.[406] Those difficulties become even more acute with AI.

One major problem with using the disparate impact theory to challenge AI is the job-related and business necessity defense. By definition, when an AI program identifies a positive characteristic, it has found a link to better job performance.[407] This leads to a likely dispositive question: is AI's finding of correlation enough to show job-relatedness and business necessity?[408] For instance, Amazon's hiring program found that being male was correlated with effective performance; if the program was implemented and later challenged, the company could argue that program identified job-related characteristics that were necessary to the business. But litigating that issue can be tricky. Under the current judicial understanding of Title VII, plaintiffs and the court would need access to

402. *Id.* § 2000e-2(a)(1).

403. Charles A. Sullivan, *Employing AI*, 63 VILL. L. REV. 395, 397–98 (2018). *But see* Stephanie Bornstein, *Antidiscriminatory Algorithms*, 70 ALA. L. REV. 519, 561–62 (2018) (arguing that some forms of AI discrimination should be considered disparate-treatment violations under the stereotyping theory, such as using metrics that may be associated with a relevant group).

404. Plaintiffs can theoretically still win a disparate impact claim after an employer shows job-relatedness and business necessity by showing that alternative practice existed that leads to less-discriminatory results, but in practice, plaintiffs almost never win on this point. 42 U.S.C. § 2000e-2(a)(2); LEX K. LARSON, EMPLOYMENT DISCRIMINATION § 24.03 (2d ed. 1975).

405. Bodie et al., *supra* note 52, at 1023–24.

406. Michael Selmi, *Was the Disparate Impact Theory a Mistake?*, 53 UCLA L. REV. 701, 740–43 (2006). The disparate impact analysis under the Age Discrimination in Employment Act is even more challenging for plaintiffs. Smith v. City of Jackson, 544 U.S. 228, 238 (2005) (establishing employer defense if challenged practice was "based on reasonable factors other than age").

407. *See, e.g.*, Barocas & Selbst, *supra* note 384 at 689–90.

408. Kim, *supra* note 369, at 866–67, 907–08, 920–21; Sullivan, *supra* note 403, at 420; *see also* James Grimmelmann & Daniel Westreich, *Incomprehensible Discrimination*, 7 CAL. L. REV. ONLINE 164, 170 (2017) (arguing that an algorithm's finding of correlation should not be sufficient to satisfy defense).

the program and the data it trained on to present a disparate impact challenge;[409] however, this information may be deemed private and raise intellectual property issues, especially if an employer is using third-party technology. Moreover, even if they have access to this information, the parties and judges (as well as, shudder the thought, juries) will need to develop expertise with this new technology.

If these hurdles can be overcome, then courts will need to address whether AI correlations can ever satisfy the job-related and business necessity defense and, if so, under what conditions. On this score, we do have some useful guidance. The EEOC has long promulgated guidelines for validating employment tests and other selection procedures under the disparate impact theory.[410] The agency should update these guidelines to account for special issues associated with AI.[411] Indeed, because of the difficulty in developing adequate data sets, as well as possible coding bugs and statistical uncertainties, it is crucial that AI decision-making schemes use valid and robust techniques to ensure they are not producing undesirable outcomes.[412] What might AI validation guidelines entail? Among the practices that should be considered are transparency and notice, program design, procedural requirements, audits, and employee input.[413]

The lack of transparency in most AI analyses is a serious cause for concern. Because AI learns through complicated, iterative analyses of data, the bases for a program's decision-making is often unclear. This lack of transparency, often referred to as the "black box" problem, could act as a mask for discrimination or other results that society deems unacceptable.[414] Imagine if Amazon had not been evaluating its AI program and ended up using an anti-female hiring process without knowing that it was causing discrimination or why. This problem is aggravated when an employer fails to notify employees that it is using AI. Increased transparency, although not a cure-all,[415] would also help mitigate the "black box" perception problem and provide more details about why the algorithm is making its choices.[416]

409. Kim, *supra* note 369, at 920–21.

410. EEOC Uniform Guidelines on Employee Selection Procedures, 29 C.F.R. § 1607 (2018).

411. Alan G. King & Marko J. Mrkonich, *Big Data and the Risk of Employment Discrimination*, 68 OKLA. L. REV. 555, 573–75 (2016) (arguing that current guidelines could be used for AI); Sullivan, *supra* note 403, at 421 (discussing current guidelines and shortcomings as applied to AI). Courts would need to defer to the EEOC's updated guidelines more than currently, however, or Congress would need to codify them, to have any lasting impact. Bodie et al., *supra* note 52, at 1033–37.

412. Interview with Junier Oliva, *supra* note 17 (describing use of auto-pilot technology on airplanes, which is frequently validated to ensure that AI systems are producing desirable and safe results).

413. Micah Altman et al., *A Harm-Reduction Framework for Algorithmic Fairness*, 16 IEEE SECURITY & PRIVACY 34, 36 (2018) (advocating that use of algorithms for policing and other areas should identify major design choices, assess algorithm's effects, measure well-being and ethical choices, and recognize potential discriminatory effects of design).

414. Kim, *supra* note 369, at 881, 888–89.

415. Andrew D. Selbst & Solon Barocas, *The Intuitive Appeal of Explainable Machines*, 87 FORDHAM L. REV. 1085 (2018) (explaining limitations of requiring explanations of machine learning).

416. *See* EXEC. OFFICE OF THE PRESIDENT, *supra* note 364, at 17; Miriam A. Cherry, *The Gamification of Work*, 40 HOFSTRA L. REV. 851, 857 (2012); Crawford & Schultz, *supra* note 364, at 126. *But see* Joshua A. Kroll et al., *Accountable Algorithms*, 165 U. PA. L. REV. 633, 657 (2017).

Computer science techniques—such as designing algorithms to avoid discrimination, make some random selections, and employ fairness constraints[417]—can also help prevent discriminatory results.[418] Moreover, procedural protections would better ensure fair and accurate analyses, such as requiring employers to notify workers of the use of AI and providing workers the opportunity correct any erroneous data.[419] Similarly, including workers in the process, such as helping to develop the target metrics used by the AI program, could garner more buy-in and possibly avoid missteps.[420] Finally, ensuring that programs are audited for discriminatory effects could provide a useful backstop.[421]

Although not perfect, AI validation guidelines would go a long way in helping to adjust the current Title VII disparate impact regime to the challenges posed by AI. But a more robust response would be to create either a special AI disparate impact rule or an entirely new disparate impact analysis that better fits AI. The primary aim for such a reform would be to provide employers with incentives to use AI in an appropriate manner. The strongest incentive would occur under a strict liability regime, although any significant increase in the risk of liability would be beneficial. A new liability standard does not even require new legislation, as the text of Title VII could support strict liability.[422] This, however, would require the Supreme Court to undergo a dramatic shift from its current, judicially created, proof-shifting analysis.[423]

In sum, AI offers both promise and risk, and our workplace laws need to be prepared for the consequences. Indeed, employers are already using AI, and it is only a matter of time before we see legal challenges to the results. Companies like Amazon are not the main concern, as they have the resources and reputational incentives to sweat the details needed to use AI in an ethical and nondiscriminatory fashion. The more serious danger involves smaller or more insulated employers that are attracted to a new technology like AI—potentially for its ability to provide a layer of insulation in the decision-making process—and have little incentive to expend the time and money to avoid discriminatory outcomes.

417. *See* Jason R. Bent, *Is Algorithmic Affirmative Action Legal?*, 108 GEO. L.J. (forthcoming 2020) (discussing legality of using algorithms to achieve fairness based on race, sex, and other protected characteristics).

418. Kroll et al., *supra* note 416, at 683–92.

419. Danielle Keats Citron & Frank Pasquale, *The Scored Society: Due Process for Automated Predictions*, 89 WASH L. REV. 1, 20–22 (2014); Kim, *supra* note 369, at 899. The UK's Data Protection Act provides similar protections for employment tests.

420. *See* Barocas & Selbst, *supra* note 384; Bodie et al., *supra* note 52, at 1033–37.

421. Pauline T. Kim, *Auditing Algorithms for Discrimination*, 166 U. PA. L. REV. ONLINE 189 (2017); *cf.* Andrew D. Selbst, *Disparate Impact in Big Data Policing*, 52 GA. L. REV. 109, 110 (2017) (advocating "algorithmic impact statements," similar to environmental impact statements, for predictive policing technology).

422. Very briefly, this theory argues that an employer's good-faith use of discriminatory AI violates two related provisions of Title VII that prohibit 1) adverse employment actions made "because of" an individual's protected class, 42 U.S.C. § 2000e-2(a)(1) (2018); and 2) actions that "limit, segregate, or classify" individuals in a way that hurts their employment conditions "because of" their protected class, *id.* § 2000e-2(a)(2). In other words, even if the employer did not intend for the program to discriminate, its reliance on such a program would violate these provisions by failing to hire applicants and classifying them "because of" their sex. Sullivan, *supra* note 403, at 12, 16–17.

423. *See supra* note 404.

Some of those companies could even use AI as a mask for intentional discrimination.[424] The risks of such transgressions necessitate an anti-discrimination regime that recognizes the shortcomings of AI and provides companies sufficient incentive to use the technology in a responsible fashion.

E. Regulating Workplace Safety: Stopping the Killer Robots

The intense media scrutiny of recent fatalities involving Teslas and other autonomous vehicles illustrates the fear associated with new technology.[425] Many of these technologies promise increased safety overall,[426] but that potential comes with risks. There are inherent difficulties associated with any substantial changes in the way people do things, particularly when they involve speeding vehicles, fast moving robots, and the like. Thus, recognizing and addressing the potential dangers of technology is essential to its widespread adoption and to ensure that workers who interact with these technologies remain safe.

The increasingly blended workplace, where human works interact with robots, AI, and other technology, raises numerous liability related questions should accidents or other harms occur. For instance, if an autonomous vehicle causes a collision that injures a worker, who is responsible? The employer that required the worker to use the vehicle? The vehicle manufacturer? The company that built the monitoring hardware? The vehicle's software developer? Given the numerous and complex systems required to operate an autonomous vehicle, it may be difficult to apportion blame. In addition, it is unclear how much, if any, responsibility the employer should shoulder. Similar issues can arise with traditional vehicles,[427] but complexities of autonomous technology amplify things. Large car companies are sensitive to these concerns because of the potential for legal liability and damage to their brand, but smaller companies may be less so. Indeed, one start-up—essentially a single individual—has already developed an inexpensive way to turn non-autonomous cars into self-driving ones.[428] Companies like this are likely to lack the resources or incentives to adequately account for safety. As a result, absent appropriate regulation, workers will be at risk of serious injury or death.

Generally, the common-law tort system's basic framework for allocating blame can cope with the harms resulting from robots, autonomous vehicles, and

424. Bodie et al., *supra* note 52, at 1014; Kim, *supra* note 369, at 884.

425. *See supra* notes 155–59.

426. *See, e.g.*, *supra* note 160.

427. Robert L. Rabin, *Accommodating Tort Law: Alternative Remedies for Workplace Injuries*, 69 RUTGERS U. L. REV. 1119, 1128–29 (2017).

428. Andrew J. Hawkins, *George Hotz is on a Hacker Crusade Against the "Scam" of Self-Driving Cars*, VERGE (July 13, 2018, 9:00 AM), https://www.theverge.com/2018/7/13/17561484/george-hotz-comma-ai-self-driving-car-scam-diy-kit (also describing his opensource software that overrides cars' driver assist systems).

other emerging technologies.[429] But when tech-related injuries happen to employees, tort law is largely inapplicable.[430] Instead, as is no surprise at this point, we have a fragmented system of federal and state regulations to address these harms.

An overly simplified summary of workplace safety law is that it rests on two pillars: the federal Occupational Safety and Health Act[431] ("OSHA") and its state counterparts, as well as individual state workers' compensation laws.[432] Workers' compensation is essentially a scheme that funnels most workplace accidents into a mandated compensation plan.[433] Because it focuses on the results of an accident rather than the cause, new technology is unlikely to have a significant impact on workers compensation systems other than changing the number and causes of injuries. For instance, we would expect to see technology reduce the number of claims by making the workplace safer,[434] yet some technology may cause injuries, such as human-robot accidents. Accordingly, as long as states do not treat tech-related injuries differently than traditional ones, we are unlikely to see much impact on workers' compensation systems. But the issue is worth monitoring in case certain technologies end up materially changing the number or severity of workplace injuries. One scheme through which this monitoring could occur is OSHA and related workplace safety laws.

A thorough overview of OSHA is (well) beyond the scope of this Article,[435] but it is worth briefly describing the statute's capacity to address technology's impact on worker safety. OSHA, like workers' compensation and other workplace laws, protects only statutory employees, so workers classified as independent contractors are largely left on their own to seek redress—mainly via the tort system—for any injuries or health issues arising from work.[436] For covered employees, OSHA provides two main forms of protection. First is its general duty clause, which requires employers to provide a workplace "free from recognized hazards that are causing or are likely to cause death or serious harm."[437] The "likely to cause" language reflects OSHA's advantage over the workers compen-

429. *But see* Andrew D. Selbst, *Negligence and AI's Human Users*, 100 B.U. L. REV. (forthcoming 2020) (arguing that AI creates unique problems for negligence under tort law).

430. *See infra* note 436. Some of the same issues can arise when a third-party is injured by a worker using a certain technology, in which case the primary issue will be whether the employer is vicariously liable for any resulting liability. Rabin, *supra* note 427, at 1129.

431. 29 U.S.C. §§ 652–678 (2018).

432. *See* JEFFREY M. HIRSCH, PAUL M. SECUNDA, & RICHARD A. BALES, UNDERSTANDING EMPLOYMENT LAW (2nd ed. 2013).

433. MICHAEL C. DUFF, WORKERS' COMPENSATION LAW (2d ed. 2017).

434. *See supra* notes 55, 75, 101, 188.

435. *See* HIRSCH ET AL., *supra* note 432, at 231–53 (describing federal and state regulation of workplace safety and health).

436. OSHA uses the typical common-law test for employment. 29 U.S.C. § 652(6) (2018); *supra* note 266. It also excludes most public-sector employees, 29 U.S.C. § 652(5) (2018), although federal agencies must establish rules that are consistent with OSHA and states typically develop regulatory systems that, while varying in many ways, track OSHA. HIRSCH ET AL., *supra* note 432, at 252–53.

437. 29 U.S.C. § 654(a)(1) (2018).

sation system by imposing a duty on employers to prevent harm before it occurs.[438] Some risks emanating from emerging technologies will obviously fall under this clause, such as the well-known, serious potential for accidents involving autonomous vehicles.[439] But other looming dangers are unlikely to trigger the general duty clause, especially in the near term. This is because the clause requires a hazard to be *recognized* as causing or likely to cause death or serious harm.[440] Thus, unknown and underappreciated risks will not impose any duties on employers, nor will-known risks that fall short of "serious harm."[441] A further limitation is that even known hazards that cause serious harm trigger the general duty clause only when there exists a feasible method to correct the hazard.[442] As a result, the general duty clause will fail to provide much, if any, protection for some risks associated with many new technologies.

The Occupational Safety and Health Administration (which I'll refer to as the "agency" to avoid confusion with the statute) also has the ability to promulgate regulations addressing specific workplace hazards.[443] Among the many problems with OSHA's notoriously cumbersome and inadequate enforcement scheme,[444] however, is that its rulemaking process is quite time-consuming and requires a substantial amount of evidence to survive judicial review.[445] As a result, the agency is often very slow to address workplace safety issues, particularly new hazards; indeed, the vast majority of "interim" standards established when the statute went into effect in 1971 have not been replaced.[446] It is no surprise, therefore, that there are no permanent standards for even relatively well-established technology like robotics.[447] That said, the agency does provide guidance for employers to improve robotics safety, but such guidance lacks teeth because the agency cannot mandate or enforce their recommendations.[448]

438. 29 C.F.R. § 1903.1 (2018). The threat of workers' compensation liability can incentivize employers to provide a safer workplace, similar to the potential of OSHA fines; however, workers' compensation laws impose no affirmative duty to address workplace safety. 29 U.S.C. § 666(b) (2018).

439. Although some may argue that autonomous vehicles or other technology are not "*likely* to cause" harm. *See supra* note 160.

440. Nat'l Realty & Constr. Co. v. OSHRC, 489 F.2d 1257, 1265 (D.C. Cir. 1973).

441. *Id.*

442. *Id.* at 1265–66.

443. HIRSCH ET AL., *supra* note 432, at 234–44 (discussing types of standards and their requirements).

444. *Id*. at 247–52 (describing OSHA's difficulties in obtaining judicial approval of its standards).

445. 29 U.S.C. § 655(f) (2018); Indus. Union Dep't, AFL-CIO v. Am. Petroleum Inst., 448 U.S. 607, 653 (1980).

446. HIRSCH ET AL., *supra* note 432, at 327.

447. Occupational Safety and Health Admin., U.S. Dept. of Labor, *Robotics: Overview*, https://www.osha.gov/SLTC/robotics/ (last visited Mar. 22, 2020). OSHA does note that some of its rules directed at machine safety might apply to robotics. Occupational Safety and Health Admin., U.S. Dept. of Labor, *Robotics: Standards*, https://www.osha.gov/SLTC/robotics/standards.html (last visited Mar. 22, 2020).

448. Occupational Safety and Health Admin., U.S. Dept. of Labor, *Robotics: Hazard Evaluation and Solutions*, https://www.osha.gov/SLTC/robotics/hazardevaluation.html (last visited Mar. 22, 2020); Occupational Safety and Health Admin., U.S. Dept. of Labor, *Robotics: Hazard Recognition*, https://www.osha.gov/SLTC/robotics/hazardrecognition.html (last visited Mar. 22, 2020); OCCUPATIONAL SAFETY AND HEALTH ADMIN., U.S. DEPT. OF LABOR, OSHA TECHNICAL MANUAL SECTION IV, CH. 4, *Industrial Robots and Robot System Safety*, https://www.osha.gov/dts/osta/otm/otm_iv/otm_iv_4.html.

Other agencies may also play a role for certain types of technology, like the Department of Transportation's guidance for autonomous vehicles.[449] But it is clear that this patchwork of regulatory authority is severely lacking. What is really needed is a comprehensive set of rules addressing technology currently in the workplace, ideally within a framework that could also consider technology on the horizon. For instance, we lack rules protecting employees from the possible ill-effects of VR use at work or the psychological and physiological stress that can occur when AI systems control the pace and conditions of work.[450] On the other hand, policymakers should do much more to incentivize employers to use technology that can improve workers' health, such as the use of robots in dangerous environments or using AI systems to identify and mitigate hazards. But a complete set of regulations is difficult given the fragmentation of workplace law.[451] The proposal to broadly centralize workplace regulation that I discuss later would address many of these issues,[452] but short of that, we should seek more coordination among relevant agencies and actors to better anticipate and mitigate tech-related hazards and encourage the use of technology to improve workers' safety.

F. A Workplace Without Boundaries: How to Regulate Ready Player One Jobs

Perhaps the most important impact on work in the last half-century, both in the U.S. and abroad, has been the rise of globalism. Among other effects, the striking expansion of global labor markets led to a dramatic increase in companies' ability to use foreign workers and other types of "offshoring."[453] Although globalism brought benefits, it also imposed significant costs on many individuals via job losses, decreased wages, and weakening of workplace standards.[454] These are the consequences of globalism's erosion of traditional, intra-national

449. In 2018, the Department of Transportation published draft updates to its autonomous vehicles guidance. U.S. Dept. Transportation, *Preparing for the Future of Transportation: Automated Vehicles 3.0*, TRANSPORTATION.GOV (Oct. 4, 2018), https://www.transportation.gov/briefing-room/automated-vehicles.

450. *See* EUROPEAN AGENCY FOR SAFETY AND HEALTH AT WORK, FORESIGHT ON NEW AND EMERGING OCCUPATIONAL SAFETY AND HEALTH RISKS ASSOCIATED WITH DIGITALISATION BY 2025 37, 45 (2018) (discussing that there is a need for regulation), https://osha.europa.eu/sites/default/files/publications/documents/Foresight_new_OSH_risks_2025_report.pdf.

451. *See* Hirsch, *supra* note 192; *infra* note 506 and accompanying text.

452. *See infra* Part IV.

453. Solid conclusions on job impacts are hard to come by, but one estimate is that the world labor supply nearly doubled in the 1990s due to the rise of globalism. RICHARD B. FREEMAN, AMERICA WORKS: CRITICAL THOUGHT ON THE EXCEPTIONAL U.S. LABOR MARKET 128–40 (2007) (noting the rise from 3.3 billion to 6 billion workers); *see also* George S. Geis, *Business Outsourcing and the Agency Cost Problem*, 82 NOTRE DAME L. REV. 955, 957 (2007) (estimating that 4.1 million service jobs moved from developed to developing economies). An employee-advocacy group has recently analyzed Department of Labor data and concluded that offshoring has resulted in an average yearly loss of 89,906 U.S. jobs since January 2017. George Faraday, *Promises Broken #2: The Offshoring of American Jobs Continue*, GOOD JOBS NATION 4 (2018), http://goodjobsnation.org/content/uploads/2018/08/Broken-Promises2.pdf.

454. *See* Brian Burgoon & Wade Jacoby, *Patch-work Solidarity: Describing and Explaining US and European Labour Internationalism*, 11 REV. INT'L POL. ECON. 849, 855–63 (2004); George S. Roukis, *Global Labor's Uncertain Future*, 30 J. COLLECTIVE NEGOT. 271, 271 (2005).

labor markets, which made it easier and more cost-effective for certain companies to use workers living abroad.[455] For those who are concerned about maintaining jobs and workplace standards, both internationally and in their home countries, this trend has been extremely problematic. Not for lack of trying, it has become apparent that there are few, if any, viable options for preventing businesses from seeking work in countries with lower labor costs and weaker work protections—leaving offshoring as a persistent feature of the modern economy.[456] As a result, certain segments of the workforce in countries like the U.S. have faced severe job losses, or significant erosions in their earning power and ability to advocate for better working conditions.

A major driver of the rise in globalism was technology, particularly advances in communications and transportation.[457] This fact naturally leads one to question whether emerging technologies are likely to contribute to this trend. Technology's ability to change or displace jobs will certainly make this problem worse for many workers by further weakening the demand for labor in certain markets.[458] But I turn here to another technology that is more directly connected to globalism: virtual reality ("VR").

As any science fiction fan could tell you, current VR technology is still quite rudimentary compared to its potential.[459] But as VR continues to develop, we will be able to simulate most face-to-face interactions from virtually anywhere. This ability, in turn, will transform many jobs. Today, most work requiring meaningful interactions must be performed in the same geographic location.[460] VR will change that. Imagine, for instance, a secondary school. Currently, the vast majority of schools have teachers and students interacting in person.[461] If VR technology can accurately mimic the in-person experience, however, a teacher could effectively teach students who are dispersed around the world.[462] Other technologies can contribute to this trend. For instance, AI-based natural

455. Geis, *supra* note 453, at 963–66.

456. Jeffrey M. Hirsch, *Making Globalism Work for Employees*, 54 ST. LOUIS U. L.J. 427, 439 (2010).

457. U.S. GENERAL ACCOUNTING OFFICE, WORKFORCE CHALLENGES AND OPPORTUNITIES FOR THE 21ST CENTURY: CHANGING LABOR FORCE DYNAMICS AND THE ROLE OF GOV'T POLICIES 6 (2004), http://www.gao.gov/new.items/d04845sp.pdf; Samuel Estreicher, *"Think Global, Act Local": Employee Representation in a World of Global Labor and Product Market Competition*, 4 VA. L. & BUS. REV. 81, 87 (2009); Katherine V.W. Stone, *A New Labor Law for a New World of Work: The Case for a Comparative-Transnational Approach*, 28 COMP. LAB. L. & POL'Y J. 565, 571 (2007)

458. *See infra* Section III.A.

459. *See, e.g.*, ERNEST CLINE, READY PLAYER ONE (2011).

460. Videoconferencing and other similar technologies are used heavily, even more so during the COVID-19 quarantine period, but they are not as effective as face-to-face interactions in most cases. FORBES, BUSINESS MEETINGS: THE CASE FOR FACE-TO-FACE 2–5 (2009), https://images.forbes.com/forbesinsights/StudyPDFs/Business_Meetings_FaceToFace.pdf.

461. Some distance learning school are in use, but they are generally perceived as inferior to in-person classrooms. Susan M. Dynarski, *Online Schooling: Who is Harmed and Who is Helped?*, BROOKINGS (Oct. 26, 2017), https://www.brookings.edu/research/who-should-take-online-courses/ (describing studies).

462. *See* CLINE, *supra* note 459.

language programs should eventually be able to provide truly synchronous language translation,[463] thereby eliminating the linguistic barriers that hinder current attempts at remote work. Moreover, advances in robotics will vastly improve VR haptics, thereby allowing individuals to virtually manipulate objects around the world.[464] Thus, in the future, many types of work will have few, if any, geographic boundaries and no physical workplace other than workers' individual VR rigs. But this leads to a question of what, if any, laws apply to such work?[465]

In general, the answer is that workers are governed by the laws of the country in which they physically work.[466] For those who seek enhanced workplace security, the goal is a more level playing field where standards do not hue too closely to the laws of a particular country. The two primary avenues for doing so are to establish multinational workplace standards or to extend one country's laws to workers in another country.[467] Neither option has proved successful thus far, but technology's amplification of this problem is likely to increase the push for both.

The inclusion of labor standards in multinational agreements is not new, nor has it been particularly successful.[468] The most robust example involves the European Union, whose labor standards cover most workers in the member countries.[469] Interpretations of those standards, however, have been notable for their willingness to exempt foreign workers. On the other hand, for many European workers, the standards have been beneficial. As a result, workers in European countries with relatively weak protections have seen improvements in their working conditions, while workers in other countries face a lower risk of offshoring.[470] But it is not realistic to expect an expansion of the transnational labor standards in the current political climate. Even in Europe, the very notion of the

463. Bernard Marr, *Will Machine Learning AI Make Human Translators an Endangered Species?*, FORBES: INNOVATION (Aug. 24, 2018, 4:24 AM), https://www.forbes.com/sites/bernardmarr/2018/08/24/will-machine-learning-ai-make-human-translators-an-endangered-species/#34fc883e3902.

464. *See supra* text accompanying notes 78–79.

465. *See generally* Mark A. Lemley & Eugene Volokh, *Law, Virtual Reality, and Augmented Reality*, 166 U. PA. L. REV. 1051, 1056 (2018). VR can also create problems related to compensation. For instance, an employer could violate wage payment laws if it pays workers in non-traditional currency, such as Bitcoin. This could be a factor in employers seeking labor in countries without wage payment requirements.

466. There are some exceptions, such as Title VII's application to a U.S. employee working abroad for a U.S. company. *See infra* notes 479–80 and accompanying text.

467. Other, more limited options, include organizing coordinated collective action among foreign workers, pressuring employers to adopt labor standard agreements, and promoting new forms of organizations that can assist workers and provide them benefits. Hirsch, *supra* note 456, at 439–64.

468. *Id.* at 457–61.

469. Estreicher, *supra* note 457, at 89. The International Labour Organization also promotes international labor standards and has 187 member states. International Labour Organization, *ILO Declaration on Fundamental Principles and Rights at Work and Annex*, 37 I.L.M. 1233 (1998). ILO standards are fairly broad, however, and for most countries, do little to create direct improvements for workers. Among other problems, the ILO has no enforcement authority and many countries, including the U.S., have not ratified most ILO standards. Christopher L. Erickson & Daniel J.B. Mitchell, *The American Experience with Labor Standards and Trade Agreements*, 3 J. SMALL & EMERGING BUS. L. 41, 47–49 (1999).

470. Sara Kahn-Nisser, *Channels of Influence: The EU and Delta Convergence of Core Labour Standards in the Eastern Neighborhood*, 29 EUR. J. DEV. RES. 127, 130 (2017).

EU has been weakened by Brexit and other forces.[471] And multinational agreements have fallen out of favor with the current U.S. administration.[472] That said, the U.S. has been open to improving labor protections in bilateral and trilateral agreements, most notably in a recent proposed update to NAFTA.[473] Attempts to protect workers via trade agreements have not been especially fruitful in the past,[474] but these agreements are better than nothing[475] and could lead the way to more meaningful steps in the future.

An alternative option is for the U.S. to extend the reach of its workplace protections beyond its borders.[476] That path, however, is not easy. The Supreme Court has long taken a restrictive view of statutes' extraterritorial reach.[477] For instance, in *EEOC v. Arabian American Oil Co. (ARAMCO)*, the Court held that Title VII did not apply to U.S. citizens working abroad for U.S. employers because it lacked a clear statement of congressional intent for extraterritorial application.[478] Later that same year, Congress amended Title VII to make clear that it should apply to U.S. citizens working abroad for U.S. companies,[479] and it has done the same for other workplace legislation.[480] Although beneficial in some cases, these extraterritorial clauses do nothing to address the broader concern of U.S. companies relying more heavily on workers in other countries. Congress

471. *See Brexit: All You Need to Know About Leaving the EU*, BBC: POLITICS (Oct. 22, 2019), https://www.bbc.com/news/uk-politics-32810887.

472. Harry G. Broadman, *Trump's Misplaced Penchant for Bilateral Trade Deals*, FORBES: LEADERSHIP (Jan. 31, 2018, 10:07 PM), https://www.forbes.com/sites/harrybroadman/2018/01/31/trumps-misplaced-penchant-for-bilateral-trade-deals/#7d93460757b9.

473. Jim Tankersley, *Trump Loves the New NAFTA. Congress Doesn't*., N.Y. TIMES (Feb. 6, 2019), https://www.nytimes.com/2019/02/06/business/nafta-trump-deal.html; *see also* EXEC. OFFICE OF THE PRESIDENT, *supra* note 364, at 20 (stressing that integrating countries' different privacy frameworks is important to ensuring "robust international commerce").

474. None of the complaints brought under the NAFTA labor side agreement, North American Agreement on Labor Cooperation, Can.-Mex.-U.S., Sept. 14, 1993, 32 I.L.M. 1499, have resulted in any concrete remedies. U.S. GENERAL ACCOUNTING OFFICE, NORTH AMERICAN FREE TRADE AGREEMENT: U.S. EXPERIENCE WITH ENVIRONMENT, LABOR, AND INVESTOR DISPUTE SETTLEMENT CASES 31 (2001); Diana Chew & Richard A. Posthuma, *International Employment Dispute Resolution Under NAFTA's Side Agreement on Labor*, 53 LAB. L.J., 38–39 (2002) (reviewing all NAALC cases filed at time of publication).

475. Even modest labor standards can provide some significant benefits to workers, but only with effective enforcement mechanisms. Estreicher, *supra* note 457, at 90–91.

476. *See generally* Lance Compa, *Pursuing International Labour Rights in U.S. Courts: New Uses for Old Tools*, 57 INDUS. REL. 48 (2002) (discussing options for U.S. litigation of foreign-related workplace claims).

477. *See* EEOC v. Arabian Am. Oil Co., 111 S. Ct. 1227, 1236 (1991).

478. *Id.* The Court's recent decision in *RJR Nabisco, Inc. v. The European Community*, 136 S. Ct. 2090 (2016), established a two-step framework for determining a statute's extraterritoriality. The first step asks "whether the statute gives a clear, affirmative indication that it applies extraterritorially." *Id.* at 2101. The second step states that "[i]f the conduct relevant to the statute's focus occurred in the United States, then the case involves a permissible domestic application even if other conduct occurred abroad; but if the conduct . . . occurred in a foreign country, then the case involves an impermissible extraterritorial application regardless of any other conduct that occurred in U.S. territory." *Id.*; *see also* Kiobel v. Royal Dutch Petroleum, 133 S. Ct. 1659, 1699 (holding that presumption against extraterritorial application applied to Alien Tort Statute claim against multinational company for human rights abuses against foreign workers).

479. 42 U.S.C. § 2000e(f) (2018).

480. *See, e.g.*, 29 U.S.C. § 623(h) (ADEA); 42 U.S.C. §§ 2000e(f), 12111(4) (2018) (ADA). Other statutes lack extraterritorial clauses. *See, e.g.*, 29 U.S.C. § 213(f) (2018) (FLSA).

has not attempted to extend traditional workplace laws to foreign workers,[481] and there is some question whether it is allowed to do so. But there is precedent for limited extensions of U.S. law to foreign employees working for U.S. employers in other countries.[482] In particular, when a law is not primarily focused on domestic matters, such as maritime legislation, then the presumption against extraterritoriality is much weaker, if it exists at all.[483] This suggests that although extending most current workplace laws to foreign workers may not be possible, new legislation targeted specifically to work done virtually may have a better chance of passing muster with the courts.

Although VR is unlikely to hasten globalism's effect on the labor market anytime soon, it will likely do so in the future. Given the current political environment, it is hard to envision a meaningful effort either to join a multinational labor standards agreement or to extend U.S. workplace protections to certain foreign workers. Yet, as VR and related technology expand companies' capacity to offshore work and further erode domestic work standards, the pressure to assist U.S. workers may increase. We can never eliminate labor cost considerations, but we do have options to reduce employers' ability and incentives to move work abroad. Failure to do so could well result in further job losses and poorer work conditions for U.S. workers.

G. Using Technology to Enable Disabled Workers

Perhaps no group of workers are most likely to gain from emerging technology than those who are disabled. Today, disabled workers are already benefitting greatly from technology that helps reduce barriers to work[484] and that assistance will almost certainly grow dramatically over time. Accordingly, our policy and legal goals should promote technological applications that aid disabled workers and mitigate some of the problems that these applications may create.

Countless innovations in development or already in use can drastically change the ways people interact, move, and work. Many of these advances will, intentionally or not, allow disabled workers to perform tasks that were previously beyond their abilities. The healthcare field is a particularly apt illustration. "Wearable" technology, while raising questions about privacy, shows real promise in enabling individuals to better manage chronic conditions such as diabetes and heart disease.[485] Moreover, advances in robotics and AI are leading to "smart"

481. For instance, Title VII's extraterritorial provision does not cover non-U.S. citizens working abroad for American companies. *See supra* note 479.

482. Kollias v. D & G Marine Maint., 29 F.3d 67, 73 (2d Cir. 1994) (applying Longshore and Harbor Workers' Compensation Act).

483. *Id.* at 71.

484. *See* Ajunwa, *supra* note 298, at 41.

485. *Cf.* CDC Found., *Worker Illness and Injury Costs U.S. Employers $225.8 Billion Annually*, (Jan. 28, 2015), https://www.cdcfoundation.org/pr/2015/worker-illness-and-injury-costs-us-employers-225-billion-annually.

prosthetics and other devices that will greatly expand disabled individuals' ability to perform various tasks.[486] Technology also holds promise as a therapeutic tool. One example is the use of VR to provide physical therapy, even in geographic areas where access to therapists is limited.[487] Other VR researchers have had some success in allowing users to control aspects of the digital environment with their thoughts.[488] Also in development are exoskeletons that could help disabled workers perform a far greater number of manual tasks.[489] These innovations are just a small sample of the developments that will increase the number of disabled individuals who are able to obtain work and expand their capabilities while on the job.

Despite the promise of technology, it does pose some risks for disabled workers and complications for both employers and employees. One issue is the discrimination problem discussed previously; if employers use AI or other technology to make personnel decisions, there is the potential of discrimination against disabled workers, possibly in violation of the ADA.[490] Additionally, as employers collect increasing amounts of personal data—whether through wearables, AI, or other information-capturing technologies—that information can be used to identify potential disabilities.[491] The employer then risks violating the ADA if it uses this information to negatively affect a disabled employee or it fails to accommodate what is now a known disability.[492]

As technology becomes increasingly integrated into workplaces, questions of access will also arise. Access can cut two ways. One issue concerns employers' voluntary adoption of technology and the need to consider its impact on disabled employees. In particular, employees' disabilities may prevent them from using mandated technology,[493] or the technology may create or aggravate medical conditions.[494] Failure to properly address these possibilities could lead to an ADA violation if disabled employees are put at a disadvantage relative to their nondisabled coworkers.

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486. Andrea Powell, *AI is Fueling Smarter Prosthetics than Ever Before*, WIRED (Dec. 22, 2017, 12:13 PM), https://www.wired.com/story/ai-is-fueling-smarter-prosthetics-than-ever-before/.

487. A VR system can provide cues to help the patient track mimic certain motions or postures, while getting feedback from the therapist. Telephone interview with Karen Chen, *supra* note 72.

488. *See* Grush, *supra* note 105.

489. Ajunwa, *supra* note 298, at 40.

490. Kevin J. Haskins, *Wearable Technology and Implications for the ADA, GINA, and Health Privacy*, 33 A.B.A. J. LAB. & EMP. L. 69, 70 (2017); *see supra* Section II.C.

491. *See supra* note 186 and accompanying text.

492. 42 U.S.C. §§ 12112(a), 12112(b)(5) (2018). A related issue has already arisen with regard to employers' use of wellness programs as a factor in personnel decisions. Alexander H. Tran, *The Internet of Things and Potential Remedies in Privacy Tort Law*, 50 COLUM. J.L. & SOC. PROBS. 263, 273 (2017).

493. *See* 29 C.F.R. § 1614.203(d)(4) (2017) (requiring federal agencies to ensure that disable employees have access to technology); *cf.* Andrews v. Blick Art Materials, LLC, 286 F. Supp. 3d 365, 371 (E.D.N.Y. 2017) (approving ADA settlement, which required art supplier to make online site accessible to visually impaired consumers).

494. Pena v. Honeywell Int'l Inc., C.A. No. 15-179 WES, 2018 WL 582579, at *6 (D.R.I. Jan. 29, 2018) (noting plaintiff's allegation that presence of robots significantly exacerbated anxiety symptoms); Perez v. Interconnect Devices Inc., No. CIV. A. 97-2191-GTV, 1998 WL 781220, at *5 (D. Kan. Oct. 22, 1998) (discussing employee's allegation that noise from robots was exacerbating hearing loss), *aff'd*, 189 F.3d 478 (10th Cir. 1999).

In contrast to the potential harm associated with integrating technology into the workplace, employers may also run afoul of the ADA by *not* providing access to technology. Disabled employees will likely request use of various technologies to assist them in their jobs, thereby triggering the ADA's reasonable accommodation mandate. Technology will not only expand the universe of possible accommodations, but also serve as an important factor into whether an accommodation is required at all.[495]

The ADA requires employers to provide disabled employees a "reasonable accommodation," unless it would be an "undue hardship" on the employer.[496] Under the reasonable accommodation analysis, an employee must first show that an accommodation appears reasonable on its face for a typical company.[497] An employer can respond by showing business-related circumstances that convert the otherwise reasonable accommodation into an undue hardship for the specific employer.[498] This analysis is often quite difficult, and emerging technology will make it more so. Courts, as well as employers and employees, will need to familiarize themselves with the availability, efficacy, and affordability of relevant technology as it becomes more widespread. But if history repeats, this process will take longer than ideal.

The Seventh Circuit's 1995 decision in *Vande Zande v. State of Wisconsin Department of Administration*[499] is emblematic of courts' need to keep abreast of technological advances. Among the accommodations requested by the disabled employee in *Vande Zande* was to work full-time at home.[500] In upholding summary judgment in favor of the employer's refusal to allow no more than part-time work at home, the court, in a decision written by then-Chief Judge Posner, held that "[n]o jury . . . could in our view be permitted to stretch the concept of 'reasonable accommodation' so far."[501] According to the court, most jobs require employees to work in teams under supervision; therefore, "[a]n employer is not required to allow disabled workers to work at home, where their productivity inevitably would be greatly reduced," and while there are exceptions, "it would take a very extraordinary case for the employee to be able to create a triable issue of the employer's failure to allow the employee to work at home."[502] Although many jobs are still unsuitable for telecommuting, advances in communications technology makes this decision seem laughably outdated.[503] Yet, the

495. Following the 2008 amendments to the ADA, use of assistive technology is no longer a factor in determining whether an employee is disabled. 42 U.S.C. § 12102(4)(E)(i)(II) (2018).

496. An employer violates the ADA if it fails to make "reasonable accommodations to the known physical or mental limitations of an otherwise qualified [employee] with a disability . . . unless [the employer] can demonstrate that the accommodation would impose an undue hardship on the operation of the business." *Id.* § 12112(b)(5)(A).

497. U.S. Airways, Inc. v. Barnett, 535 U.S. 391, 401–02 (2002).

498. *Id.* at 402.

499. 44 F.3d 538 (7th Cir. 1995).

500. *Id.* at 544.

501. *Id.*

502. *Id.* at 544–45.

503. To its credit, the court did acknowledge that telecommuting's reasonableness "will no doubt change as communications technology advances." *Id.* at 544. *But see* Robert Iafolla, *Work at Home Gets Skeptical Eye*

problem with *Vande Zande* is not that it lacked a crystal ball, it is that the court made a gross generalization about technology's effectiveness. Rather than allow a jury to determine, based on the specific facts of the case, whether telecommuting would be reasonable, the court entered a broad holding that erased most employees' ability to use technology to promote the goals of the ADA. If technology is to fulfill its potential for disabled workers, courts must be better informed about technological developments and be more open to their application in the workplace.[504]

On the whole, technology is likely to be a boon for disabled workers, especially over the long run. But we should expect significant hiccups along the way as employers clumsily adopt some technologies and resist requests for others, while courts reveal their lack of familiarity with devices more complicated than computers and (maybe) smart phones. Efforts should be made to better educate the courts and public about useful workplace technologies, while providing employers incentives to adopt technologies that assist disabled employees.[505] But our fragmented workplace regulatory system is not equal to the task of comprehensively adopting these strategies—yet another example of the need to reform our governance of a workplace undergoing major technological changes. Which brings us to the next topic of discussion . . . .

IV. WHAT NEXT? FUSING OUR FRAGMENTED WORKPLACE LAWS

Emerging technologies are eliciting a considerable number of diverse workplace concerns: widespread job losses, worker misclassification, privacy, discrimination, safety and health, globalism, and disabled workers. The possible solutions to these issues are even more plentiful and varied. We could—and most likely, will—randomly adopt some of these responses as problems capture sufficient attention from the public and policymakers. But this haphazard approach leaves much to be desired, as it will only worsen the current situation, in which different groups of workers enjoy varying degrees of protection that they may or may not be able to enforce.

The common thread among these challenges is most of them are as complex and interrelated as the technologies from which they spring. Problems of this sort demand an equally coordinated set of responses. Responses that our fragmented set of federal, state, and local workplace policymakers are unable to produce. We should, instead, strive for a more comprehensive strategy. One that reflects the complexity, seriousness, and scope of the problems it is trying to solve.

from Courts as Disability Issue, BLOOMBERG LAW (Feb. 21, 2019, 5:15 AM), https://news.bloomberglaw.com/daily-labor-report/work-at-home-gets-skeptical-eye-from-courts-as-disability-issue.

504. As proof of this point, there are very few reported cases involving employment accommodations via technologies such as robotics or VR. Part of the explanation for the dearth of cases is that these technologies are still new enough that many individuals are not aware of their availability or that their cost remains prohibitively high.

505. Rather than the ADA's stick-only approach, tax breaks or other financial incentives may be merited.

This Article lacks the capacity for a full discussion of the path forward, but some general proposals follow. Central among them is an attack on our fragmented workplace. Multiple jurisdictions—federal, state, and local—regulate the workplace in different ways, apportioning or sharing enforcement responsibilities among various agencies and private actors.[506] And even within a single jurisdiction, numerous statutes regulate different aspects of work.[507] As I have argued elsewhere, there have long been strong arguments for minimizing or eliminating this fragmentation by implementing both "vertical integration" (concentrating regulation within a single jurisdiction, the federal government) and "horizontal integration" (minimizing the variety of statutes within a given jurisdiction).[508] The additional strain that emerging technology will place on this fragmented system further supports this argument.

This Article has explored ways in which technology will create new problems for workplace law and exacerbate current ones. Policymakers and private actors will have to contend with unfamiliar innovations that they don't fully understand, making technology's effect on the workplace difficult to predict and regulate. Although there is an argument that a decentralized governance process allows for experimentation that would be beneficial in such circumstances, its potential value will likely be overwhelmed by the confusion and gaps that it will generate.[509] Many legislatures will simply avoid regulating difficult questions at all, leaving workers unprotected from a variety of harms. Moreover, if state or local governments are free to legislate, the result will be a set of disparate rules that make compliance difficult,[510] especially for companies that operate in multiple jurisdictions.[511] The interrelated nature of many technologies also suggest a coordinated legislative response. Because technologies are often used together in unexpected ways, piecemeal legislation that addresses only isolated issues that have risen to prominence will be relatively ineffective and incomplete.

For these reasons, a centralization of workplaces laws is ideal, albeit unlikely. One approach to accomplish this goal would be to establish a new national

506. Hirsch, *Nationalizing Workplace Law*, *supra* note 192, at 1036–49 (describing large number of statutes, including ones governing wages and hours, family and medical leave, employment benefits, among others, as well as multiple statutes prohibiting different types of discrimination).

507. *Id.*

508. *Id.* at 1052–68 (arguing that, in general, the benefits of a unified set of labor and employment laws outweighs the costs).

509. *Id.* at 1053–64.

510. Jeffrey M. Hirsch, *The Law of Termination: Doing More with Less*, 68 MD. L. REV. 89, 99–100 (2008) (arguing for importance of making employer compliance achievable); *see also supra* note 229. This choice also assumes that federal regulation would have some teeth, which is not necessarily true. For instance, the tech industry is pushing for the FTC to enforce privacy regulations. Dina Temple-Raston, *Why the Tech Industry Wants Federal Control Over Data Privacy Laws*, NPR (Oct. 8, 2018, 5:00 AM), https://www.npr.org/2018/10/08/654893289/why-the-tech-industry-wants-federal-control-over-data-privacy-laws. But given that agency's tradition of weak enforcement, such a measure would likely fail to achieve the promised benefits of a unified approach.

511. Kharpal, *supra* note 348. California, for instance, recently enacted a law that, among other things, would allow damage suits against companies that suffer data breaches. Assemb. B. No. 375, 2017–18 Assemb. Reg. Sess. (Cal. 2018). Major tech companies responded by pushing for a federal set of rules that would preempt California and other states that might follow suit. Temple-Raston, *supra* note 510 (noting also more narrowly targeted measures in Illinois and Vermont).

regulatory scheme, which I will refer to as the "Law of Work." This unified law would allow, for example, an amended approach to the employee classification system[512] that would apply throughout the labor market, rather than a disparate set of classification standards depending on which statute is involved and whether it is a federal, state, or local provision. But even without a new, comprehensive workplace law, Congress could make a coordinated legislative effort to address the broad swath of issues presented by emerging technologies. In addition, Congress could empower a single agency to enforce whatever legislation it pursues or already exists. Such an agency would be better positioned to implement comprehensive and forward-looking policies to address impeding issues. In contrast, isolated and sporadic responses to the challenges that will accompany new technology—in addition to the shortcoming of our current workplace regulatory system—will be insufficient.

Short of a general centralization of work law, more modest approaches are available. One option that fulfils some of the aims behind the Law of Work is to develop a targeted response to emerging technology workplace issues.[513] The Department of Labor, for instance, could create a new department focused on technology's impact in the workplace. This department could conduct research, improve data collection,[514] and make policy recommendations, all while coordinating with relevant players in the public and private sector. Such an effort would not be a panacea, but it would certainly improve the current situation, where no single entity is considering the panoply of issues implicated by developing technologies.

V. CONCLUSION

Society has long grappled with both technology and changes in the way we work. But this current period feels different. The breadth and speed of technological developments and their expected impact on the workplace has the quality of something more than a typical evolution of work. It is impossible to know whether we are on the verge of a new era of work, but the chance is very real. Unfortunately, the one thing that we do know for sure is that our system of workplace governance is unprepared for such an occurrence.

If we are entering a technology driven revolution, the ramifications are immense. Massive job losses, millions of workers falling through the gaps of already weak protections, a workplace utterly devoid of privacy, tech-enabled discrimination, and risks to workers' health and safety are all on the table—as are, of course, many benefits as well. Even without a true revolution, technology will

512. *See supra* Section III.B.

513. In 2018, the President created the National Council for the American Worker, which is intended to address future job concerns through a coordinated effort involving federal, state, and local governments; private entities, such as employers, unions, and non-profits; and educational institutions. Included in this effort's focus are employment issues related to emerging technologies; however, the council has yet to produce anything or even appear to be engaging in any substantive work at this point. Exec. Order No. 13,845, 83 Fed. Reg. 35,099 (July 19, 2018).

514. *See supra* note 46 and accompanying text.

unleash many of these same problems, albeit to a lesser degree. In addition, the workplace is becoming blended, with human work increasingly reliant on technology—a development that will magnify employers' control over workers. As a result, the existing imbalance of power associated with globalism and other conditions will worsen, leading to more of the inequality and social disruptions that have already rocked society in the past decade.[515]

Our current fragmented system of workplace laws has already done a poor job dealing with the challenges of globalism. Technology, at a minimum, will make these problems more severe. At worst, technology will shatter this system, leaving a critical mass of workers without any meaningful protection, power, or voice in the workplace.[516] Either way, technology should spur us to reform the way we regulate work. We should do away with the byzantine set of laws that make compliance difficult and enforcement near impossible, while still leaving many workers with inadequate, or no, protections. Technology will bring both good things and bad to the workplace, but if we don't prepare, the latter will almost certainly outweigh the former. Instead, we should use emerging technology as an opportunity to consider anew our governance of the future of work.

515. Other countries have not been immune to this political and economic unrest, particularly in Europe. Liz Alderman, *These 5 Numbers Explain Why the French Are in the Streets*, N.Y. TIMES (Dec. 4, 2018), https://www.nytimes.com/2018/12/04/world/europe/france-economy-protests.html (describing expanding "Yellow Vest" protests).

516. *See supra* note 6 and accompanying text (describing workers unrest that led to federal labor law).