

The next era of  
**human | machine**  
**PARTNERSHIPS**



**EMERGING TECHNOLOGIES' IMPACT  
ON SOCIETY & WORK IN 2030**

## **INSTITUTE FOR THE FUTURE**

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## ABOUT THIS RESEARCH

In 2017, Dell Technologies partnered with the independent futures research group, [Institute for the Future \(ITF\)](#), to explore the emerging technologies shaping the future of the human experience over the next decade, and the specific impacts and implications they will have on society and work. To execute this, ITF relied on its decades-long study on the future of work and technology, in-depth interviews with key stakeholders, and the opinions and ideas generated during an all-day facilitated workshop with a diverse set of experts from across the globe. Experts informing the report include:

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# Introduction

At its inception, very few people anticipated the pace at which the internet would spread across the world, or the impact it would have in remaking business and culture. And yet, as journalist Oliver Burkeman wrote in 2009, “Without most of us quite noticing when it happened, the web went from being a strange new curiosity to a background condition of everyday life.”<sup>1</sup>

Today’s emerging technologies also feel like strange, new curiosities. Artificial Intelligence (AI), augmented and virtual reality, home robots, and cloud computing, to name only a few of the sophisticated technologies in development today, are capturing the imaginations of many. The advanced capabilities of today’s emerging technologies are driving many academics, entrepreneurs, and enterprises to envision futures in which their impacts on society will be nothing short of transformative. At a recent expert workshop hosted by Dell Technologies and the Institute for the Future (ITF), participants suggested that the technologies in play over the next decade have the potential to “solve some of the intractable problems that humanity has faced for so long,” offer the opportunity to “increase productivity [such that] all our basic needs [are taken care of],” and fundamentally reframe “notions of what it means to be a person.”<sup>2</sup>

Whether or not these emerging technologies will realize these ambitious possibilities is uncertain. What is certain is that they will intersect and interact with powerful demographic, economic, and cultural forces to upend the conditions of everyday life and reshape how many live and work in 2030. As a result,

many organizations and people will navigate uncharted waters over the next decade, unsure of what lies ahead. In Dell’s Digital Transformation Index study, with 4,000 senior decision makers across the world, 45% say they are concerned about becoming obsolete in just 3-5 years, nearly half don’t know what their industry will look like in just three years’ time, and 73% believe they need to be more ‘digital’ to succeed in the future.

With this in mind, we set out with 20 experts to explore how various social and technological drivers will influence the next decade and, specifically, how emerging technologies will recast our society and the way we conduct business by the year 2030. As a result, this outlook report concludes that, over the next decade, emerging technologies will underpin the formation of new human-machine partnerships that make the most of their respective complementary strengths. These partnerships will enhance daily activities around the coordination of resources and in-the-moment learning, which will reset expectations for work and require corporate structures to adapt to the expanding capabilities of human-machine teams.



# Emerging Technologies Impacting Our Lives

There is no universally agreed upon determination of which technologies are considered emerging. For the purpose of this study, IFTF explored the impact that Robotics, Artificial Intelligence (AI) and Machine Learning, Virtual Reality (VR) and Augmented Reality (AR), and Cloud Computing, will have on society by 2030. These technologies, enabled by significant advances in software, will underpin the formation of new human-machine partnerships.

## Robotics

For decades, robots have performed activities that humans should not or do not want to do. This includes dangerous situations, repetitive tasks, or tasks that do not require special cognitive or problem-solving skills. In the most advanced manufacturing sectors—among Japan’s carmakers, for example—robots are already able to work unsupervised, around the clock, for up to 30 days without interruption.

Rapid developments across science, technology, engineering, and communications have brought about what has been called the new Industrial Revolution, or “second machine age,” which will greatly expand robots’ competencies and functions. With these changes, a whole suite of jobs is being reimagined as automation displaces and disrupts human labor, the benefits of which have been well chronicled.

While offshoring manufacturing jobs to low-cost economies can save up to 65% on labor costs, replacing human workers with robots can save up to 90% of these costs.<sup>3</sup> China is currently embarking upon an effort to fill its factories with advanced manufacturing robots, as workers’ wages rise and technology allows the industry to become more efficient. The province of Guangdong, the heartland of Chinese manufacturing, has promised to invest \$154 billion in installing robots. According to a report released by PwC, more than a third of U.K. jobs could be at “high risk” of automation by the early 2030s and robots could take over 38% of current U.S. jobs in the next 15 years.<sup>4</sup>

Buoyed by their commercial success, the adoption of robots will extend beyond manufacturing plants and the workplace. Family robots, caregiving robots, and civic robots will all become commonplace as deep learning improves robots’ abilities to empathize and reason. Google recently won a patent to build worker robots with personalities. While there are certainly regulatory and legal hurdles, as well as cultural acceptance, to overcome, this introduction of robots into our personal lives will continue over the next 15 years.

ohmnilabs.com



### OhmniLabs

Ohmni is an affordable telepresence, self-charging and self-repairing home robot.

## Emerging Technologies Impacting Our Lives (cont.)

### Artificial Intelligence and Machine Learning

Artificial Intelligence has come a long way from the days of Herbert Simon's Logic Theory Machine program in 1956. Since 1997, when a chess-playing computer, Deep Blue, beat Gary Kasparov, the reigning world chess champion, machines have become smarter, faster, and able to manage increasingly complex tasks.

Approximately 1,500 companies in North America alone are doing something related to AI today, which equates to less than 1% of all medium-to-large companies. We're seeing this in the financial services industry already, with data recognition, pattern recognition, and predictive analytics being applied to huge data sets on a broad scale. In a 2015 report, Bank of America Merrill Lynch estimated that the AI market will expand to \$153 billion over the next five years—\$83 billion for robots, and \$70 billion for artificial intelligence-based systems.<sup>5</sup>

According to Michelle Zhou, an expert in AI, development can be thought of in three stages.<sup>6</sup> The first is recognition intelligence—algorithms that recognize patterns; followed by cognitive intelligence—machines that make inferences from data; with the final stage being virtual human beings. It is plausible that, by 2030, we will enter the second stage in AI as this technology continues to progress. AI is being applied in both simple and complex applications—from autonomous vehicles to Apple's Siri. Recently, an AI program called Libratus from Carnegie Mellon University beat the world's best professional poker players in Pittsburgh after a 20-day event. Significantly, the machine was able to outsmart the humans by using "imperfect information." This is because, in poker, there is a degree of missing information. Players will never reveal the cards in their hand until they must (unlike chess, where everyone can see the pieces and possible moves).

In addition to their ability to make decisions with imperfect information, machines are now able to learn from their experiences and share that learning with other AI programs and robots. But AI progress also brings new challenges. Discussions surrounding who or what has moral and ethical responsibility for decisions made by machines will only increase in importance over the next decade.



#### Libratus Supercomputer

During the "Brains vs. Artificial Intelligence Re-Match" in 2017, the supercomputer, Libratus, developed at Carnegie Mellon University's School of Computer Science, reigned supreme in Texas Hold'em against some of the world's best professional poker players.

## Virtual Reality and Augmented Reality

Although both Virtual and Augmented Reality are changing the form factor of computing, there is a simple distinction between the two. VR blocks out the physical world and transports the user to a simulated world, whereas AR creates a digital layer over the physical world. Despite the difference, both technologies represent a fundamental shift in information presentation because they allow people to engage in what Toshi Hoo, Director of IFTF's Emerging Media Lab, calls "experiential media" as opposed to representative media. No longer depending on one or two of our senses to process data, immersive technologies like AR and VR will enable people to apply multiple senses—sight, touch, hearing, and soon, taste and smell—to experience media through embodied cognition.

Both VR and AR stand to transform not only media and entertainment but also drive development of innovative use cases in education, health care, travel and transportation, construction, and manufacturing. The information layer that both technologies create will accelerate the melding of digital and physical identities, with digital trails and traces forming a digital coating over individuals' physical environments. On-demand access to AR learning resources will reset expectations and practices around workplace training and retraining, and real-time decision-making will be bolstered by easy access to information flows. VR-enabled simulation will immerse people in alternative scenarios, increasing empathy for others and preparation for future situations. It will empower the internet of experience by blending physical and virtual worlds.

Right now, analysts project revenues associated with AR technologies and services will grow to about \$90 billion by 2020, the majority of which will be generated through revenue spent on hardware. VR is forecasted to grow more modestly, increasing to \$30 billion by 2020.<sup>7</sup> Yet, as authoring tools get simplified, making it easier to create VR content, VR will catch up to AR. Over the next decade, Hoo forecasts that VR, combined with vast sensor networks and connected technologies, will be one of many tools that enable distributed presence and embodied cognition, allowing people to experience media with all their senses.

Dell.com



### Oculus VR with Dell Precision Workstation

Students use Virtual Reality for an immersive and educational experience.



## Emerging Technologies Impacting Our Lives (cont.)

### Cloud Computing

It's important to recognize that Cloud Computing isn't a place, it's a way of doing IT. Whether public, private, or hybrid (a combination of private and public), the technology is now used by 70% of U.S. organizations. This figure is expected to grow further, with 56% of businesses surveyed saying they are working on transferring more IT operations to the cloud, according to IDG Enterprise's 2016 Cloud Computing Executive Summary.<sup>8</sup>

Chitale Dairy exemplifies the power of cloud computing to improve the economic well-being of dairy farmers in India. Recently, Chitale Dairy launched a 'cow to cloud' initiative in which each cow is fitted with RFID tags to capture data that is held in the cloud. The relevant analysis of this data is then sent to the local farmers via SMS and the web, to alert farmers when they need to change the cows' diet, arrange vaccinations, etc. The timely delivery of this information is increasing the cows' yield, supporting local farmers, whose livelihoods depend on the dairy farms, and enabling Chitale to manage a part of the supply chain which is normally fraught with uncertainty.

While the cloud is not a recent technological advancement, cloud technology only really gathered momentum in recent years, as enterprise grade applications hit the market, virtualization technologies matured, and businesses became increasingly aware of its benefits in terms of efficiency and profitability. Increasing innovation in cloud-native apps and their propensity to be built and deployed in quick cadence to offer greater agility, resilience, and portability across clouds will drive further uptake. Start-ups are starting to use cloud-native approaches to disrupt traditional industries; and by 2030, cloud technologies will be so embedded, memories from the pre-cloud era will feel positively archaic by comparison.



#### Chitale Dairy

Chitale Dairy launched the 'cow to cloud' initiative to improve the health and well-being of cows on dairy farms in India.



# Human-Machine Partnerships by 2030

Recent conversations, reports, and articles about the intersection of emerging technologies and society have tended to promote one of two extreme perspectives about the future: the anxiety-driven issue of technological unemployment or the optimistic view of tech-enabled panaceas for all social and environmental ills. Perhaps a more useful conversation would focus on what the new relationship between technology and society could look like, and what needs to be considered to prepare accordingly. By framing the relationship between humans and machines as a partnership, we can begin to build capacity in machines to improve their understanding of humans, and in society and organizations, so that more of us are prepared to engage meaningfully with emerging technologies.

Of course, people have lived and worked alongside machines for centuries. From the hand axe, possibly the first example of a human-made device designed to enhance human power, to time-saving home devices such as lawn mowers and vacuum cleaners, to calculators, personal computers, and the proliferation of mobile devices. However, society is about to enter a new phase, characterized by even greater efficiency and possibility than ever before.

As processing power increases 10 times every five years (Source: Moore's Law), humans will be eclipsed by computers in many areas. Machines will bring lightning speed and accuracy to all manner of tasks. However, it would be a fallacy to assume that technology is making human effort redundant. It's doubtful that computers will have fully mastered the fundamental, instinctive skills of intuition, judgment, and emotional intelligence that humans value by 2030. Over the next decade, partnering with machines will help humans transcend their limitations.

Human-machine partnerships will enable people to find and act on information without interference of emotions or external bias, while also exercising human judgment where appropriate. They'll learn to team up with technologies integrated with machine learning tools to help activate and deactivate the

resources they need to manage their daily lives. And they'll partner with AR/VR technologies to develop necessary work skills, blending experiential media with human judgement to perform well at work.

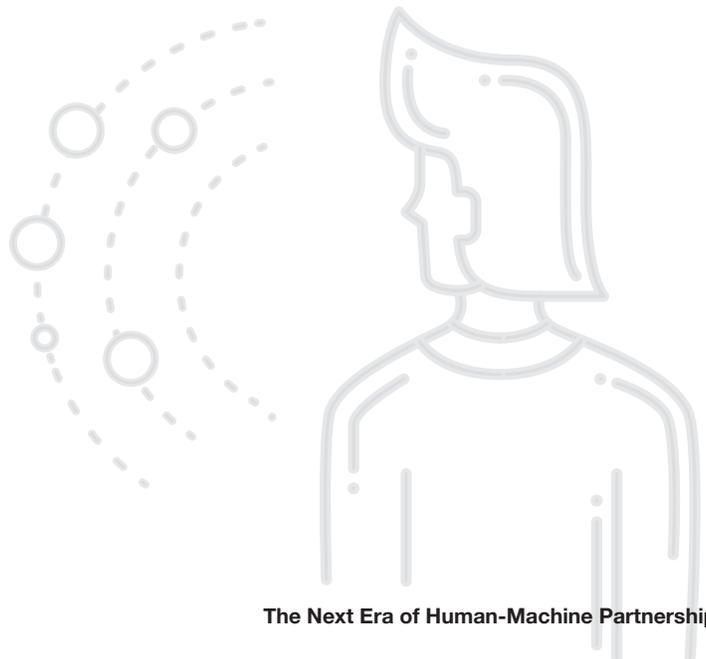
Meanwhile, organizations will increase value and customer satisfaction by growing their reliance on machine learned systems, making it possible for organizations to find and deploy resources rapidly to wherever they are needed, whenever they are needed, to create value and higher customer satisfaction.

Their ability to evaluate talent will also be bolstered by VR/AR technology, which will increase managers' ability to evaluate a worker's aptitude for gaining new knowledge or learning new skills and applying this knowledge to a new scenario.

Given the pace of industry disruption, now is the time to strengthen individual and organizational capacities to engage actively in human-machine partnerships. The next section describes the impact on individuals and organizations and how they'll come together to produce mutually beneficial partnerships to enhance daily activities and reset expectations for learning and work.

**"This [human-machine partnerships] is a great opportunity for mankind. By offloading more, we'll be able to focus on what humanity does best."**

— Norman Wang, Opaque Media



# Impact on Individuals and Organizations by 2030



The sophisticated capabilities of today's emerging technologies are underpinning the formation of new human-machine partnerships, which will have significant impact on both individuals and organizations. Working in partnership with machines will enhance people's ability to coordinate resources and learn in-the-moment, which, in turn, will reset expectations for work and require corporate structures to adapt to the expanding capabilities of human-machine teams.



## Digital Conductors

Today, an increasing portion of human mobility needs are being met by an app. Soon it will be hard to justify keeping a car in a garage or maintaining a piece of equipment that's rarely used, when technology is providing what people need, when they need it. And it's not just mobility services that are being mediated through an app. Already, the number of digital platforms that are being used to orchestrate either physical or human resources has surpassed 1,800.<sup>9</sup> They are not only connecting people in need of a ride with drivers, or vacationers with a place to stay, but job searchers with work, and vulnerable populations with critical services. The popularity of the services they offer is introducing society to the capabilities of coordinating technologies and resetting expectations about the ownership of fixed assets.

By 2030, populations' needs and resources will be orchestrated by self-learning, digital technologies, allowing humans to take the role of digital resource conductors. Technology will work as an extension of people, helping orchestrate, manage, and automate many day-to-day activities. And because the technology will be woven into everyone's lives (some will even be implanted), and personalized to the individual, some needs will be met often before people even realize they have them. These digital technologies will be integrated with machine learning to create a population of digital orchestration systems, harnessing technology to arrange and direct resources to produce a desired result.

Digital natives will lead the charge. As they become parents, they'll rely upon human-machine partnerships to manage work and family commitments. They'll be joined by the millions of people involved in caring for a loved one. In regions of Asia and Europe where people aged 80 years or older comprise the fastest growing subsets of their populations, the retirement-age cohort will remain larger than the working-age population for decades to come. Many relatives of elderly people will use lightweight and affordable home robots to cultivate co-presence, and depend on coordinating platforms to schedule and monitor caregiving services on-demand to find support for their loved ones.

By 2030, many will be savvy digital orchestra conductors, relying on their suite of personal technologies, including voice-enabled connected devices, wearables, and implantables; to infer intent from their patterns and relationships, and activate and deactivate resources accordingly. Yet, as is often the case with any shift in society, there is a risk that some segments of the population will get left behind. Individuals will need to strengthen their ability to team up with machines to arrange the elements of their daily lives to produce optimal outcomes. Without empowering more to hone their digital conducting skills, the benefits that will come from offloading 'life admin' to machine partners will be limited to the digitally literate.

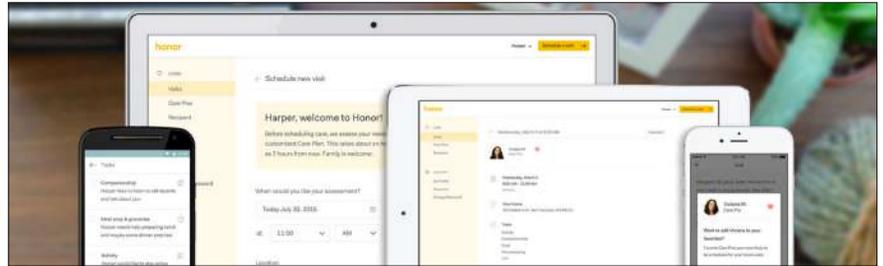
**“If you imagine this partnership [between humans and machines] transforming how we arrange and direct our lives to seamlessly provide what we need, before we need, with just the wave of a hand per se, it's possible to imagine a future in which machines become extensions of ourselves. Today we have digital natives. In ten years, we'll have digital conductors.”**

—Thuc Vu, Co-founder and CEO, OhmniLabs

## A Day in the Life 2030 ...

Janine, a freelance designer, just received a notification from her AI assistant that her elderly aunt is unwell. Janine accesses her aunt's home robot, which is constantly monitoring her aunt's vital signs. She sees that the algorithmic health system has already diagnosed the issue and has ordered her medicine. Janine also added some flowers to the delivery to cheer up her aunt. The whole package is delivered within the hour via a drone. Janine coordinated all of that while commuting in a driverless, shared ride service programmed to pick her up and go directly to her daughter's school. Janine's AI assistant monitors the data flowing from her daughter's implantable health tracker. Janine concludes that her daughter's blood sugar levels must have been low because as her car pulls up, a delivery drone is dropping off a healthy snack.

## Signals of Change



**Honor** is an app that matches patients with caregivers, and coordinates meals, transportation, housekeeping, and companionship, so older people can be cared for and carers can be present—without physically being in the same room. It uses one platform to manage all aspects of eldercare. Although it provides patient care, its founder, Seth Sternberg, says, “Honor is really about the technology”—connecting health care professionals (people) and those in need of care with one another.<sup>10</sup>

joinhonor.com



**Original research** conducted by Institute for the Future in 2016 identified more than 1,800 digital work platforms (similar to Uber, Seamless, Upwork, etc.) in operation around the world. Notably, the vast majority of the platforms were founded in the last five years, suggesting that the tools and services that digital conductors will need to orchestrate their work and home lives are only beginning to form.

IFTF



# Work Chasing People

Human-machine partnerships will not only help automate and coordinate lives, they will also transform how organizations find talent, manage teams, deliver products and services, and support professional development. Human-machine partnerships won't spell the end of human jobs, but work will be vastly different.

By 2030, expectations of work will reset and the landscape for organizations will be redrawn, as the process of finding work gets flipped on its head. As an extension of what is often referred to as the 'gig economy' today, organizations will begin to automate how they source work and teams, breaking up work into tasks, and seeking out the best talent for a task. Instead of expecting workers to bear the brunt of finding work, work will compete for the best resource to complete the job. Reputation engines, data visualization, and smart analytics will make individuals' skills and competencies searchable, and organizations will pursue the best talent for discrete work tasks.

The ability to orchestrate both physical and human resources will make it possible for organizations to activate, deactivate, and deploy resources to wherever and whenever they are needed. Not only will this make the organization leaner and more competitive, it will also reduce fixed costs and overheads, and place them on the path to becoming more agile and profitable. However, none of this is assured. To prepare for 2030, organizations will need to build out their capacity to disaggregate the tasks and duties of jobs, as they are designed today.

Businesses will need to manage this shift carefully. Upon first glance, any reduction in full-time employment could seem perilous for the economic stability of individuals and families. However, reframing talent from fixed to variable resources will

unleash novel opportunities for a diverse pool of truly global talent. These skilled individuals will benefit from a suite of sophisticated communication and social collaboration tools that allow independent workers and teams to coordinate across institutions and time zones. By loosening the ties between work and geography, it will be possible to chip away at the misalignment of global talent that exists today. With regions of South-Central Asia and Sub-Saharan Africa projected to grow by almost one billion people by 2030, work, particularly digital work, will search for the top talent and innovative ideas housed in emerging regions.

Work chasing people could also reduce personal biases and stereotypes in the job seeking process. Integrating VR technology into recruitment protocols, for example, enables the prospective worker to demonstrate competency by showcasing skills without revealing gender or ethnicity. Hiring through immersive technologies could improve the dismal representation of women in computing jobs (currently, in the United States, only 26% of them are held by women), and open more doors to people who, historically, have not had equal opportunity to demonstrate their abilities.

For continuity, strategic advantage, and other critical reasons, there will still be many roles that will benefit from having full-time employees with long tenures within a single organization. Yet, organizations will need to apply a more discerning lens to distinguish when full-time employment is necessary and when procuring the top talent for a specific set of tasks is more prudent. Similarly, organizations will need to rethink the recruitment process and determine when immersive and experiential technologies serve as better hiring tools than human judgment. Without incorporating these expanded capabilities of machines, organizations will run the risk of missing out on new channels to identify optimal talent.

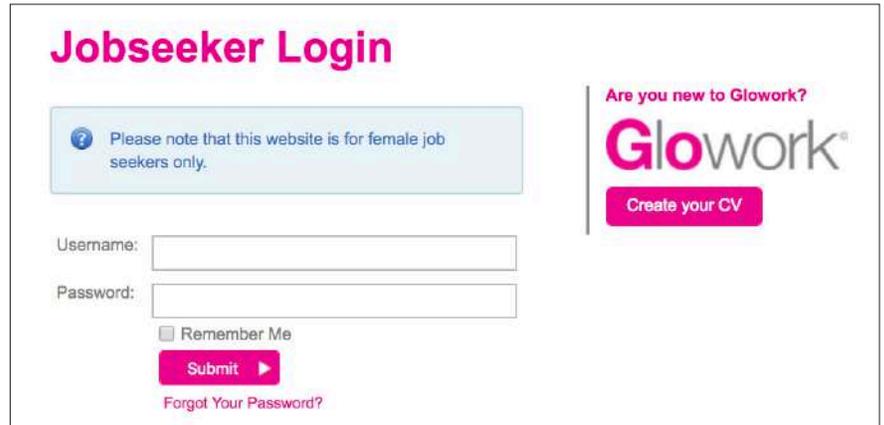
**“ I lead a community of young, post-college, active technology users in Ghana and West Africa, and my work is to give them access to global opportunities”**

—William Senyo, Co-Founder & Chief Executive Officer, Impact Hub Accra, Ghana

## A Day in the Life 2030 ...

Eng is a natural when it comes to being entrepreneurial. He uses Working Local as a kind of “dating service” to find great opportunities. Today, Eng has been routed a project from a candy company in Sweden looking for help with market research as they consider opening exports to the Philippines. They are particularly interested in finding someone who can interview local shopkeepers in Manila and take photographs of their candy displays for analysis by computer vision systems. Eng has always liked the process of figuring out what people want. He is happy to see that the Working Local system is starting to recognize his talent for this and will probably offer similar opportunities in the future.

## Signal of Change



**Glowork** is the first women’s employment organization in the Middle East and has launched a platform that links female jobseekers with employers. So far it has put over 3,000 women in the workplace, and found work-from-home jobs for 500 women. Leveraging big data, employers can search for candidates based on different search criteria as well as the right target market for them.<sup>11</sup>

glowork.net



**Alice**, a technology powered by Circular Board, is the world’s first artificial intelligence platform for women entrepreneurs. Alice connects founders in real-time with carefully curated resources specific to their industry, stage of growth, and location. As Alice populates, machine learning will allow her to predict the needs of founders to guide them to referrals, events, mentors, and access to capital and ecosystems.

helloalice.com



# In-the-Moment Learning

The U.S. Bureau of Labor Statistics says that today's learners will have 8 to 10 jobs by the time they are 38. Many of them will join the workforce of freelancers. Already 50 million strong, freelancers are projected to make up 50% of the workforce in the United States by 2020.<sup>12</sup> Most freelancers will not be able to rely on traditional HR departments, onboarding processes, and many of the other affordances of institutional work.

Not only will workers have many jobs, the tasks and duties of the jobs they'll perform will be markedly different from what they studied. The experts that attended the IFTF workshop in March 2017 estimated that around 85% of the jobs that today's learners will be doing in 2030 haven't been invented yet. This makes the famous prediction that 65% of grade school kids from 1999 will end up in jobs that haven't yet been created seem conservative in comparison.<sup>13</sup>

Whether either forecast comes to fruition, it's clear that, by 2030, workers will create new work infrastructures to acquire the skills and knowledge they will need to execute their work successfully. They will routinely improvise, learn from each other, and make their own way. Some will rely on past work experiences, frameworks, or mental models. Others will experiment across different platforms, discovering their own workarounds and pioneering their own innovations. These factors combined, will seriously challenge traditional establishments. Most will partner with machines to learn while on-the-gig. By 2030, in-the-moment learning will become the modus operandi, and the ability to gain new knowledge will be valued higher than the knowledge people already have.

To acquire the necessary knowledge, some will use AR technologies to perform unfamiliar and complex tasks on the job. Instead of depending on technical schools or training programs to learn new skills and retrain displaced workers, workers, wearing an AR headset, will be fed the information that they need in real-time and in their field-of-vision so they can do the work. As Amit Mahajan, Managing Partner at Presence Capital, forecasted, "A worker in the future may put on their AR headset and, just like a ride-sharing driver, start receiving requests to physically perform technical operations."<sup>14</sup> Others will depend on apps and services that are designed to engage users in learning during the idle moments of their lives. One early example of this is WaitSuite, developed by researchers at MIT's Computer Science and Artificial Intelligence Laboratory, to turn every waiting opportunity into a learning opportunity (a practice called 'wait-learning').<sup>15</sup>

As the transfer of knowledge will be increasingly offloaded to emerging technologies, individuals will shoulder the burden of using these new technologies to acquire necessary skills to demonstrate proficiency. As a result, people will need to know how to access information and learn through immersive and experimental media such as AR and VR. Whether it's using VR/AR technology to prepare response teams for emergency events or teaching someone how to fix a leak, emerging technologies will reshape the methods and tools available to impart information. This will require both access to technology as well as increased confidence in their know-how to utilize emerging technologies.

**“Workers in the gig economy will self-direct their wage. They'll increase their salary by taking on jobs in which they can learn. People are learning as they go and considering new avenues for their career in the process. This will have wide-ranging implications—on work and educational establishments.”** –Eri Gentry, Institute for the Future

## A Day in the Life 2030 ...

When Lydia was in her early 20s, she spent over \$5,000 to study automotive mechanics in New York City. Shortly after, she found steady work as an automotive technician at a large dealership. Throughout her tenure, she has routinely taken online courses to update her skillset and attended trainings related to specific car brands. Since her employer introduced AR technology into the repair shop, she doesn't have to sacrifice family time and modest savings to acquire new skills. When she is charged with performing an unfamiliar or complex task, she slips on her safety glasses equipped with AR technology. As she begins the task, relevant information is served up, across her field of vision, guiding her process throughout the task. What's more, Lydia uses a personalized system, so the information and guidance she receives is built on what she already knows, and delivered in the way she learns best.

## Signals of Change



**WaitSuite** was developed by researchers at MIT's Computer Science and Artificial Intelligence Laboratory. WaitSuite is embedded directly into existing tasks so users can learn as they wait for a WhatsApp message to appear for instance, without having to leave the WhatsApp platform. Acquiring skills through apps like WaitSuite will only grow as more people strive to learn in the moment.

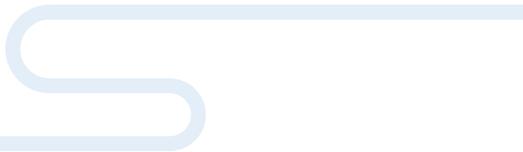
[people.csail.mit.edu](http://people.csail.mit.edu)



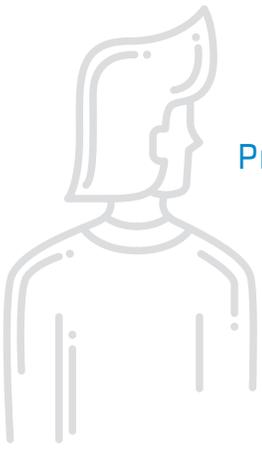
**DAQRI**, based in Los Angeles, California, is using state-of-the-art AR devices to display information and work instructions over a worker's environment, enabling them to complete a task safely and efficiently. With DAQRI's technology, workers are able to see their colleague's field of view and provide assistance—meaning field workers will never have to work alone, without the aid of their team's collective intelligence.

[daqri.com](http://daqri.com)

# Preparing for the Next Era of Human-Machine Partnerships



The sophisticated capabilities of today's emerging technologies will fuel a new level of human-machine collaboration and codependence. A future in which people partner with machines to build on their mutual strengths provides tremendous possibility to improve the conditions for everyday living. Classifying the skills that machines should bring to the table and what humans should contribute to the partnership is key. Forging strong working relationships depends upon each party bringing something unique to the collaboration. This section helps jump-start the new distribution of human and organizational skills and traits needed to thrive in the next era of human-machine partnerships.



## Preparing for the Next Era of Human-Machine Partnerships (cont.)

### Individuals

**For individuals**, domain expertise, the combination of experience, context, and knowledge on how “things get done,” will continue to be a decidedly human trait over the next decade. In addition to domain expertise, the set of attitudes often associated with entrepreneurs—vision, perseverance, creative problem-solving—will be a critical trait for all workers to employ. The ability to take a measured approach to balancing the big picture objectives of the organization with an entrepreneur’s drive to design workarounds and circumvent constraints will differentiate the humans from the machines. In other words, the skills traditionally employed by entrepreneurs will be fundamental for all workers.

While the creative skills of humans are often touted as superior to what machine intelligence might produce, human passion may be even more challenging to program. As highly valued as soft skills may be for humans to contribute to the new partnerships—such as creativity and empathy—the human drive that compels people to act is equally important. Brian Mullins, CEO and co-founder of DAQRI, believes passion is a clear advantage that humans will have over machines. As Mullins argued, “If you pick up a device and learn how to do something that you couldn’t do before, you could fire up a passion in people and that is what’s going to make a change in our world. This is how the application of these technologies will solve even more interesting problems on a global scale.”<sup>16</sup>

As the rise of reputation engines, data visualization, and smart analytics make individuals’ skills and competencies increasingly searchable, cultivating and preserving a strong personal brand will be considered basic professional hygiene over the next decade. In order for rewarding and challenging work to find them, people will need to maintain a favorable, professional reputation in one’s network.

Many will depend on machines to run the daily activities associated with managing personal brands and professional reputations, exemplifying another critical skill for individuals to develop—the nimble ability to integrate lightweight automation tools into their own work and home lives. Instead of resisting the affordances of automation tools, being able to apply them to one’s own life will help individuals to easily offload automatable tasks, like personal brand audits, and hone the needed human skills in work and at home.

Finally, as AI cloud services enable more applications and devices to incorporate AI capabilities without heavy investment in the technical infrastructure, access to information will be even more expansive than it is today. In 2030, skills in information qualification and judgment will remain critical, as will the new skill of interpreting an output produced by an algorithm. The ability to make sense of combined human-machine outputs will be key for success in the next era of human-machine partnerships.

#### INDIVIDUAL SKILLS & TRAITS

- **Contextualized intelligence:** nuanced understanding of culture, society, business, and people
- **Entrepreneurial mindset:** applying creativity, learning agility, and an enterprising attitude to find workarounds and circumvent constraints
- **Personal brand cultivation:** a searchable and favorable digital identity as basic work hygiene
- **Automation literacy:** the nimble ability to integrate lightweight automation tools into one’s own work and home life
- **Computational sensemaking:** ability to derive meaning from blended machine and human-based outputs

# Organizations



**For organizations,** building out technological capabilities will be key. Central to this will be recognizing that the threat of falling victim to security breaches is no longer a technology problem, but a business problem. This will elevate the role of building and maintaining secure systems, as well as designing effective response strategies. Over the next decade, people will digitally transmit more and more traceable data, blending, in many cases, their physical and digital identities. As a result, maintaining consumer trust will be vital. Organizations will need to show that they've gone to the nth degree to protect their customers' data. As Zulfikar Ramzan, Chief Technology Officer at RSA Security, explained, "Any ambitious enterprise will be truly a joint venture between business and security."<sup>17</sup> Understanding the business implications of security breaches will drive organizations to develop risk-mitigating security strategies that work both to prevent attacks and respond and resolve incidents quickly when they occur.

Meeting the exacting expectations of consumers will be equally critical for organizations' success in 2030. Whether it's the delivery of a product, execution of a service, or even identification of the next job, any delay in a digital transaction will be increasingly unacceptable to consumers. As AI is progressively applied, organizations will be able to fix problems and offer new services at speed, representing a continuous cycle of improvement. Eliminating latencies, responding in real-time, and activating this automatic cycle of improvement will be another key organizational competency to perfect.

Organizations will need to quickly ramp-up their internal competency to ensure that the growing number of algorithms that are running more and more aspects of their business align with their brands and values. In addition to ensuring that the outputs from the machine-learned systems are accurate, for public relations and litigation purposes, organizations will need to be adept at reviewing the assumptions built into machine systems to prevent the systems from exhibiting implicit racial and gender bias.

Especially in a future of work chasing people, organizations will need to test and reset the assumptions employees have around the value of work. They'll need to understand how the value of work in people's lives is changing, and to assess what will be their anticipated return on time spent working. Digital natives will expect to apply their individual skills around digital conducting at work, and will view jobs as opportunities to learn and make a meaningful impact. Organizations that support those aspirations will attract the next decade's top talent.

Finally, as more automated machine-learned systems partner with workers, finding ways to create spontaneous and novel approaches to accomplishing tasks will help inspire creativity in the workplace. Implementing structures and processes that incent workers to deviate from algorithmic systems will reduce the likelihood that systems are running on historical or outdated assumptions, and impose attractive challenges for the workforce to outsmart the machines.

## ORGANIZATIONAL SKILLS & TRAITS

- **Business-driven security:**  
embed security as a business strategy
- **Eliminate latencies:**  
exceed consumer expectations for real-time delivery
- **Algorithmic branding:**  
ensure algorithms align with organizational values
- **Diversifying value of work:**  
reset assumptions behind the value of work
- **Inspire innovation:**  
incent workers to deviate from machine-learned systems

# Conclusion: Human-Machine Partnerships in 2030

Both individuals and organizations are grappling with the digital and workforce transformations underway today. As these transformations are informed and influenced by emerging technologies over the next decade, people will develop new and deeper relationships and new dependencies on machines, at home and in the workplace. If we start to approach the next decade as one in which partnerships between humans and machines transcend our limitations and build on our strengths, we can begin to create a more favorable future for everyone.

Jordan Howard, Social Good Strategist and Executive Director of GenYNot, sees tremendous promise for the future of human-machine partnerships: “Many of the complex issues facing society today are rooted in waste, inefficiency, and simply not knowing stuff, like how to stop certain genes from mutating. What if we could solve these problems by pairing up more closely with machines and using the mass of data they provide to make breakthroughs at speed? As a team, we can aim higher, dream bigger, and accomplish more.”

Liam Quinn, Dell Chief Technology Officer, likens the emerging technologies of today to the roll-out of electricity 100 years ago. Quinn argues that we no longer fixate on the “mechanics” or the “wonders” of electricity, yet it underpins almost everything

we do in our lives. Similarly, Quinn argues, in the 2030s, today’s emerging technologies will underpin our daily lives. As Quinn provokes, “Imagine the creativity and outlook that’s possible from the vantage point these tools will provide: In 2030, it will be less about the wonderment of the tool itself and more about what that tool can do.”<sup>18</sup>

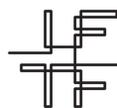
By 2030, we will no longer revere the technologies that are emerging today. They will have long disappeared into the background conditions of everyday life. If we engage in the hard work of empowering human-machine partnerships to succeed, their impact on society will enrich us all.



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