FUTURE OF WORK

FORECASTING EMERGING TECHNOLOGIES' IMPACT ON WORK
IN THE NEXT ERA OF HUMAN-MACHINE PARTNERSHIPS

INSTITUTE FOR THE FUTURE

DELLTechnologies

ABOUT INSTITUTE FOR THE FUTURE

Institute for the Future (IFTF) is the world's leading futures thinking organization. For over 50 years, businesses, governments, and social impact organizations have depended upon IFTF's global forecasts, custom research, and foresight training to navigate complex change and develop world-ready strategies. IFTF methodologies and toolsets yield uncommonly coherent views of transformative possibilities across all sectors that together support a more sustainable future. Institute for the Future is a registered 501(c)(3) nonprofit organization based in Palo Alto, California.

DELL TECHNOLOGIES

Dell Technologies is a unique family of businesses that provides the essential infrastructure for organizations to build their digital future, transform IT and workforce and protect their most important asset, information. The company services customers of all sizes across 180 countries—ranging from 99 percent of the Fortune 500 to individual consumers—with the industry's most comprehensive and innovative portfolio from the edge to the core to the cloud.

ABOUT THIS RESEARCH

Dell Technologies partnered with the independent futures research group Institute for the Future (IFTF) to explore how emerging technologies could reshape the work environment over the next decade. The research builds on the organizations' collaboration in 2017, when IFTF distilled informed opinions from 20 experts from around the world to forecast the "next era of human-machine partnerships." Two years later, IFTF is forecasting how a new dynamic between humans and machines may inform the future of work. To execute this inquiry, IFTF relied on its decades-long study on the future of work and technology, and an expert workshop held in Palo Alto, California in November 2018 with participants from across the globe.

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INTRODUCTION

The technologies that are emerging today already make it possible to more aptly match the right work to the right person regardless of their gender, age or geographic location. Imagine if, as the day-in-the-life scenario below depicts, job seekers in 2030 routinely demonstrated competencies to potential employers through mobile gaming apps.

Emerging tech today is not only creating new possibilities for how people and jobs find each other more seamlessly, they are also enabling new ways of working together. These advancements in technologies will require new skills and capabilities for workers to excel in the 2030 work environment.

This report explores how collaborative AI, multimodal interfaces, extended reality (XR), and secure distributed ledgers will intersect with evolving social and economic forces to shape how we prepare for, find and work in 2030. It builds on a 2017 Institute for the Future (IFTF) report entitled *The Next Era of Human-Machine Partnerships,* which forecasted that partnering with machines will help make the most of the complementary strengths of humans and machines. Since then, IFTF and its consortium of global experts have been exploring how these partnerships will

transform our lives, the way we work and the economy by 2030 in a three-part research series. The insights provided by our experts inspire new possibilities and help inform IFTF's forecast of three shifts that have the potential to recast the future of work, and open the door for more people and communities to pursue meaningful, creative and sustaining work.

Technological advancement is one undeniable force that will impact the future of work, but how these and other emerging technologies shape the future for workers is up to us. Without deliberate effort to apply emerging technologies to promote a more inclusive and equitable work environment in 2030, the advances in technology may not yield as positive a future.

We invite you to read on to uncover examples of emerging technologies stimulating and enhancing collaboration today, as well as the tectonic shifts that human and machine partnerships could spur to help reshape the future of work. As exciting as the possibilities may be, this future is not guaranteed; our experts also identify key dilemmas that will need to be overcome to cultivate a more equitable and inclusive future to empower the next generation of workers.

LAGOS, NIGERIA

A DAY IN THE LIFE—2030

Ndidi messages her friends that she got the gig. The process was typical: after attending a friend's recruitment event for his social VR company, she got an invite code to play a recruitment game and she followed through, squeezing in time to play it on her device during her commute. The game was fun and she felt immediate gratification when she leveled up quickly. Ndidi scored high in intellectual curiosity and attention to detail, and her results indicated that she was skilled in spatial reasoning, a strength she didn't know she possessed. She had strong leadership potential, it said. A gig offer from an immersive architecture firm came not 48 hours later.

EMERGING TECHNOLOGIES THAT REARCHITECT THE WORLD OF WORK

The changes to work and learning in 2030 will be enabled by the maturation and proliferation of today's emerging technologies. These technologies will birth new industries, jobs, places of work and working patterns. Four emerging technologies are critically important to understand how humans and machines might work in concert with each other to better match people to meaningful, creative and sustaining work, and improve collaboration within and between organizations. These technologies are collaborative AI, multimodal interfaces, extended reality (XR), and secure distributed ledgers.

Collaborative AI

"The robots are coming for our jobs" has been a common concern expressed in discussions about AI. What underpins this sense of anxiety over job competition and scarcity is the concern that advancing AI systems will be sophisticated enough to do the work that humans do today. A more useful reframing articulates the relationship between human and machines as a partnership, through which the two groups work together to achieve more. Working within this framework, it is possible to envision cooperative AI systems in which human strengths are programmed and integrated into machine intelligence. Just as humans need to improve our ability to offload tasks that are better suited for machines, so will AI systems need to be designed to recognize computational limitations and know when to lean on their human partners for help with completing a task.[i] AI explicitly designed for collaboration will help build capacity in machines to improve their understanding of humans.

SIGNAL OF CHANGE

The Allen Institute for Artificial Intelligence aims to build common sense into machine systems so that they can be better collaborative partners for humans.[ii] Recently, its computer vision research team Perceptual Reasoning and Interactive Research (PRIOR) released a collaborative game in which the AI system uses its ability to reason and make inferences to communicate with a human partner. In the game, the AI and its human partner trade off illustrating scenes to try to understand what the other has drawn. Rather than looking to outperform a human (such as in a chess match), the researchers at PRIOR are building machine systems that can better communicate and interact with human partners.

Multimodal Interfaces

The modalities of seeing, hearing and touching have been the more commonly used human senses in human-machine interactions. Emerging interfaces are integrating haptic feedback, gesture recognition and even smell to provide alternative mediums for displaying and interacting with data. Multisensory integration will expand the possibilities for form factors, diversify the user experience and make machines more accessible to different types of users. Imagine when workers can access data using gesture recognition, or when smell becomes integrated into VR experiences.

SIGNAL OF CHANGE

Ultrahaptics creates tactile sensations that do not require controllers or wearables.[iii] Users can control buttons and sliders with 'mid-air haptics' without having to touch the surface of the technology. Interacting without physically touching the technology can keep public technologies such as kiosks and ATMs cleaner. Gesture interfaces can also improve safety in medical environments and in vehicles because it helps keeps users' focus on where it should be and away from the device.

Secure Distributed Ledgers

Secure distributed ledgers like blockchains provide an immutable, transparent data storage mechanism, allowing all parties to access all transaction data. They enable applications like smart contracts, where transactions are algorithmically triggered when objective criteria are met. By 2030, smart contracts will be connected more seamlessly to real-world events. This will facilitate the ability to automate a whole host of activities, including real-time compensation that is linked to the completion of a work task.

SIGNAL OF CHANGE

Etch is a smart contract-based payroll platform that allows for real-time payment of wages.[iv] Built on top of the Ethereum blockchain, Etch seeks to the reduce the administrative burdens associated with payroll and accelerate the pace at which people can get paid. Promoting their service as "the first evolution in payroll since the Industrial Revolution," Etch offers an alternative way for employees to be paid. Instead of being a dependent on employers' payroll structures, a smart contract pay system like Etch makes it possible for workers to receive their wages in real time.

Extended Reality (XR)

Current technologies blend digital and physical worlds; the two will become even more intricately overlaid over the next decade, enabled by more innovative experimentation with extended reality (XR). XR, which includes augmented reality (AR), virtual reality (VR) and mixed reality (MR), combines real and virtual environments and encompasses all human-machine interactions generated by computer technology and wearables.[v] The blended environments allow users to turn what is otherwise abstract information into rich, interactive experiences. By 2030, more organizations will rely on XR to superimpose a virtual layer over physical spaces to experience and share content on any computing device.

SIGNAL OF CHANGE

Interplay Learning uses Virtual Reality (VR) and 3D simulation-based training software to train HVAC and solar technicians, making it easier for workers to gain new knowledge and skills. Workers have access to over 100 hours of scenario-based learning coursework via their phone, computer or in VR to advance their learning on their own time. [vi]
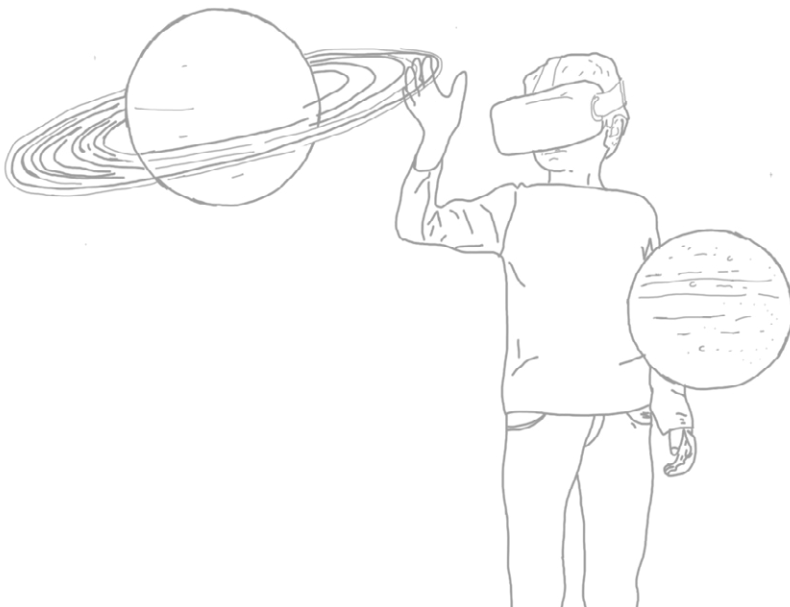
OPPORTUNITIES FOR HUMAN-MACHINE PARTNERSHIPS: THREE SHIFTS TRANSFORMING THE FUTURE OF WORK

Increasing opportunities for more people and communities to pursue meaningful, creative and sustaining work is the cornerstone of both national and global efforts to improve economic prosperity by 2030, particularly for women and young people. In fact, the United Nation's 2030 Agenda for Sustainable Development, which came into effect on January 1, 2016, states, "We will work to build dynamic, sustainable, innovative and people-centered economies, promoting youth employment and women's economic empowerment, in particular, and decent work for all."[vii]

The human-machine partnerships emerging over the next decade can help realize the goals and targets outlined by the United Nations and echoed in national policies across the globe. They offer the possibilities to create more equitable ways to prepare and connect people, particularly youth and women, to income-generating opportunities. And human-machine partnerships enable novel approaches to spreading decision-making and collaboration across networks of workers.

This section describes the three shifts that could help shape a more inclusive and rewarding work environment over the next decade. The forecasted shifts are:

Inclusive Talent   **Empowered Workers**   **AI Fluency**

SHIFT 1:
INCLUSIVE TALENT

A DAY IN THE LIFE—2030

LONDON, ENGLAND

For hiring manager Lydia Kim, a new employee's first day is often the first time she sees the person she has hired. She knows they are competent; the AI system her company uses to spot and recruit talent has an admirable track record in finding people ready and prepared to contribute on day 1. She knows their personality; she has interviewed them in a social VR space and observed them working with others from the organization in virtual simulations. But how the potential hire has chosen to present herself in these virtual locations is up to her. So, what she often doesn't know when she offers them a job is their age, gender and, unless required for the job, their geographic location. With the benefit of an AI system that can evaluate an individual's ability based on their competencies and assess their potential as well, Lydia and her team have overhauled their hiring process. Their new way of finding people has expanded their pool of potential talent and helped the organization meet their stated goals around diversity and inclusion.

Recent advances in deep learning are making it possible for powerful algorithms to identify skills and capabilities that are not explicitly described on a résumé. New software systems can help create a richer picture of an applicant by extrapolating relevant skills related to their hobbies and past experiences, and through applying contextual information about how other workers from the same educational institution or learning pathway have fared in the position. The ability to include a diverse set of inputs into the hiring process may reveal new insights to employers—about the expertise, traits and potential of the ideal candidate, for example, which could extend the talent pipeline to include people with a wide range of backgrounds and experiences.

In Lagos, Nigeria, West African Vocational Education (WAVE) aims to create a new set of norms and practices around hiring. To include more people with diverse backgrounds and experiences, WAVE finds, screens, trains, places and supports West Africans between the ages of 16 and 30 in hospitality and retail jobs. They do this through what the social venture calls "a double-sided financial model" in which both the trainee and the employer shoulder some of the cost.

According to WAVE's CEO Misan Rewane, assessment tools should be designed to allow potential hires the opportunity to "show rather than tell" future employers their ability to succeed on the job. Rewane argues that most employers don't know which competencies are

accurate predictors of job performance. Proxies, like degrees and work experience, she cautions, might predict "confidence and quick reasoning, but little else."[viii] Applying emerging technologies to the work of identifying appropriate talent may enhance an organization's strategic efforts around diversity and inclusion.

Over the next decade, machine-learning systems will form partnerships with humans to support the challenging work of hiring and retaining talent. This will ease the way for people, notably women and younger workers, to be evaluated not only by their compatibility with the present-day workforce or their past performance (or lack thereof), but on their future contributions and how they align with the desired direction for an organization.

SHIFT 1:
INCLUSIVE TALENT

Tools that improve an organization's ability to identify new talent will help build out the workforce in growing 21st century industries like gaming and Esports, already multi-billion-dollar industries. The next million gamers (to add to the approximately 2.4 billion who already play) are expected to come from countries such as Kenya, Nigeria, China, India, Mexico and Brazil.[ix] This growth will drive the need to create culturally relevant content. To meet that demand, organizations will need to be able to better evaluate the skills and knowledge that the generation which has grown up playing what one expert called "hard-core games" will bring to the workforce.[x]

Notably, by 2030, inclusive talent practices may reveal as much to employers about their own assumptions around hiring as they will help people find the right positions. Employers and hiring managers may gain a more precise understanding of the skills, aptitudes and personalities that help an individual succeed in their organization. These emerging human-machine partnerships will enable them to experiment with new types of workers to inform how they form teams and design incentives to increase productivity, morale and retention.

⚙ SIGNAL OF CHANGE

Eightfold combines Applicant Tracking System (ATS) and Human Resource Information System data with publicly available data to uncover the ideal candidate for a given position. It also employs 'candidate masking,' withholding all evidence of personal characteristics (age, gender, ethnicity, geography) from hiring managers before interview selections are made.

⚙ SIGNAL OF CHANGE

Knack aims to uncover the 'hidden potential of every person' by using digital games, behavioral science and AI to match individuals' personal strengths with professional work. The start-up measures human potential and catalogs them as knacks (traits and abilities), superknacks (potential to do well in a career) and ultraknacks (customized for a specific employer).

New offerings, such as Eightfold's Enterprise Talent Intelligence Platform, may improve humans' ability to evaluate seemingly unrelated skills and knowledge, along with personality traits and interests to determine if someone is a good fit for an open position.[xi] Other services, such as Knack, which combines video games, behavioral science and AI, will help uncover skills and capabilities unknown to both the individual and employers.[xii] And digital credentialing platforms, such as Credly, which aims to build a "common, verified language" for skills and demonstrated competencies, will facilitate organizations' ability to understand applicants' learning histories and better recognize individuals' full potential.[xiii]

SHIFT 2:
EMPOWERED WORKERS

A DAY IN THE LIFE—2030

BEIJING,
CHINA

A Day in the Life – 2030. Beijing. China. The burgeoning field of genomic medicine is built on collaboration. Most scientists and clinicians engaged in understanding and treating people with genetically defined diseases operate under no false pretense that their scientific discovery or successful treatment is the sole result of their individual effort, or even the work of a small team. Metabolic Geneticist Li Min, like almost all of her colleagues entering the field of genomic medicine in the late 2020s, was trained to be networked scientist, and to conduct distributed research in real-time. The collaborative platforms she uses (often multimodal and XR) first gained popularity in the gaming world but are now routinely integrated into her research practices. Incentives have evolved to reflect the norms and practices in genomic research. Publishing first—that is, being listed as the first author in peer-reviewed biomedical journals—is not as highly valued as before. Credit for any advancement in the scientific community's understanding is automatically tracked and attributed to the people and AI systems involved in the work. The complexity and scope of the scientific challenges being tackled in 2030 require a coordinated approach by thousands if not millions of humans and machines. Dr. Min and her contemporaries are leading the way in re-organizing research labs and clinical practices to support this new way of networked working.

A growing movement to design work infrastructures that promote collaboration and reward contribution is taking shape. Gaming and coding communities hint at the ways that people will collaborate to get stuff done. Innovative organizations are experimenting with reputation-weighted decision making, automated profit-sharing payrolls, and open, mutable policies and codes of conduct. Over the next decade, a new organizational structure will emerge that decentralizes decision-making and empowers workers. It will be enabled by a number of technologies including secure distributed ledgers and machine-learning systems.

Data for Democracy is a 4,000-member organization with members residing in every time zone across the globe.[xiv] To work collectively to advance their issue of ensuring that data and technology are used for good, it relies on human-machine partnerships to empower its members.

For instance, the organization's projects operate in Slack channels, a single place for contributors to share messages, tools and files.[xv] It even onboards new members in a Slack channel. Slack, explains Data for Democracy founder Jonathon Morgan, is its own "ecosystem" for coordinating projects and hackathons.[xvi]

Working in self-selecting channels as opposed to on fixed teams has not detracted from a sense of community. In fact, says software developer Margeaux Spring, "Data for Democracy is the most welcoming, helpful and safe virtual space I have ever participated in."[xvii] The infrastructure that fosters trust also yields results. To date, the group has completed 20 projects with 29 in progress, logging over 267,000 Slack messages in the process.[xviii]

Sharing many of the functionalities of Slack, the messaging app Discord provides a robust but lightweight way for gamers to connect and strategize with other players in real-time, using text, voice or video. Since 2015, Discord has amassed more than 130 million users who participate in user-generated servers, which operate like chatrooms, that have subtopics and search capabilities.[xix] Another collaborative platform, Github, was originally viewed as a tool for developers to host and review code and build software together. Now, Github is home to wide-ranging projects undertaken by distributed communities.

Collaboration platforms such as Slack, Discord and Github offer clues to the social norms, cultural practices and workers' expectations that will inform how work is completed a decade from now. For teams that are geographically distributed, these tools help facilitate constant connection and coherent, team-based actions.

SIGNAL OF CHANGE

Discord is a free voice, video and text chat app, highly popular with players of strategy games in which team communication is critical. For a significant portion of the 14 million daily users (who, on average, collectively send over 315 million messages each day), it provides a community of like-minded people interested in accomplishing (game-related) tasks together.

Over the next decade, organizations that aim to foster collaboration will work to empower workers by cultivating the real-time collaboration practices already embedded in gaming, coding and distributed communities.

The forecasted shift toward empowered workers may lead to a greater number of decentralized organizations that operate more like Data for Democracy or a gaming community than they do a traditional organization. Start-up Colony's goal is to build the governance framework for these types of organizations. Built on the Ethereum blockchain, the platform "automates the project management process by aggregating the collective intelligence of the workforce to suggest and assign tasks, make decisions and provide feedback on people's work."[xx] Colony envisions a future of self-organizing companies that "run via software not paperwork," and in which, according to CEO Jack du Rose, "the relationship is with the contract, not with the company."[xxi]

Companies running on software may make monitoring and quantifying workers' contributions much easier, which may lead to new practices around compensation. Imagine if workers could choose how frequently they want to be paid. Some may prefer to be paid monthly or bi-weekly, however, others may choose to be paid as soon as they earn it— daily, hourly or even in real time. According to Euros Evans, CEO of a London-based start-up called Etch, "We hope by people being paid as soon as they've earned it, we can reduce the need for payday loans and other such instruments to plug spending gaps, as well as improve peace of mind."[xxii] Over the decade, real-time payroll could extend to real-time profit sharing, triggered the moment the profit is realized by an organization.

Similarly, some workers will be motivated by more than a paycheck. For some, it might be self-actualization, or the ability to employ their knowledge in a meaningful way. To keep pace with the diversity in motivations, organizations will need to pursue a portfolio of compensation resources that spans beyond monetary.

SIGNAL OF CHANGE

Colony constructs the tools people need to be able to quickly and easily work together to accomplish a discrete task. As CEO Jack du Rose explains, instead of relying on Upwork, groups can tap a "network of people that you already trust… but do not need to be on payroll all of the time."[xxiii] As a next step toward a more open workforce, Colony's upcoming application will give teams a hub for incentivizing and organizing open contributions to their projects.
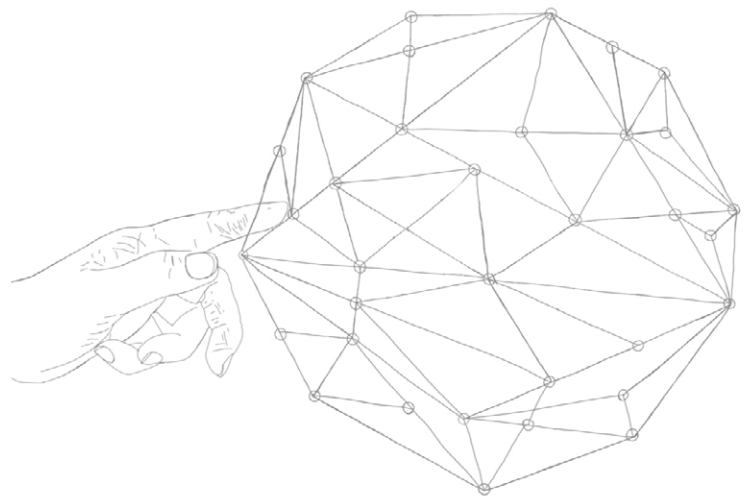
SHIFT 3:
AI FLUENCY

BUENOS AIRES, ARGENTINA

Buenos Aires. Argentina. After two years working as a systems programmer for a large hospitality chain, Laura invests more of her personal time in virtual learning courses on positive psychology and behavior change. Before taking a full-time role, Laura had concentrated most of her course work on intelligent agent design, learning the ins and outs of robotics AI programming. Now, with a couple of years of work experience, Laura has figured out that her technical expertise is less valuable than her ability to work with the company's AI systems. She is part of the cohort of AI natives who have joined the workforce over the last few years. Unlike digital natives, millennials and other more experienced workers at her organization, she grew up navigating her coursework and personal life with her infallible AI assistant at her side. Working in partnership with an AI assistant is second nature to her, but Laura has noticed that many of her colleagues who didn't grow up with AI struggle to integrate it into their workflows. So, instead of re-programming the company's AI systems, most of her time at work is now spent helping her colleagues partner more smoothly with those systems. Laura doesn't know if some of her Gen X colleagues will ever stop writing their own emails, but, the mentoring by AI natives like herself is a step in the right direction.

The future of work is inextricably linked to the future of learning. How we educate our youth translates into their preparedness as they enter the workforce. And how we retrain and upskill our existing workforce allows them to stay relevant in a changing work environment. The learning, retraining and upskilling over the next decade will include improving everyone's knowledge of and capabilities in AI. And this won't necessarily mean teaching coding or even broader technical skills. In a new world of work, learning to effectively judge what machines can and cannot do, as well as what they should and should not do, will be a critical capability for workers in the future. In return, human strengths and capabilities will need to be integrated into AI systems to help workers partner more collaboratively with them. Classifying the strengths and capabilities of both humans and machines will be a core aspect of having a strong command of AI systems in the future.

There is little debate that the pace of change is accelerating—and with it, the rate at which people acquire the ever-evolving skills and knowledge they need to execute their jobs. Yet, our ability to prepare today's learners for tomorrow's work is hampered by a lack of shared understanding of what people will need to know to be successful in the 2030 work environment.

At minimum, experts forecast that workers' skills will include a set of capabilities needed to apply AI effectively in their work. A 2017 study published by MIT Sloan Management Review identified three categories of AI-driven business and technology jobs: "trainers, explainers and sustainers."[xxiv] According to study authors James Wilson, Paul Daugherty and Nicola Morini-Bianzino, AI trainers will be needed to develop AI personalities and train them to convey empathy; AI explainers will be enlisted to elucidate algorithmic decision-making; and AI sustainers will seek to prevent AI from doing harm.

Increasingly, consensus is forming among experts that it is the partnership between humans and machines that will have the most potent impact. As Wilson and Daugherty argue, the greatest benefit of AI "will be in complementing

and augmenting human capabilities, not replacing them."[xxv] Others, like Dennis Mortensen, CEO and founder of x.ai, echo that sentiment, viewing the introduction of AI as something that will make us "better at doing our jobs, and better at being human."[xxvi] And, Mihir Shukla, chief executive of Automation Anywhere, envisions of a future of work in which bots are seen as "digital colleagues."[xxvii]

SIGNAL OF CHANGE

x.ai built Amy and Andrew, autonomous AI scheduling assistants, to help, as the company's CEO explains, "automate everything you can" to free up human's time and attention for higher-order thinking.[xxviii]

To create future work environments in which machines are viewed as colleagues and the comparative advantage of humans lies in our higher-order thinking and emotional intelligence, human strengths will need to be programmed and integrated into the machine intelligence. Just as humans need to improve our ability to offload tasks that are better suited for machines, AI systems need to be designed to recognize computational limitations and know when to lean on their human partners for help with completing a task.

Though these may include application or industry-specific skills—it may be a kind of meta-knowledge about AI, or a deep understanding of human and machine systems, that sets workers apart. Over the next decade a type of AI fluency may emerge. For humans, AI fluency will include knowing how to leverage machine intelligence to manage workflows and accomplish tasks as well as knowing the limitations of the AI systems. And, the ability to know when a human is better suited to complete a task or set of activities will be a form of human fluency that machines will need to develop. Importantly, keeping pace with how each other's evolving capabilities might be changing will be part of building fluency in AI.

Interestingly, many skills that experts view as part of AI fluency are not, today, universally recognized as skills at all. Compassion and judgment, for instance, are often thought of as innate traits. But the emergence and success of programs like Stanford University's "Compassion Cultivation Training" suggest that people can learn them as skills. In

addition, a present-day education in tech can leave out discussions of how to create systems where there is responsibility, transparency and accountability. However, examining what these values mean and how to implement them will be critical for developing true AI fluency.

By 2030, AI fluency will not necessarily mean knowing coding languages. A machine can catalogue facts and figures faster and more comprehensively than any human, but, many experts agree, understanding the context those facts fit within is something humans will likely remain uniquely capable of between now and 2030. Ultimately, the experts' perspectives suggest, to some degree, we may have to rethink and rescope what we consider skills in the first place.

SIGNAL OF CHANGE

Stanford University offers an 8-week course taught by clinical psychologists, researchers and scholars to help people train their minds "to intentionally choose compassionate thoughts and actions and develop skills that help you relate to others."[xxix] Executives and managers are encouraged to attend. Stanford faculty in Psychology, Psychiatry and Behavioral Sciences and Neuroscience are actively engaged in understanding compassion and altruism to help reduce distress for individuals and improve relationships.
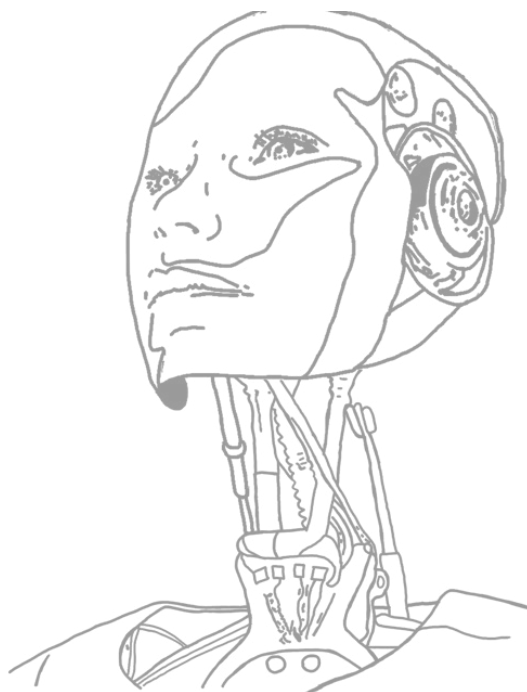
NAVIGATING DILEMMAS:
PREPARING FOR HUMAN-MACHINE PARTNERSHIPS' IMPACT ON WORK

One of the primary objectives of undertaking a study of what work might look like in 2030 is to spark actions today, actions that help accelerate and spread the conditions anticipated in the future, or actions that prevent or slow them down. If our collective interest is to increase opportunities for more people and communities to find meaningful, creative and sustaining work, then anticipating hurdles and leveraging the affordances that the emerging human-machine partnerships offer are critical actions to take in the present. As we further engage with new technologies, we will discover future dilemmas that we must successfully navigate to fully realize human-machine partnerships. These dilemmas include algorithmic bias in work environments, a digital skills gap and a re-examination of workers' rights and protections on the global scale.

Algorithmic Bias

Using human-machine partnerships to improve the process of connecting people to the right job is relatively new to how most organizations hire. While there are many favorable advancements and novel solutions that promote more inclusive hiring, there are a number of risks to consider. First and foremost, we must challenge the assumption that hiring managers know what constitutes an ideal employee. The fact may be that many organizations don't actually know what type of person with which mix of skills excels in their environment. To generate large, robust models, we will need more data not only about potential hires but also data about how past hires have performed. The data, generally considered proprietary, will improve the machine-learning systems, and they will help expose biases and unseen hiring practices of organizations.

For human-machine partnerships to enable more inclusive talent practices, we also need to do more to understand algorithmic bias. People seeking work must be able to understand how their profiles are being interpreted by the machine-learning tools that employers will use to inform their hiring decisions. As professors Peter Cappelli, Prasanna Tambe, and Valery Yakubovich wrote in a 2018 white paper, "The outcomes of human resource decisions (such as who gets hired and fired) have such serious consequences for individuals and society that concerns about fairness—both procedural and distributive justice—are paramount."[xxx] And organizations will need to be steadfast in ensuring that their systems' decision-making algorithms align with their values. Ethical practices, including full visibility to the factors informing algorithmic hiring models, will be essential to prevent biases and for these tools to promote a shift toward inclusive talent.

Digital Skills Gap

As worker evaluation practices change and new methods of discovering talent emerge, it is possible that by 2030, older generations may feel shut out of parts of the economy. Using gamification in systems to test applicants' or employees' aptitudes may reward younger people who have grown up gaming. And a lack of familiarity with collaborative platforms and working in networks may also hinder some workers' ability to take full advantage of the 2030 human-machine partnerships. This is a concern that workers and managers have already expressed. According to 4,600 global business leaders, 54% forecast the next generation of workers will disrupt their workforce with their ingrained digital skills and mindset, and 58% agree that they'll

struggle to provide equal opportunities to multiple generations of workers.[xxxi]

As new workers conditioned to gaming and to the quick pace of change enter the workforce and rise in the workplace, seniority may count for less. Organizations will need to be prepared to upskill seasoned, experienced workers in new ways of working and learning. One way this may occur is through cross-generational or reverse mentoring, where younger colleagues advise on topics such as technology and change management. This reversal of the mentoring relationship is occurring now. According to research with 12,000 Gen Zers, 77% of young respondents are willing to mentor older co-workers in tech.[xxxii]

Workers' Rights and Protections

The shift toward empowered workers challenges us to think about the role of national and local oversight over work arrangements. If one of the objectives of a distributed organization is to decentralize opportunity such that anyone qualified to accomplish a task can do so irrespective of where they live, what are the labor policy changes that would need to be put into place? If people are being compensated for their contributions and not for a fixed amount of time, how will workers' rights and protections be upheld and enforced?

In certain countries, full-time employment is the means by which people receive financial protections for their individual and family's healthcare, contributions to retirement pensions and guaranteed pay for sick or vacation time, among other benefits. Let's say an emerging technology such as secure distributed ledgers grant people the ability to seamlessly create work agreements. How then will people navigate the different laws and regulations associated with workers? How will they do so in a way that is fair to workers? It may be that in order to realize a more equitable future for work, governing structures will need to keep pace with these changing work arrangements.

CONCLUSION

As we consider the future for the individual who acquires a job via machine-learning systems that measure human potential through gameplay, we have to think more deeply not only about new hiring practices, but also about what her work itself will entail. As she pursues a 21st century career path, she'll begin to cultivate a trusted community of colleagues. Will she then build a collaborative organization with some of them in which governance is allocated according to their contributions? Or will she get hired by an established organization with nondiscriminatory practices (where age, gender, ethnicity and geography are not included in the vetting process)? Indeed, will the fact that she is an AI-fluent woman living in Lagos, Nigeria who lacks professional experience but is an avid gamer, be seen as an invaluable asset to her employer?

The next decade brings with it an opportunity to apply emerging technologies such as collaborative AI, multimodal interfaces, extended reality and secure distributed ledgers to shape the future such that more people can engage in meaningful, creative and sustaining work. This report argues that these technologies can enable three shifts—inclusive talent, empowered workers and AI fluency—toward a reimagined future for work, one in which the human-machine partnerships forming over the next decade produce a more inclusive and equitable future.

This opportunity is not a foregone conclusion, however. Technological advancement is one undeniable force that will shape the future of work. It is already happening: AI is entering the workplace today at a rapid clip, offloading certain tasks and displacing workers from jobs. Without deliberate effort to apply emerging technologies to promote a more inclusive and equitable work environment in 2030, the advances in technology may not yield as positive a future. With the benefit of a long view, however, we can imagine how AI in the workplace can generate a variety of new work roles and create "new, uniquely human" jobs.[xxxiii]

Emerging technologies are just part of the picture. They will intersect with other social and economic forces to create new tensions and challenges. Navigating the dilemmas outlined in the report will require a thoughtful, imaginative and forward-looking approach. By applying the insight gained by looking out ten years, we have the opportunity to strengthen the partnerships between humans and machines and bolster opportunities for economic empowerment and decent work for all.

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