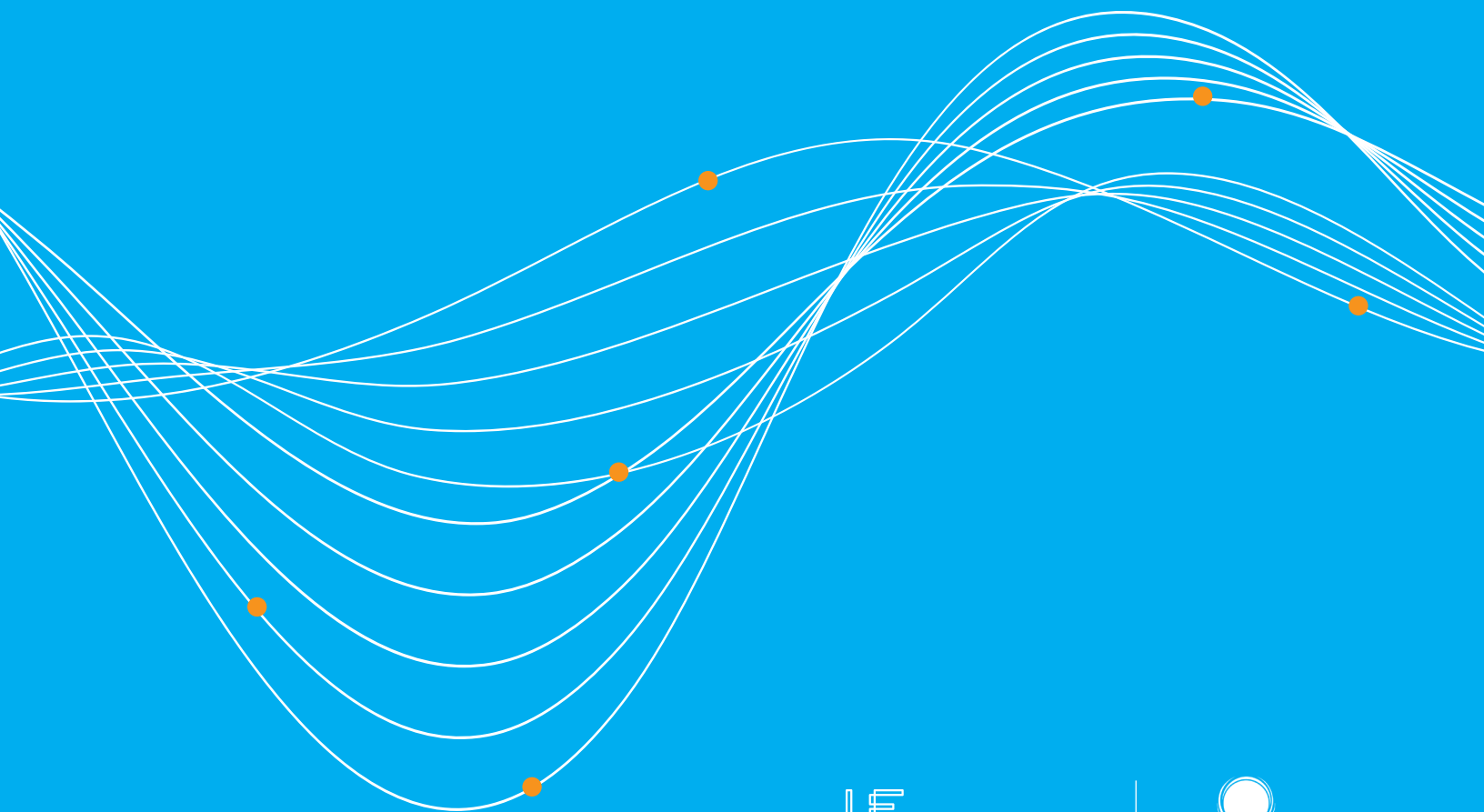# AI Forces Shaping Work & Learning in 2030

Report on Expert Convenings
for a New Work + Learn Future

October 2018

INSTITUTE FOR THE FUTURE

Lumina
FOUNDATION

INSTITUTE FOR THE FUTURE

Institute for the Future (IFTF) is an independent, nonprofit 501(c)(3) strategic research and educational organization celebrating 50 years of forecasting experience. The core of our work is identifying emerging trends and discontinuities that will transform global society and the global marketplace. Our research generates the foresight needed to create insights that lead to action and spans a broad territory of deeply transformative futures, from health and health care to technology, the workplace, learning, and human identity. As an educational organization, IFTF strives to comply with fair-use standards and publish only materials in the public domain under the Creative Commons 4.0 International License (CC BY-NC-ND 4.0). The Institute for the Future is based in Palo Alto, California. (www.iftf.org)

LUMINA FOUNDATION

Lumina Foundation is an independent, private foundation in Indianapolis that is committed to making opportunities for learning beyond high school available to all. We envision a system that is easy to navigate, delivers fair results, and meets the nation's need for talent through a broad range of credentials. Our goal is to prepare people for informed citizenship and for success in a global economy.

Lisa Abeyta
President and CEO
APPCityLife

Alivia Blount
Developer Programs Analyst
(Working Learner)
Facebook

Daniel Cannon
President
Iterative Consulting

Hope Clark
Research Affiliate
Institute for the Future

Kevin Clark
Federation Leader & President
Content Evolution
CEO, ChoiceFlows Inc.

Christine Chmura
CEO
Chmura Economics

Jason Crabtree
Founder and CEO
Fractal Industries

Anthony Dalton
Executive Vice President
Educational Results Partnership

Van Davis
Principal
Foghlam Consulting

Justin Edwards
Lead Software Engineer
Innovate+Educate

Brian Fleming
Executive Director
Sandbox ColLABorative
Southern New Hampshire
University

Marlene Garcia
Strategic Initiatives Group
Apple Education
Apple

Marina Gorbis
Executive Director
Institute for the Future

Piotr Gmytrasiewicz
Associate Professor
Computer Science
University of Illinois at Chicago

Ken Goldberg
Professor & Department Chair
Industrial Engineering &
Operations Research

William S. Floyd Jr.
Distinguished Chair in Engineering
University of California Berkeley

Elvis Ha
Director of Product Development
Cornerstone OnDemand

Skyelar Head
Electrical & Computer
Engineering, Intern
(Working Learner)
Texas A&M, Department of
Defense

Parminder K. Jassal
Director, Work + Learn Futures
Institute for the Future

Pavandeep Kalra
Director, Data Science
Cloud & AI
Microsoft

Tandeep Kaur
Analyst
Renegade Consulting

Paul LeBlanc
President
Southern New Hampshire
University

Mike Liebold
Distinguished Fellow
Institute for the Future

Keld Lundgaard
Senior Data Scientist
Salesforce

Ryan Macpherson
Portfolio and Investment Manager
Autodesk Foundation

Merrilea Mayo
Founder
Mayo Enterprises

Alex Measure
Senior Economist
U.S. Bureau of Labor Statistics

Jamie Merisotis
CEO & President
Lumina Foundation

JK Muthukumarasamy
Chief Architect
Shutterfly

Chalapathy Neti
VP Watson Education
IBM

Roy Pea
David Jacks Professor of
Education & Learning Sciences;
Director, School of Education,
& Computer Science; H-STAR
Institute Stanford University

Tess Posner
CEO
AI4ALL

Zach Pousman
Founder
Helpfully

Ashwin Ram
Technical Director of AI,
Office of the CTO
Google Cloud

Preetha Ram
Co-founder & CEO, OpenStudy
Associate Provost,
Internationalization & Chief
Academic Expansion Officer
Harrisburg University of Science
and Technology

William J. Ryan
President
Ryan Consulting

Yustina Saleh
Senior Vice President
Analytics
EMSI

Tiffany E. Shubert
Director of User Experience,
Seismic
President
Shubert Consulting

Jim Spohrer
Director, Cognitive OpenTech
IBM

Susan Stucky
mediaX Distinguished Visiting
Scholar
Stanford University

Michael Taft
Co-founder and CEO
ZogoTech

Landon Taylor
CEO
Base11

Leila Toplic
NLG Tech Task Force
NetHope

Kathi Vian
Distinguished Fellow
Institute for the Future

Holly Zanville
Senior Adviser
Credentialing and Workforce
Development
Lumina Foundation

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FOREWORD

What's the connection between a non-profit foresight organization and a private foundation dedicated to improving education beyond high school? Simple: a shared desire to maximize individual opportunity, boost economic growth, and help ensure social stability.

Those goals are lofty, we know. But we at Institute for the Future and Lumina Foundation see this shared challenge—that of imagining tomorrow's work + learn ecosystem—as one well worth taking. In fact, we're convinced it is a challenge the nation must fully embrace.

Lumina Foundation focuses on meeting a specific national goal for education attainment: While 33.4% of Americans hold a postsecondary school degree today (according to Census Bureau data), by 2025, we want 60% of Americans to hold a degree, certificate, or some other type of high-quality credential beyond high school. We're certain that such credentials will be increasingly important—both to individuals' success and to the nation's progress. But we know that today's students—and tomorrow's—face an uncertain future, fueled by major technological change and significant demographic shifts. That's why Lumina is looking ahead, trying to imagine the coming work + learn ecosystem. Will degrees, certificates, industry certifications, digital badges, licenses, and other types of credentials be important verifications of learning in 2030 and beyond? And what will work, the key driver of credentialing, be like?

> The way we organize to get things done and to create value is not fixed. It is shaped by available technologies, social norms, and regulatory systems of the times. Not only are the structures and flows of organizations being transformed, their functions and purposes are, too. Leaders will need tools to seamlessly transition and thrive in distributed and fluid organizational environments.
>
> — Marina Gorbis, Executive Director of IFTF

> Our children will need to prepare for a rapidly changing work + learn future, as will their parents and the nation's entire adult population. What is not as clear: What will be most important in 2030, and what actions do we put into place now to prepare for the future?
>
> — Jamie Merisotis, CEO & President, Lumina Foundation

Institute for the Future (IFTF) focuses on developing a broadly shared understanding of tomorrow's world—what we call a "global literacy of the future"—among the 9 billion globally connected citizens over the next 50 years. While IFTF's core clients are corporations and governments, many education institutions are also seeking assistance. Increasingly, we recognize that rapid, significant social and economic changes require new ways to blend work and learning. Unfortunately, it's difficult to identify the type of curricula that can properly prepare students to succeed in the next decade and beyond. IFTF has taken a step in this direction by creating a Future Skills tool that can help identify, promote, and deliver the 21st-century skills that are crucial to future success.

IFTF's annual future forecasts interpret current signs of change and suggest new strategies for navigating this turbulent period of transition. The first step in that process is to gain expert insights—a step that IFTF and Lumina recently took by hosting more than 45 national thought leaders for focused conversations about the signals of change they see and what they portend. In this report, we're pleased to share the first of two conversations with our common communities of interest: students, workers, employers, educational institutions, researchers, and policymakers.

We're very grateful to the national experts who joined IFTF and Lumina for these conversations. Their insights offer vital perspectives to help shape the work + learn ecosystem.

Parminder K. Jassal, Ph.D.
Director, Work + Learn Futures
Institute for the Future

Holly Zanville, Ph.D.
Senior Advisor for Credentialing and Workforce Development Lumina Foundation

INTRODUCTION

Today's kindergartners will graduate from high school in 2030. What will the work + learn environment be like for these young students and those that will graduate after them? The transformative nature of the changes forecasted to transpire (think autonomous cars, on-demand everything, and populations of people fleeing some locations made unlivable by climate change) suggests that the only way to understand the future of learning and working is by first exploring the future of living.

One of the forces driving transformative change over the next decade is the growth in intelligent agents (machines that act in place of humans). In 2018, Institute for the Future (IFTF) and Lumina Foundation convened experts from diverse fields to explore the conditions and context of a future rich in machine intelligence and its impact on work and learning. The first expert session was held at IFTF's headquarters in Palo Alto, California, and a second session was held at the Sandbox CoILABorative at Southern New Hampshire University (SNHU) in Manchester, New Hampshire.

IFTF provided the attendees background reading before the sessions and opened each session with a quick rehash of compelling research data on the future to lay the groundwork for the day's discussions. Lumina added information on nine key building blocks that have been identified for a connected work + learn ecosystem, asking whether these will likely be the building blocks for a work + learn ecosystem in 2030. (See appendix for more details on the building blocks.)

Facilitated by IFTF's futurists, more than 45 experts representing the tech industry, government, education, policy, and community and economic development participated in the east- and west-coast discussions. Experts represented diverse areas: technology, medicine, science, finance, environment, education, and the local community. Many of them are "practical visionaries," already working in the trenches to make a new future, drawing on visions that stem from—and in turn, shape—their practical innovations. In addition, themes from recent IFTF research, plus several one-on-one interviews, supplemented the diversity of thought. This report summarizes the experts' views on what skills will likely be needed to navigate the work + learn ecosystem over the next 10–15 years—and their suggested steps for better serving the nation's future needs.

OBJECTIVES FOR CONVENINGS

» Identify the skills everyone will need to navigate the changing relationship between machine intelligence and people over the next 10-12 years.

» Develop implications for work, workers, students, working learners, employers, and policymakers.

» Identify a preliminary set of actions that need to be taken now to best prepare for the changing work + learn ecosystem.

Three key questions guided the discussions:

What are the LEAST and MOST essential skills needed for the future?

While scans of the work + learn horizon typically focus on identifying the most essential skills for success, the experts started their discussion by cataloging the least essential skills. No one was surprised to find tasks like repetitive learning and rote memorization on the list. But the experts also challenged the much-hyped value of coding and AI programming skills in a future in which workers and learners will be creating their own AI apps from thousands of existing modules, using simple interfaces much the way they grab images from a Google search to create PowerPoint presentations today. Focusing on least essential skills helped to inform where not to invest our individual and collective learning efforts.

Where and how will tomorrow's workers and learners acquire the skills they really need?

Experts responded to four distinct but possible future scenarios. They agreed that learning will happen anywhere and everywhere with the blending of formal and informal learning. AI apps and agents will support data collection, data analysis, and even pattern identification in real time wherever working learners find themselves. But deeper understanding of the artificially intelligent world—and how to put it to work on the big problems facing communities—will likely happen through socialization as people work together to test their ideas, develop prototypes, and engage intelligent machines in their solutions. In preparation for this future, today's schools might

shift to become community work + learn labs. We may think of them as a kind of AI-enhanced do-it-yourself workshop for solving physical, social, and economic problems that confront local communities or even communities connected around the world. A key role of intelligent agents may be to connect these communities and amplify their efforts.

> As one expert summed it up: "Sociology becomes more important when thinking about the impact of AI, since major changes will likely happen through socialization as people work together to test their ideas, develop prototypes, and engage intelligent machines in their solutions."

Who is accountable for making sure individuals can thrive in this new economy?

In a new world of work, driven especially by AI, institutionally-sanctioned curricula could give way to AI-personalized learning. This would drastically change the nature of existing social contracts between employers and employees, teachers and students, and governments and citizens. Traditional social contracts would need to be renegotiated or revamped entirely. In the process, institutional assessment and evaluation could well shift from top-down to new bottom-up tools and processes for developing capacities, valuing skills, and managing performance through new kinds of reputation or accomplishment scores.

Ideas generated during Expert Workshop at IFTF on April 23, 2018.
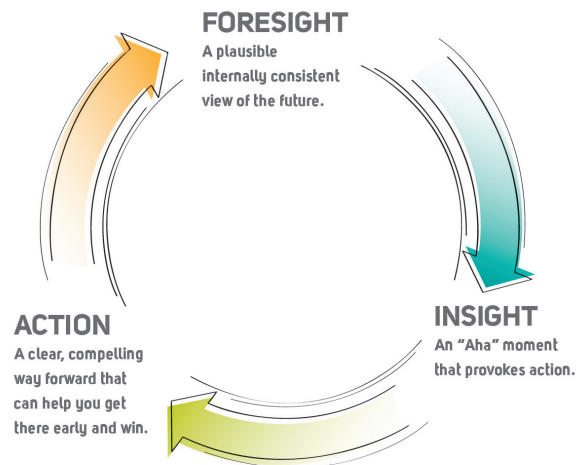Anthony Weeks, Graphic Recorder

KEY DISCUSSIONS

IFTF employs a methodology called "Foresight-Insight- Action," which is based on a forecasting technique developed in the late 1950s by Dr. Olaf Helmer while he was at the Rand Corporation. Dr. Helmer, who co-founded IFTF in 1968, called it the Delphi Method, and it replaced isolated futurists making "haphazard intuitive gambles" with panels of diverse experts engaged in "operational games" and acting out the "roles of decision- and policy-making entities."

IFTF uses the Delphi Method in facilitated discussions with expert groups to arrive at a consensus on opinions. Instead of holding a roundtable discussion to hammer out a group position—a process often flawed by compromise, strong personalities, and deference to senior people at the table—experts are presented with key questions and scenarios about the future. The results are summarized and shared with the experts to deliberate. As a result, opinions may frequently converge, or two distinct opinions may sometimes emerge.

At the two workshops, IFTF used this Foresight-Insight-Action methodology to facilitate the work + learn futures discussion. After convening a diverse group of thinkers and practitioners, IFTF facilitators asked them to think about what will go away in 10 years and then think about what will be most import-ant. Next, IFTF facilitators invited the participants to immerse themselves in the future by considering four potential scenar-ios of what 2030 might look like based on research about the drivers of change. Then, participants identified action steps relevant to each scenario. Lastly, participants reflected on the process and summarized critical actions that may be needed, regardless of which scenario(s) of the future might prevail.

The workshop's agenda was organized based on this methodology, with several sessions devoted to **foresight**—establishing a set of assumptions about what could change in the next decade—and one session each to explore **insights** for what this change would mean for stakeholders in the work + learn ecosystem and brainstorm possible **actions** in response. This flow was designed to first and foremost establish a perspective on the change we can anticipate in the next decade and also begin the process of thinking through its implications and the responses they demand. What follows is a summary of these sessions.

FORESIGHT
A plausible internally consistent view of the future.

INSIGHT
An "Aha" moment that provokes action.

ACTION
A clear, compelling way forward that can help you get there early and win.

INSIGHT

"Aha" moment when we begin to translate our foresight into implications for the choices we face. We provoke insight with all kinds of tools, such as mythic stories, aligning with one long curve of change, and building resilience to many future possibilities. In the end, insights point us towards opportunities we can begin to pursue today and threats we need to avoid, and cultivate visions of long-term aspirations and preferred futures.

— Institute for the Future

FORESIGHT SESSION: To provide context for the convenings, IFTF shared its recent research on future skills people will need over the next decade from Future Skills: Get Fit for What's Next.[1] This research forecasts that mastering human–machine collaboration or "befriending the machines" will be critical to thriving in the work + learn ecosystem of the future. To ensure that individuals are fit for the future and have the skills needed to succeed, everyone will need to increase their "AI IQ," improve their digital fluency, and enhance their level of comfort with actions conducted through simulations.

To prepare for the convenings, experts contributed their perspectives by recommending pre-readings. Readings helped participants become familiar with each other's areas of expertise and points of view regarding AI and machine intelligence.

The agenda for each convening kicked off with an exploration of AI-related signals, trends, drivers, and wildcards influencing how AI will reshape the way we work, learn, and live in 2030. Next, groups brainstormed specific skills needed to thrive in the new era of human–machine collaboration. The collection of ideas prompted difficult and provocative questions such as:

» What does a future rich in AI systems mean for a country experiencing significant divides—economic, racial, health, cultural, and political?

» How does the potential erosion in trust in institutions influence the implementation and use of machine-learning algorithms?

» What would a potential decline of conventional full-time jobs and the rise of contingent or alternative work mean for the experience of "working," and what is AI's role in encoding the new ways we are compensated for work?

» What is the role of humans in the future? How do we address human versus machine perspectives and tension about ownership of jobs? Will machines be viewed as "anti-human"?

» How do we take care of ourselves and others in a future in which a "quantified self" movement might be mainstream, with people using environmental, embedded, and ingested sensors to track the conditions around and inside their bodies?

INSIGHT SESSION: Using the material generated during the morning brainstorm, participants worked with four IFTF-generated 2030 potential scenarios of the future along a spectrum. At one end was, "Don't believe all the hype—there is not the major change many were predicting back in 2018," and at the other end was, "There are so many differences, humans are just a cog in the wheel with machines dominating work and indeed our lives." The other scenarios fell within these two potential scenarios. (See Appendix for the detailed scenarios.)

ACTION SESSION: At the workshops, participants worked together to identify and prioritize actions that could be taken based on the foresight and insight generated during the earlier sessions.

KEY DEFINITIONS

» **AI IQ is knowing how to best leverage artificial intelligence to manage workflows and accomplish tasks.**

» **Digital fluency is keeping current with the digital standards and practices in the domains in which you work.**

» **Simulated action is knowing how to navigate virtual and augmented reality spaces seamlessly.**

Future Skills: Get Fit for What's Next, Institute for the Future
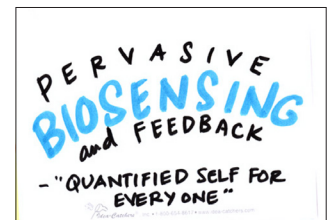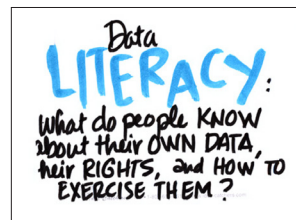
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Ideas generated during Expert Workshop at IFTF on April 23, 2018. Anthony Weeks, Graphic Recorder

In the first step of the Foresight-Insight-Action process, people use expert opinion and research to synthesize plausible, internally-consistent visions of the future.

Least and Most Essential Skills for an AI World

During the convenings, participants drilled down on the specific, near-term skills that workers and learners will need to "befriend the machines." The conversations surfaced three key themes. To effectively "befriend the machine"—increase AI IQ, attain digital fluency, and master simulated action—people will need: 1) a set of foundational skills that will be valuable regardless of how far or fast technology advances; 2) a level of access and know-how that will help them effectively leverage the new technology; and 3) a foresight mindset that will help them stay ahead of machine capabilities.

Foundational skills for the future

There was widespread agreement that the pace of change is increasing and many of the "least useful" skills are those that are specific to certain applications and tools because they are likely to be useful for only a small window of time. In contrast, the most useful skills will be those that are more foundational —skills that cut across many industries and domains and are not in danger of encroachment by AI.

There was consensus that "learning to learn" will be critical. Part of this is a matter of technique—active listening and knowing how to regulate and direct attention. And part of this, one expert asserted, is simply a matter of mindset—learners must recognize that their journey will never stop.

They must see themselves as lifelong learners. With this mindset, learning is a constant aspect of daily life. The skills needed to make use of this mindset involve knowing how to identify the kinds of learning that will help individuals stay relevant in current roles or pursue new ones, as opposed to just learning things that are interesting. In addition, knowing how and where to find learning resources will be critical.

Similarly, participants agreed that knowing how to find information is going to be more important than having the information memorized. Essentially, with almost limitless information available at our fingertips, the ability to find the right information quickly and effectively, to "sleuth the truth," will be highly valued. This is easier said than done and will require a complex set of subskills, such as skepticism and critical thinking.

Finally, there was also acknowledgment in both convenings that the work + learn ecosystem is likely one in which employers will no longer play the role they once did. What is the new role of the employer as social contracts change and the burden of health insurance and other safety nets might fall on the shoulders of workers? Navigating changing work arrangements will require a new set of fundamental skills. In a fast-paced world, potentially without standardized business hours and work schedules, the only structure many workers might have will be largely self-imposed. People will have to balance work with learning, social and family obligations, self-care, and health management. They will need to be able to balance multiple work tasks, projects, and gigs without the aid of human managers. As such, learning to be self-motivated and disciplined, or seeking out and utilizing tools and services to take on some of that management function, will be key.

Access and know-how for directing and deploying technology effectively

In October 2017, Chris Wanstrath, CEO of Github, the foremost code-sharing and social networking resource for programmers today, made a bold statement: "The future of coding is no coding at all." He believes that the writing of code will be automated in the near future, leaving humans to focus on "higher-level strategy and design of software." Many of the experts at the convenings agreed. Even creating the AI systems of tomorrow, they asserted, will likely require less human coding than is needed today, with graphic interfaces turning AI programming into a drag-and-drop operation.

> Many excellent, much-hyped, and well-intended initiatives to teach youth coding may be equipping kids with skills that will not be in demand in a decade.
>
> — Chris Wanstrath, CEO, Github

Digital fluency does not mean knowing coding languages. Experts at both convenings contended that effectively "befriending the machine" will be less about teaching people to code and more about being able to empathize with AIs and machines, understanding how they "see the world" and "think" and "make decisions." Machines will create languages to talk to one another. Another participant said, "So we'll need

'machine whisperers' who understand the syntax of machines and can learn their language."

One dimension of being a "machine whisperer" involves having a deep understanding of human ethics and being able to translate that into machine language. Knowing how to identify machine bias will be particularly important. Already today, there are several controversies and even horror stories of algorithmic discrimination, or ways in which AI perpetuates existing inequality or even creates new inequalities. (These stories are well-documented in books like *Weapons of Math Destruction, Automating Inequality*, and *Algorithms of Oppression*.)

The skills to know how to create systems where there is responsibility, transparency, and accountability are often left out of discussions of getting people equipped with tech skills, but they will be critical for developing true digital fluency. Of almost equal importance to understanding how to harness the capacities of AI, virtual reality, and other emerging technologies, is knowing their limitations—learning to effectively judge what machines can and cannot do, knowing when you need a human being, and keeping pace with how the human–machine relationship might be changing.

A foresight mindset to stay ahead of machine capabilities

Participants agreed that just about any repetitive, quantitative activity can and will be automated in the next decade. Machine vision will become advanced and accessible enough that many physical tasks that required human labor in the past will be done by a machine in the future. For instance, a family farmer in Japan was recently able to fairly easily rig up an automated cucumber sorting machine.[2] And breakthroughs in robotic actuators will allow for robot limbs that can move in very precise ways, further opening physical human labor to automation.

Moreover, skilled white-collar work is also at risk of automation. For instance, McKinsey estimates that 22% of a lawyer's job and 35% of a law clerk's job can be automated.[3] One Indian e-commerce company, Myntra, has had success employing AI for roles once played by artists—one of its best-selling shirts was, according to the *New York Times*, designed by a pair of algorithms. According to researchers at the University of Oxford, there was a 47% decline in secretarial jobs between 2001 and 2013, due to both technological advances and overall job cuts.[4]

The experts agreed that, over the next decade, we're likely to see AI take on even more administrative roles, like scheduling and organizing meetings and events, planning projects, and

even writing basic communications. Some experts even contended that much of today's decision-making—like choosing venues, lodging, catering, and hiring temporary staff—will be automated as well. Planning and some decision-making will fall off everyone's to-do list because, as one expert remarked, "AI assistants can pick that up."

As AI takes on more quantitative tasks in our economy, it will bring into sharper focus the importance of communication and the ability to navigate what one participant called "human messiness." Humans, of course, aren't a monolith and many experts flagged skills for empathizing and communicating across social and cultural divides and contexts as increasing in importance as we move into the future.

One place where these skills will be critical is in health work. We can anticipate an increase in health-related jobs due to population aging. And with current projections suggesting a substantial caregiving shortage in the United States and many other countries, several experts expect we'll turn to technology for help. Today, there is substantial evidence that AI is capable of outperforming humans in certain kinds of medical diagnosis and treatment recommendation.[5] However, humans may be needed to interpret that information and communicate it to care staff and patients in a clear, compassionate, and accessible manner.

One expert described the combination of AI with a human—who has deep emotional intelligence, social skills, and the ability to think at a meta-level—as a "complete machine." Machines provide information and recommendation (and execution of low-stakes transactions) while humans provide wisdom and judgment, make important decisions, and communicate or act on machine recommendations with humanity and compassion. And while health is at the vanguard—where we see some of the clearest examples today—this dynamic will be true across many industries such as education and learning, as well as customer service. This storytelling and translation role will also be key to designing artificial reality (AR) and virtual reality (VR) experiences and mastering simulated action.

VISION OF A COMPLETE MACHINE

Machines provide information and recommendation (and execution of low-stakes transactions) while humans provide wisdom and judgment, make important decisions, and communicate or act on machine recommendations with humanity and compassion.

Usually, when we think about future skills we want to know the most essential skills. But thinking about least essential skills can be a more provocative way to see the shift from today's landscape to the future horizon. According to the AI experts, skills like coding, programming, and mechanical repairs may end up being the least important skills in the new AI era, mostly because intelligent machines are going to do those tasks. What disappears from our list—and our classes and careers—when we take the time to think about what will be least essential?

Three key disruptions to the existing world of work framed the least essential skill conversation: 1) new industrialized social technologies will create uniform products for people, causing the very nature of ownership and jobs to change; 2) work will evolve from individual hiring and roles to hiring of teams and "team production"; and 3) work will focus more on work roles than jobs, because the tasks that need to be performed will change on a regular basis.

Here's a list of many skills the experts do not expect to see much of—if at all—in the future:

Manual coding. Systems will be self-programming.

Building AI systems. Graphic interfaces will turn AI programming into drag-and-drop operations making them easier to build.

Calendaring, scheduling, and organizing. There won't be need for email triage.

Planning and even decision-making. AI assistants will pick this up.

Creating more personalized curricula. Learners may design more of their own personalized learning adventure.

Writing and reviewing resumes. Digital portfolios, personal branding, and performance reputation will replace resumes.

Language translation and localization. This will happen in real time using translator apps.

Legal research and writing. Many of our legal systems will be automated.

Validation skills. Machines will check people's work to validate their skills.

Driving. Driverless vehicles will replace the need to learn how to drive.

Just about any repetitive task. If it's repeatable, intelligent machines will learn to do it. But physical labor doesn't entirely fall into this category. Any type of physical work that currently demands high pay (e.g., electricians, plumbers) may continue to be high-priority skills.

Here's a list of the most essential skills needed for the future:

Designing AI systems using quantitative and algorithmic thinking. This is a mode of thought that goes well beyond computing and provides a framework for reasoning about problems and methods of their solution. One expert used the vacuum cleaner as an example. Designers of intelligent vacuums need to be sure that AIs understand the difference between cleanliness versus cleaning. In other words, designers need to make sure that the vacuum doesn't think that the command "clean" means to dump the dirt out on the floor after it has finished vacuuming.

Managing reputation. Knowing how to protect, trade, donate, and reap your own value from data about you is how you'll manage your reputation and build your personal brand—and learning how to curate your brand in multiple media and many cultures is the first key to success.

Storytelling and interpretive skills. The ability to tell a story becomes more complicated with big data. People will need skills to learn how to make sense of massive amounts of data to tell a story.

First principles thinking. Actively questioning every assumption you think you "know" about a given problem or scenario, and then creating new knowledge and solutions from scratch, will be a valuable practice.

Communicating with machines as machines. This is the ability to understand how AI systems operate.

Augmenting high-skilled physical tasks with AI. While machines will take over repetitive physical tasks, a premium will be placed on skills requiring both muscle and brains. For example, physical tasks such as plumbing and installing electrical wiring in a house could be augmented using wearable technology such as exoskeletons.

Optimization and debugging frame of mind.
Understanding logic and syntax to improve training data, monitor data, and make sure that the machines are doing what we want them to do will be essential.

Creativity and growth mindset. Having the ability to embrace change and creatively respond to rapid economic changes (such as adjusting business models) will be valuable.

Adaptability. This can involve readily pursuing ways of learning to learn and avenues for understanding other cultures.

Emotional intelligence. This means having empathy and vulnerability such as the ability to connect information to people in a personal way and manage "human messiness."

Truth seeking. Skills including critical thinking, seeking out the truth, identifying the source of false information, understanding how to validate information, and understanding how logical fallacies operate will all be essential.

Cybersecurity. Skills to protect unauthorized access to computerized systems will be essential.
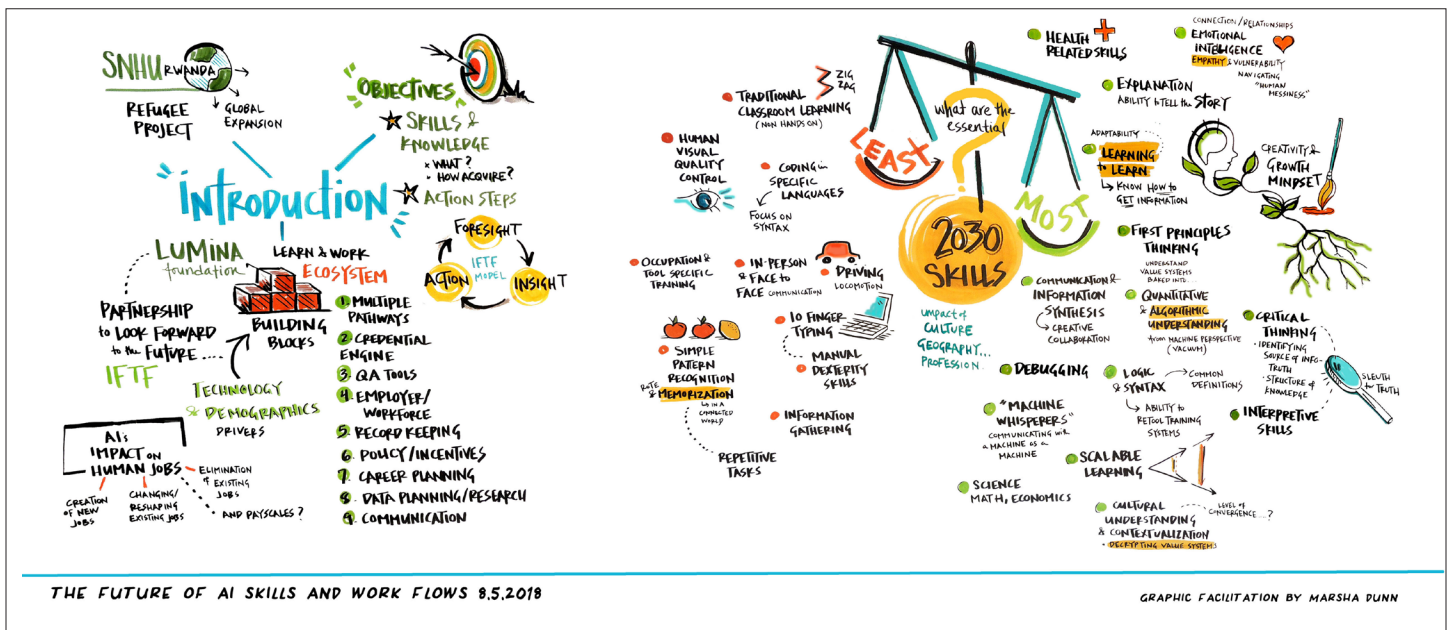
Ideas generated during Expert Workshop at SNHU on August 6, 2018.
Marsha Dunn, Graphic Recorder

Human–Machine Collaboration Brainstorm

Experts brainstormed what a new world would look like that requires human–machine collaboration. They explored the question, "What are the key forces, directions of change, or megatrends shaping the world in 2030?" The discussion focused on demographic shifts and forces, climate and environmental changes, social dynamics, privacy concerns, and culture and belief systems driving how AI is used.

Experts described a new world of AI, where there is an explosion of noisy data and more devices, where physical and geographical borders become more fluid as all information is stored in a central cloud or node with on-demand access. Due to the psychological impacts of information overload, small data—turned into smart data—becomes more important than big data. This data is retrieved and migrated to where it is needed to solve problems and lessen anxiety by creating novel solutions to the world's vexing problems.

Experts conceded that while new solutions will emerge, new problems and questions will also accompany them. For example, quantum computing will increase computation power to the point where there's zero-cost computing, allowing all of today's security systems to be compromised in just an hour. And, of course, experts viewed privacy as an ongoing concern, heightened, as some anticipated, due to a rise of IOT terrorism. Genomes will be sequenced for free, and natural categories of science that were once immutable will become mutable.

Some experts questioned whether, with the increase of computation power and the consequential increase of productivity, wages will increase. There is an ethos of innovation by human–machine collaboration, so the question of who owns and gets compensated for developing new intellectual property remains. If machines will be taking credit for performance optimization, what is the role of the human?

New population dynamics and the shifting of valuable resources will drive people to megacities inhabited by a mostly white aging population supported by a largely non-white younger population. Some areas will become uninhabitable, with access to water, food, and necessities becoming an issue, while other areas once uninhabitable will become habitable.

This drastic restructuring of society will be underscored by a U-shaped demographic change that creates districts that are not politically representative, creating newly formed networks and non-traditional power structures. Universal basic income could become a new social safety net ensuring that everyone has an even playing field to work, learn, and live.

These new networks, formed by people from around the world, will use AI supported by the growth in "edge computing" and distributed devices. Edge computing is a method of optimizing applications or cloud computing systems by taking some portion of an application, its data, or services away from one or more central nodes (the "core") to the other logical extreme (the "edge") of the Internet, which makes contact with the physical world or end users. This allows valuable data and resources to be distributed to remote areas of the world that need them the most.

While AI will allow new groups of people to connect and work together, there is a possibility that belief systems will become more divergent instead of convergent. Experts described how the existing melting pot will "unmelt" and become more like a mosaic of humans and machines. AI will enable the creation of new synthetic biologies, wearable technologies, and even bionic hybrids of humans and machines. And, just like humans have rights, robots might also have rights because they are playing the role of caregiver, companion, and child to humans (or other robots).

AI Impacts on the World in 2030

The experts considered the new world created from the previous brainstorming session through two questions: "How does AI accelerate/change this new world? What new forces does AI create?"

Because of machine "sea steading" (where machines can establish themselves outside typical land and physical boundaries), experts proposed that AI will give people more freedom to choose where they want to live and border crossing will be streamlined.

Internet service providers will be eliminated, and borders between machine–human cultures and geographies will become blurred. One expert explained the possibility of "crossing borders as a transgender, using facial recognition rather than interacting with a human." In this case, gender becomes irrelevant. How does AI determine gender based on facial recognition?

Experts thought that AI holds great promise in enabling climate solutions and could help us solve some of the world's most "wicked problems," but it also could increase demand for power, which has a negative impact on the climate. For example, does the cost of managing cryptocurrency outweigh increased demand on consumption of energy? They agreed that we need to leverage quantum computing to make more energy-efficient systems. AI can help us navigate this risk proactively instead of reactively.

Another scenario that experts considered was one in which AI leads to "personalized everything," which changes the concept of personhood. Because of new efficiencies due to AI, humans will have more free time and there will be a growth of idleness. In this future, will it be humans or machines entertaining us? Will people deal with growing isolation by receiving "robot love" through robot spouses, kids, and caregivers? And will this change the nature of human relationships? On a positive note, one AI expert commented that "doctors will be freed up to spend more time to engage with patients."

Because of the new role that AI systems play in human lives, they should be designed to support "ethical human behavior" such as ethical dilemmas, defense applications, social contracts, and transnational treaties. While government will likely be an early adopter of AI, it is also a regulator; this will create a conflict of interest within existing power structures and require us to reimagine governance. New AI systems, some suggested, will also impact the very nature of how we think about economics. From this point of view, one expert commented that the "importance of GDP declines," as there is a new focus on quality and growth of free time leading to new AI-based metrics of the economy and well-being.

Preparing for an AI-rich world will also likely require that we measure and compensate for employment and work differently. Will we be measuring teams or individuals? The measures will be redefined for each configuration. People could be paid for their work in fractional equity and cryptocurrency validated by blockchain. As a result, a diversified portfolio model could emerge with the opportunity to build credits and a reputation in a marketplace of value exchange using the participation of people plus tools.

The structure and organization of work flows could change with major disruption in the kinds of work, geographies of work, and work units. How do we develop workers that have a design and innovation mindset, for example? How will we measure innovation mindset where failure is common? How will we measure productivity in a shapeshifting work environment where traditional full-time work for a highly recognized company is no longer the gold standard?

The experts concluded that future education models need to include, embrace, and support the building of portfolios. When building a reputation, the future worker will be navigating and advancing themselves, but their ranking will likely go up and down—perhaps like Yelp ratings. We need to be careful to avoid a "winner takes all" scenario and provide incentives to make contributions where the need is greatest. Some suggested that colleges and universities might imitate the draft model for NFL teams, where the worse off get the best player(s) for the next year.
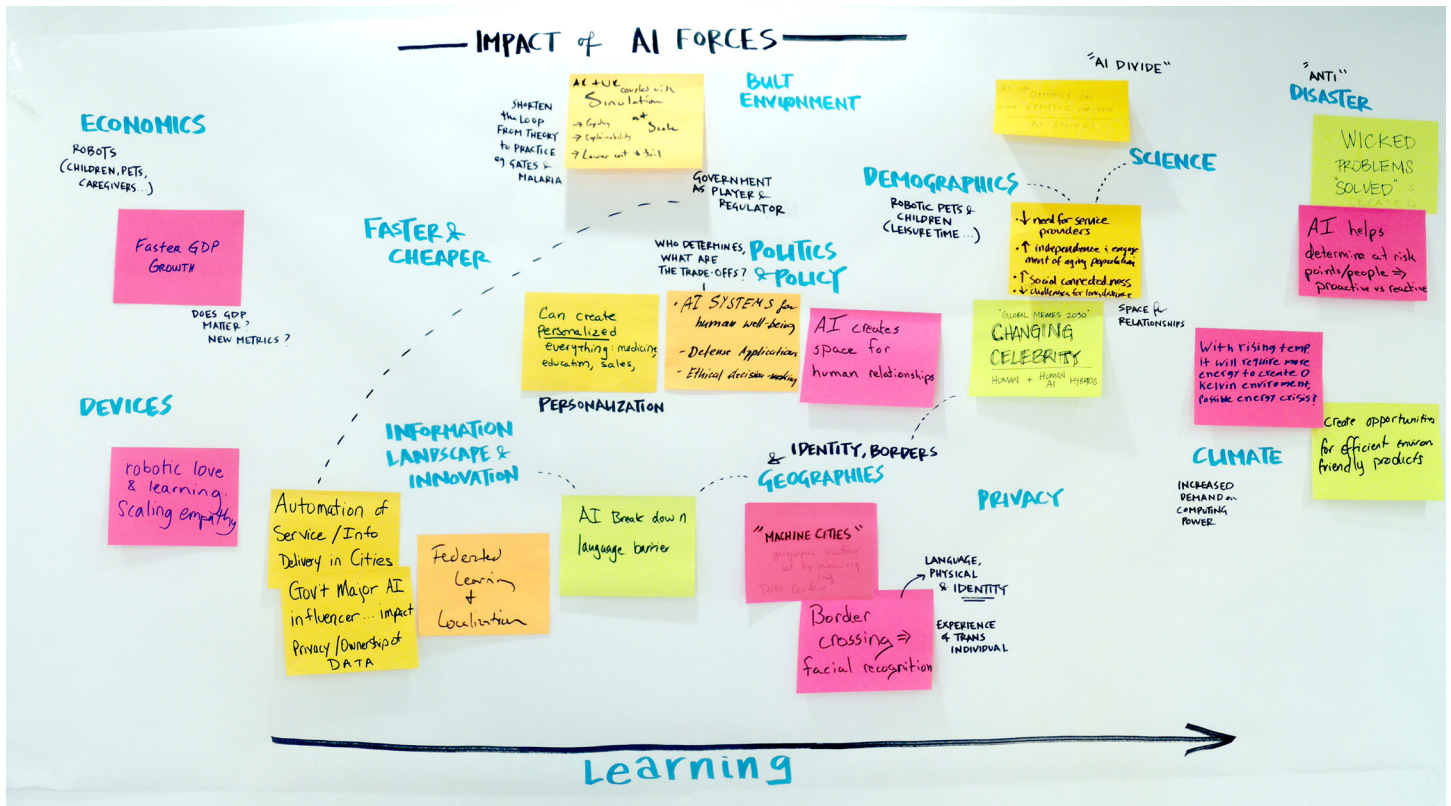
Ideas generated during Expert Workshop at SNHU on August 6, 2018.
Marsha Dunn, Graphic Recorder

Deep Dive into Key Future Skills (Super Skills)

The following questions framed a deep-dive discussion around future skills: What are the new skills, jobs, and learning paths in the world that we envision for 2030? Are we going to have credentials in 2030? Will they matter? How will certain professional credentials (e.g., in health care) be regulated? Experts were reminded that there can be both competing and contradictory views when building a vision for what the future will look like in 2030.

Two opposing views about credentialing emerged: credentialing goes away versus there is more granularity in credentials.

Some experts posited that we won't be using credentials in the future; rather, we will be testing for competencies developed through "just-in-time, just-in-place" learning. Hence, there will be a need to design tests to be more democratic and less biased. Tests should not be binary (e.g., do you know the information or not?), but rather, can you demonstrate what you know? We should be testing levels of mastery through immersive collaborative simulations that are AI driven.

In the new AI world, everyone will be a teacher and everyone will assess the teacher. Assessments will become less relevant where more weight is given to teachers who can vouch for you by witnessing important skills such as human–machine collaboration skills. One expert asked, "Are we moving to human judging versus assessing?" There was a concern that we probably don't want machines to do the judging. As a result, there is increased value in human judgment.

Experts believed that assessments should capture the experiential components of learning, and evaluate and translate this information into something that is meaningful for the individual. Faculty will become AI–human coaches that facilitate learning experiences. Students become workers and work + learn combination schools emerge with cross-disciplinary majors (e.g., the psychology of humans and the psychology of machines become more integrated).

The role of the teacher evolves and there is a "death of disciplines," creating a new class of higher education worker that goes beyond curriculum development to create cross-disciplinary learning experiences. There is one major caveat

to this way of teaching: we need to be careful that it doesn't take twice as long to acquire these skills. In the 2030 world and beyond, there is more granularity in credentialing, so credentialing could become even more important.

These new AI skills point to the decline of "black boxes" (where the contents of a piece of equipment or technology are mysterious to the user), which will be replaced by designs that are more transparent and value-centric. A new learning pathway emerges to develop the ability to understand AI and human colleagues, including machine colleagues. Skills also include the ability to inject values, monitor implicit biases, and evaluate AI outputs. A different type of project management will emerge with a focus on managing the machine, human, and human–machine process.

New roles (jobs) for humans are likely to emerge, such as:

» Individualized Medicine Managers

» Data Auctioneers

» AI Brokers

» AI Debuggers

» IOT Repair Technicians

» Machine Psychologists

» User Model Designers

» Empathy Coaches

» Data Hygienists

» Truths and Metrics Directors

One expert emphasized that we will see not just new jobs but new business models. There will be a growing distinction between "jobs" and "roles." We will need to understand the "psychology of machines" as AIs will not understand their own decisions. One expert asked, "Will it be easier to understand how an AI comes to make a decision than a person? Sometimes people can't even understand their own decisions." The role of humans will be to enable AIs to work with us to do what we want machines to do to optimize our own (human) performance.

How will we prepare learners for these new roles in the future? One expert commented, "Apprenticeships are a good model for reinforcing relationships between learning and working." Another expert shared an example of a "one-year accelerated college followed by a virtual reality experience." While all experts agreed that there is a need to document the intersection of learning paths, skills, and jobs, questions remained: "How does this intersection become a point of record? What is the magnitude of consequence on decisions for the three vectors that intersect?"

One expert predicted that real-time personalized optimized pathways will emerge in the form of a "path recommender" to help individuals navigate the intersection of learning paths, skills, and jobs. There may even be recommendations for several revenue-generating work + learn roles at one time.

In collaboration with Google Cloud, IFTF produced a publication entitled Beyond Organizations: New Models for Getting Things Done, which dives deeper into the forces that shape the way we organize to get work and learning done. It maps out seven powerful transformations in organizational processes that we will see in the future, such as moving from resumes to reputations for talent recruitment, from co-location to distributed teams to get work done, and moving from money to a portfolio of incentives for compensation.
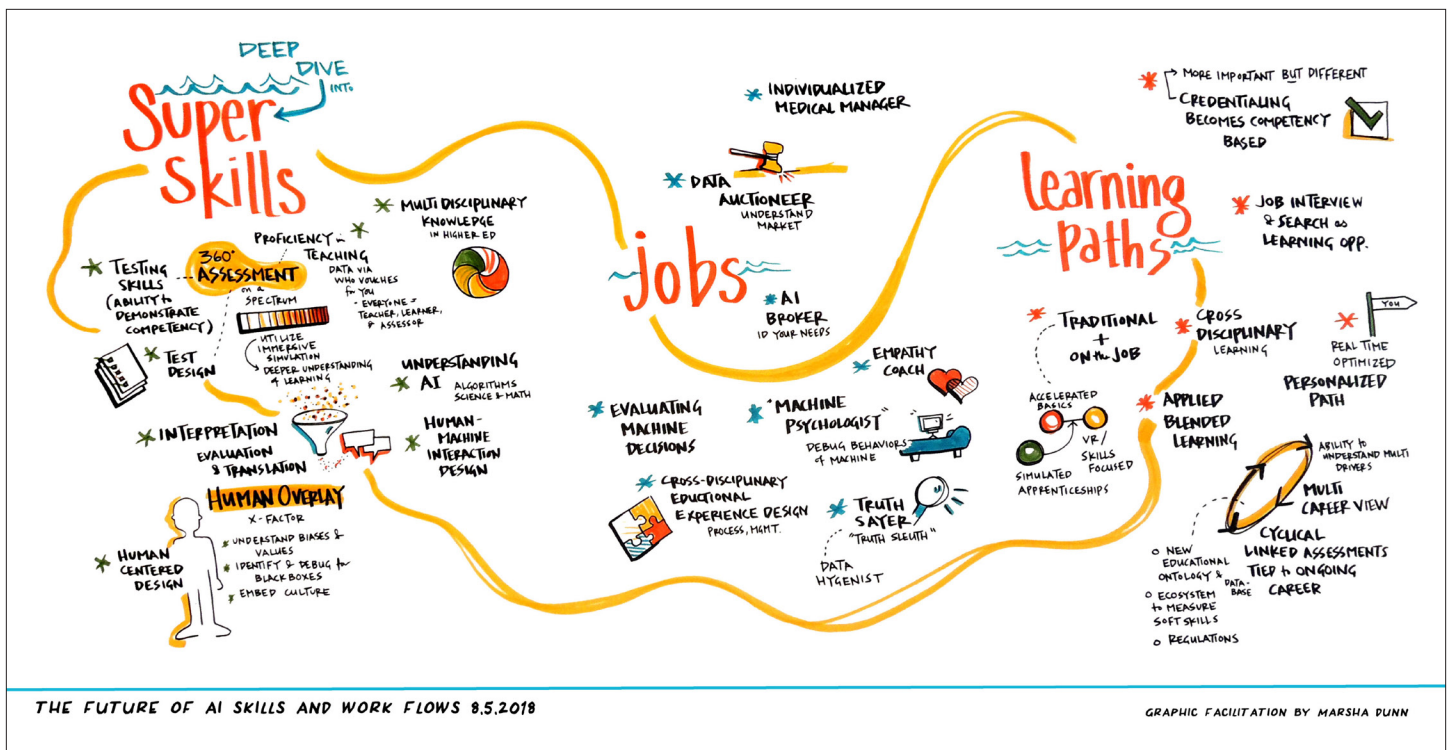
Ideas generated during Expert Workshop at SNHU on August 6, 2018.
Marsha Dunn, Graphic Recorder

In the second step of the Foresight-Insight-Action process, people convert foresight into meaningful insights about the future, identifying what is of critical importance for specific stakeholders.

Envisioning the Future through Four Scenarios

At the workshop, participants used scenarios to begin surfacing insights for workers and learners. To set the stage, experts divided into four groups to explore one of four different potential future scenarios, all happening in parallel in the year 2030, through the lens of a worker–learner. The scenarios were: 1) AI is a background condition of everyday life and the jobs that are left for humans are often low-paying and overseen by AI systems; 2) the expanded competencies and functions of AI have disrupted humans across all industries; 3) advancements in AI and cognitive intelligence enable most people to be algorithmically connected to work via digital matchmaking systems; and 4) AI has advanced but has not had a transformative and life-altering impact on how we work and live. (Detailed scenarios are contained in the Appendix.)

For each scenario, the experts considered a number of questions, including:

1. What are the skill sets that serve this future?

2. What are the new vulnerabilities and new risks?

3. What, if anything, is the safety net? What are the new opportunities?

4. What action steps should be taken today in light of this scenario?

While each of the future scenarios generated actions specific to that scenario, some actions appeared in all four scenarios. This suggested that it may not be important to be able to precisely predict the future. Rather, it may be more important to look at the main signals, trends, and drivers of change to determine actions needed—no matter what the scenario. One action especially emerged as central to all scenarios: a focus on learning.

Experts in both sessions expressed concern that, without deliberate and comprehensive interventions, an AI divide will emerge, disadvantaging groups without access to the tools or the know-how needed to leverage the capabilities of intelligent agents. Experts also anticipate that regional differences, and the degree to which individuals are "connected," will impact the implementation and practices of emerging tech systems, informed, by a large degree, by the level of trust different cultures have in our tech systems.

WHATEVER THE FUTURE BRINGS, IT WILL BE IMPORTANT TO FOCUS ON LEARNING

One action summarized best what we need to do to prepare for the future: all learners will need a range of competencies and skills. Key among them:

» "Learning to learn"—specifically "on your own" and "with others"

» Having a foundation in math, science, IT, and cross-disciplines yet knowing "how" to find what you need when you need it

» Developing the behaviors of grit, empathy, and effective communication

The rise of a new world of work, where traditional employment is drastically redefined, prompted the experts to envision new work arrangements underpinned by algorithmic match-making between tasks and workers. How will individuals be employed? Who will employ them? Many cautioned that designing the platform economy to ensure that individuals are connected is critical for producing a more equitable future for all workers and learners. The role of policymakers—and governments—in the apportionment and allocation of equity in resources and access to tech connections will be paramount to a well-functioning and fair work + learn ecosystem.

Whatever specific scenarios emerge, there was consensus that "time is speeding up" through "uneven fits and starts." Changes will be occurring more rapidly than we can imagine right now, and these changes will be especially disruptive because they will impact us unevenly. Specific industry sectors will be impacted before others; certain regions or pockets of the nation will be impacted before others; and governmental policies will typically move more slowly than the changes that will benefit from checks and balances, regulation, and accountability systems.

Without deliberate and comprehensive interventions, an AI divide will emerge, disadvantaging groups without access to the tools or the know-how needed to leverage the capabilities of intelligent agents (machines that act in place of humans).

The role of policymakers—and governments—in the apportionment and allocation of equity in resources and access to tech connections will be paramount to a well-functioning and fair work + learn ecosystem.

Changes will be occurring more rapidly than we can imagine right now, and these changes will be especially disruptive because they will impact us unevenly.

Here's a summary of emerging themes from navigating all the future scenarios:

» Scaling of Distributed Work and Teams

» Leveraging and Optimizing the Work and Talent Marketplace Using New Principles and Platforms

» Understanding What Students Want and Need to Learn

» Developing Personalized Learning Tools

» Incorporating Multicultural Views into AI

» Changing Power Structures Shifting from Top-Down to Bottom-Up to Benefit Working Learners

» Viewing the Adoption and Adaptation to Technology through an Anthropological and Sociological Lens

» Creating an Evolutionary Higher Education Model

» Developing New Behaviors and Patterns of Interaction

» Developing Standards and Guidelines for Data, Privacy, and Security
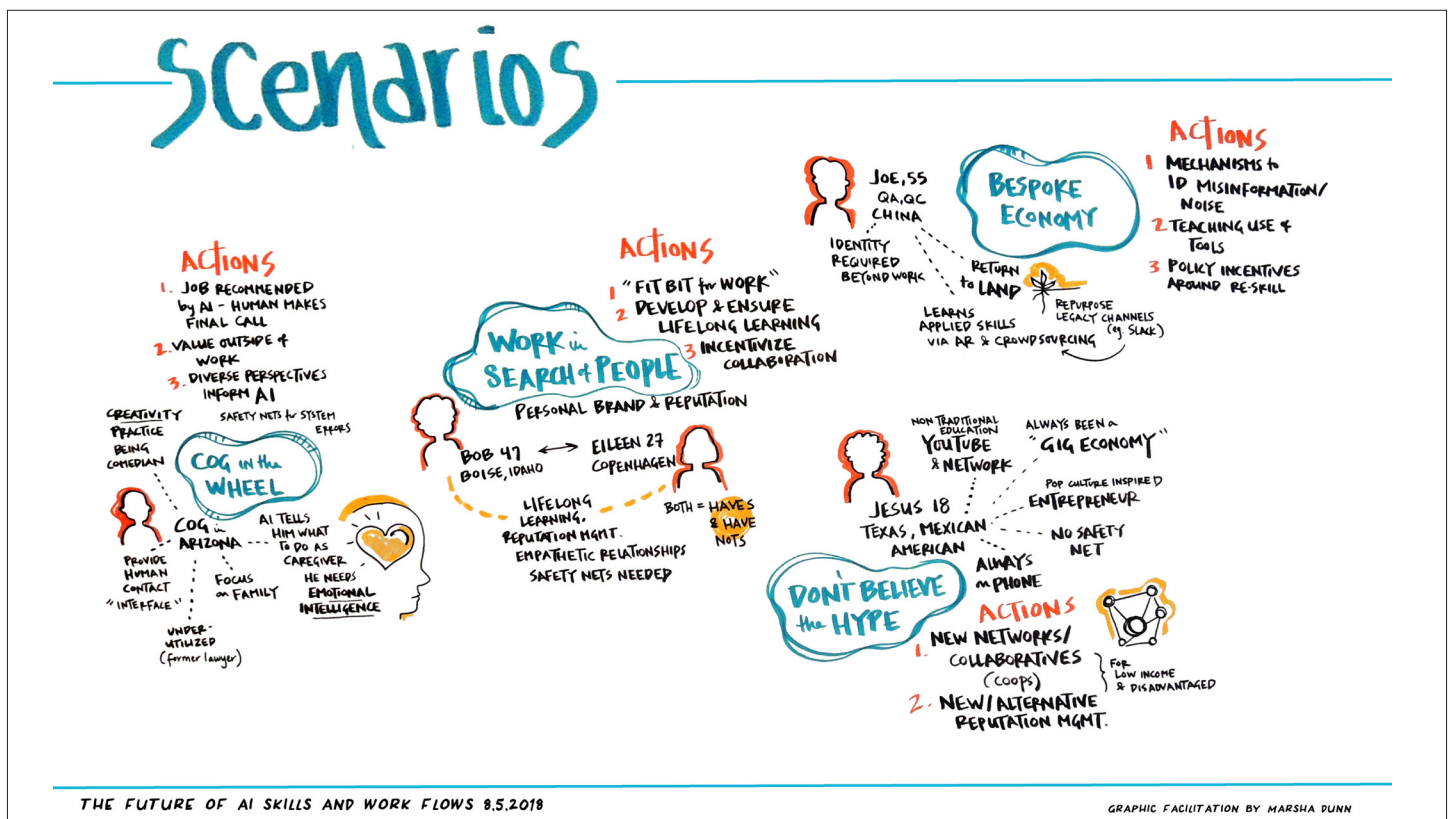
Ideas generated during Expert Workshop at SNHU on August 6, 2018.
Marsha Dunn, Graphic Recorder

As the last step of the Foresight-Insight-Action process, actions are prioritized to develop a clear and compelling way forward. This process helps to visualize potential actions across an organization, identify and engage networks of collaborators that cross traditional boundaries, and brainstorm experiments to refine strategic efforts.

Creating a Connected Work + Learn Ecosystem

At the workshops, participants worked together to identify and prioritize actions that could be taken based on the foresight and insight generated during the earlier sessions. Common actions that emerged from all four future scenarios included:

» **Prepare all "systems."** Schools will continue to be important places to teach competencies and skills. Parents will be important teachers for children. Workplaces will also be important places for learning— and many learners will need instruction on how to work effectively as part of human–machine teams.

» **Integrate learning and work.** Education systems will need to be integrated with work—in an education–work ecosystem. To enable movement within the ecosystem, credentials that focus on judging performance could be useful, but only if transparent and portable. However, ratings and rankings may be more useful. The competencies and skills that stand behind credentials will need to be identifiable, using a common language to enable: a) credential providers to educate and train for an integrated education–work system; b) employers to hire people and upgrade their skills; and c) governments (federal, state, and local) to incentivize and regulate programs and policies that support the education–work system.

» **Assess learning.** Assessing competencies and skills acquired in multiple settings and modes (including artificial reality and virtual reality tools) will be essential. AI will enable powerful new assessment tools to collect and analyze data about what humans know, and more importantly, can do.

» **Build fair, moral AI.** There will be a high priority on ensuring that AI has built-in checks and balances that reflect moral values and honor different cultural perspectives. The "values and cultural profile" of a machine will need to be transparent so that they can be understood by workers and learners.

» **Prepare for human–machine futures.** Machines will join humans in homes, schools, and workplaces. Machines will likely be viewed as citizens, with rights. Humans must prepare for side-by-side "relationships" with machines, especially in situations in which machines will be managing aspects of education, work, and life formerly managed by humans. Major questions will also arise about the ownership of AI structures— what does ownership look like, and who profits from ubiquitous AI structures?

» **Build networks for readiness and innovation.** Open and innovative partnerships will be needed for whatever future scenarios emerge. In a data-rich world, we won't solve problems alone; networks, partnerships, and communities will be key.

The future is like a game. We have to play it to see how it turns out. But if we wait until the future actually happens, it's too late to shape it or change our strategies for a better outcome.

— Jane McGonigal
IFTF creator of the OS Ethical Toolkit
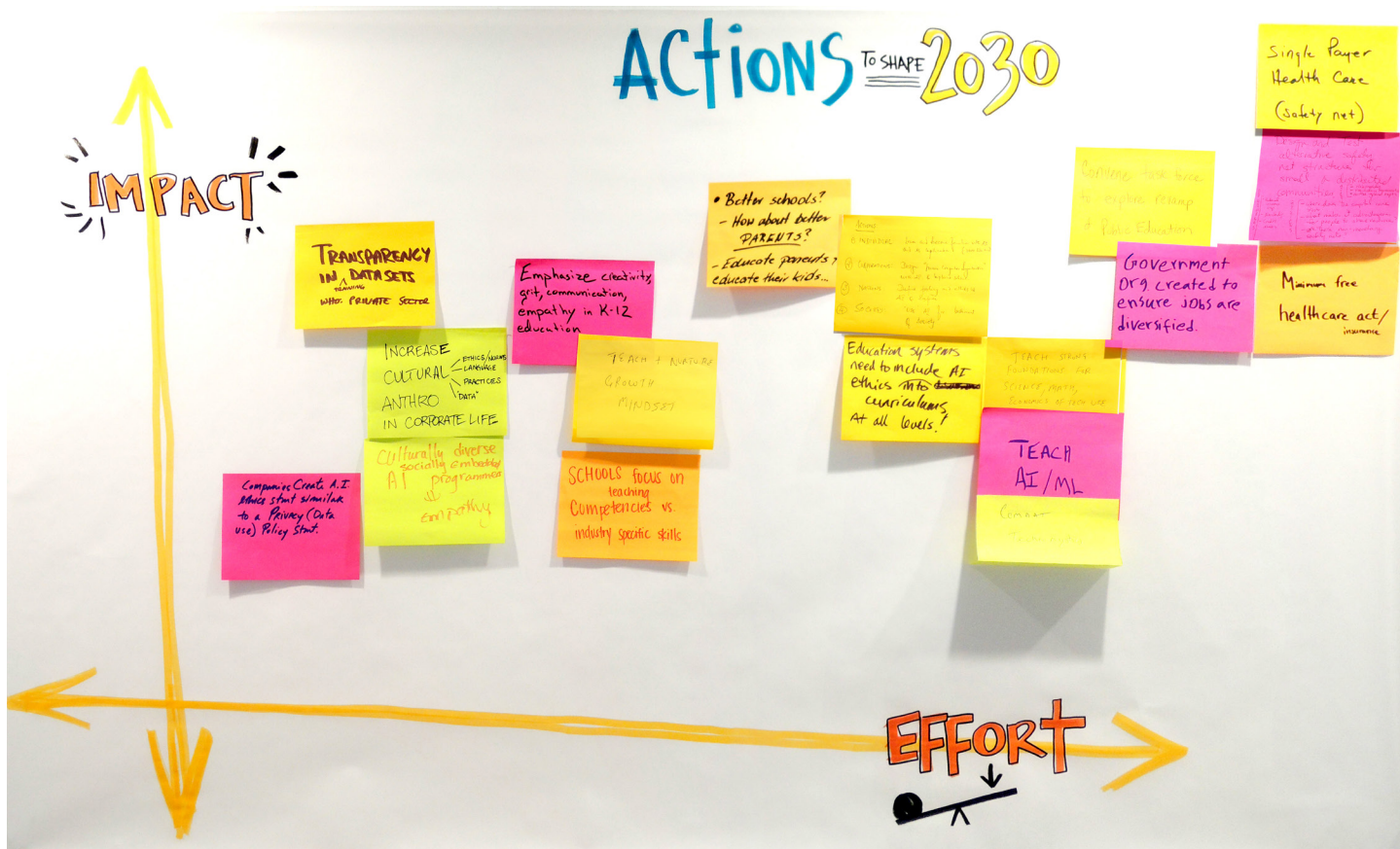
Ideas generated during Expert Workshop at SNHU on August 6, 2018.
Marsha Dunn, Graphic Recorder

CONCLUSION

The rise of machine intelligence is just one of the many powerful social, technological, economic, environmental, and political forces that are rapidly and disruptively changing the way everyone will work and learn in the future. Because this largely tech-driven force is so interconnected with other drivers of change, it is nearly impossible to understand the impact of intelligent agents on how we will work and learn without also imagining the ways in which these new tools will reshape how we live.

The Foresight-Insight-Action process during the AI expert convenings revealed new insights about the future in 2030 and generated common actions to navigate a new work + learn ecosystem. The focus was not on predicting the future, but rather using foresight and insights to explore ways to shape a new equitable future. Underscoring all of the actions that were identified as part of this process is the need for traditional learning models to evolve and create new opportunities that prepare individuals to be "fit for the future."

In the 2030 and beyond world, employers will no longer be a separate entity from the education establishment. Pressures from both the supply and demand side are so large that employers and learners will end up, by default, co-designing new learning experiences, where all learning counts.

The perspectives contained in this report about the future of work and learning help all of us to better understand what is needed to prepare people for success in life and careers in 2030 and beyond. We can't always be confident in what the future holds, but we can be confident in certain actions that will help us navigate rapid change more effectively, such as learning to learn (on your own and with others), empathizing with and understanding human and machine behavior, and having the ability to be resilient in times of major disruption. Most importantly, new partnerships and resource configurations are needed to execute a new work + learn ecosystem that will help individuals, disadvantaged or otherwise, take advantage of new opportunities that the future holds for them.

Ideas generated during Expert Workshop at SNHU on August 6, 2018.
Marsha Dunn, Graphic Recorder

SUPPLEMENTAL RESOURCES

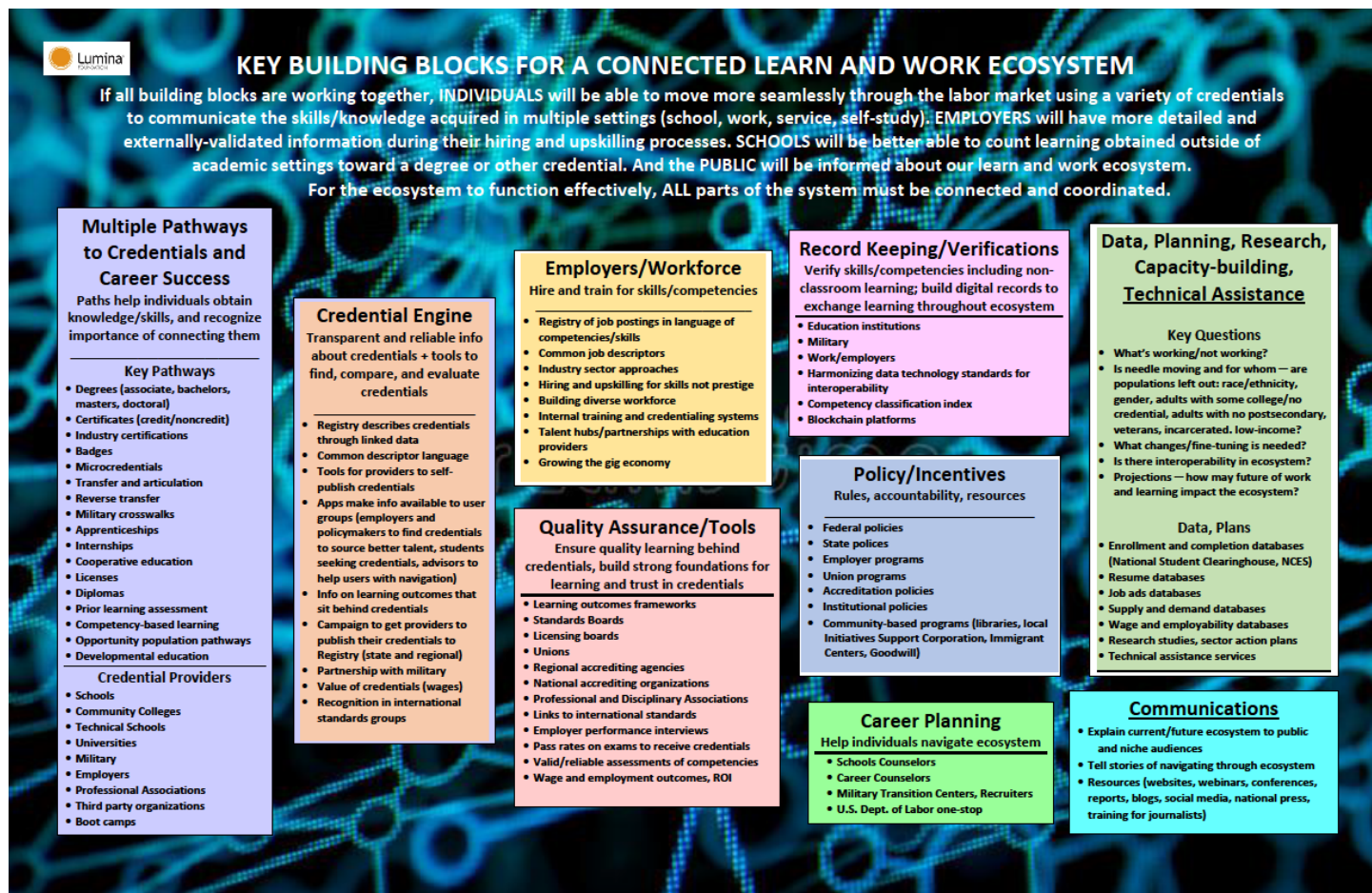## Lumina's Nine Building Blocks for a Connected Work + Learn Ecosystem

These are the key building blocks to build an ecosystem benefiting individuals, employers, educational entities, and the public.

KEY BUILDING BLOCKS FOR A CONNECTED LEARN AND WORK ECOSYSTEM

If all building blocks are working together, INDIVIDUALS will be able to move more seamlessly through the labor market using a variety of credentials to communicate the skills/knowledge acquired in multiple settings (school, work, service, self-study). EMPLOYERS will have more detailed and externally-validated information during their hiring and upskilling processes. SCHOOLS will be better able to count learning obtained outside of academic settings toward a degree or other credential. And the PUBLIC will be informed about our learn and work ecosystem. For the ecosystem to function effectively, ALL parts of the system must be connected and coordinated.

Multiple Pathways to Credentials and Career Success
Paths help individuals obtain knowledge/skills, and recognize importance of connecting them

Key Pathways
- Degrees (associate, bachelors, masters, doctoral)
- Certificates (credit/noncredit)
- Industry certifications
- Badges
- Microcredentials
- Transfer and articulation
- Reverse transfer
- Military crosswalks
- Apprenticeships
- Internships
- Cooperative education
- Licenses
- Diplomas
- Prior learning assessment
- Competency-based learning
- Opportunity population pathways
- Developmental education

Credential Providers
- Schools
- Community Colleges
- Technical Schools
- Universities
- Military
- Employers
- Professional Associations
- Third party organizations
- Boot camps

Credential Engine
Transparent and reliable info about credentials + tools to find, compare, and evaluate credentials
- Registry describes credentials through linked data
- Common descriptor language
- Tools for providers to self-publish credentials
- Apps make info available to user groups (employers and policymakers to find credentials to source better talent, students seeking credentials, advisors to help users with navigation)
- Info on learning outcomes that sit behind credentials
- Campaign to get providers to publish their credentials to Registry (state and regional)
- Partnership with military
- Value of credentials (wages)
- Recognition in international standards groups

Employers/Workforce
Hire and train for skills/competencies
- Registry of job postings in language of competencies/skills
- Common job descriptors
- Industry sector approaches
- Hiring and upskilling for skills not prestige
- Building diverse workforce
- Internal training and credentialing systems
- Talent hubs/partnerships with education providers
- Growing the gig economy

Quality Assurance/Tools
Ensure quality learning behind credentials, build strong foundations for learning and trust in credentials
- Learning outcomes frameworks
- Standards Boards
- Licensing boards
- Unions
- Regional accrediting agencies
- National accrediting organizations
- Professional and Disciplinary Associations
- Links to international standards
- Employer performance interviews
- Pass rates on exams to receive credentials
- Valid/reliable assessments of competencies
- Wage and employment outcomes, ROI

Record Keeping/Verifications
Verify skills/competencies including non-classroom learning; build digital records to exchange learning throughout ecosystem
- Education institutions
- Military
- Work/employers
- Harmonizing data technology standards for interoperability
- Competency classification index
- Blockchain platforms

Policy/Incentives
Rules, accountability, resources
- Federal policies
- State polices
- Employer programs
- Union programs
- Accreditation policies
- Institutional policies
- Community-based programs (libraries, local Initiatives Support Corporation, Immigrant Centers, Goodwill)

Career Planning
Help individuals navigate ecosystem
- Schools Counselors
- Career Counselors
- Military Transition Centers, Recruiters
- U.S. Dept. of Labor one-stop

Data, Planning, Research, Capacity-building, Technical Assistance

Key Questions
- What's working/not working?
- Is needle moving and for whom — are populations left out: race/ethnicity, gender, adults with some college/no credential, adults with no postsecondary, veterans, incarcerated, low-income?
- What changes/fine-tuning is needed?
- Is there interoperability in ecosystem?
- Projections — how may future of work and learning impact the ecosystem?

Data, Plans
- Enrollment and completion databases (National Student Clearinghouse, NCES)
- Resume databases
- Job ads databases
- Supply and demand databases
- Wage and employability databases
- Research studies, sector action plans
- Technical assistance services

Communications
- Explain current/future ecosystem to public and niche audiences
- Tell stories of navigating through ecosystem
- Resources (websites, webinars, conferences, reports, blogs, social media, national press, training for journalists)

Lumina FOUNDATION

Futures Terminology Key Definitions

Action

As the last step of the Foresight-Insight-Action process, this is where one chooses a clear and compelling way forward. This part of the process helps visualize potential actions across an organization, identifies and engages networks of collaborators that cross traditional boundaries, and brainstorms experiments to refine strategic efforts.

Discontinuity

This is a dramatic shift resulting from an unanticipated termination of a trend, leading to changing practices, behaviors, offerings, attitudes, and/or investments.

Driver

A driver is a large force made up of intersecting and interacting signals, trends, discontinuities, and other inputs that shape and inform the long-term future.

Foresight

Foresight is the process of turning facts about the present into clear and actionable views of the future. Foresight is a mindset that encompasses creative thinking about future possibility and systemic analysis of patterns that affect change. Foresight tools help to sense change and communicate vision.

Insight

This is the "aha" moment when we begin to translate our foresight into implications for the choices we face. We provoke insight with all kinds of tools, from aligning with one long curve of change to building resilience to many future possibilities. In the end, insights point us towards opportunities we can begin to pursue today and help us identify threats we need to avoid and cultivate visions of long-term aspirations and preferred futures.

Map (Visual Framework)

A map is a visual forecast. It provides an at-a-glance look at the future—typically revealing not only the analytical framework but also a host of perspectives, signals, scenarios, and even artifacts of the future. It is IFTF's all-in-one view of the future.

Scenario (Alternative Future)

A scenario is a story about a future state, on a specific time horizon, based on explicit and internally consistent assumptions about the drivers of change.

Signal

A signal is a new product, new practice, new market strategy, new policy, or new technology that has the potential to grow in scale and geographic distribution. It captures emergent phenomena sooner than traditional social science methods and focuses attention on the margins of society rather than the core.

Trend

This is a pattern of gradual change in a condition, output, or process, or an average or general tendency of a series of data points to move in certain directions over time, represented by a line or curve on a graph.

Wildcard

A wildcard is a low-probability but high-impact event that severely impacts key assumptions about the future.

IFTF Future Fit–Future Skills Map

This map outlines a work + learn framework that identifies peak performance zones and associated super skills that workers and learners will need to succeed in the workforce of the future.

The map can be downloaded here: http://www.iftf.org/fileadmin/user_upload/futureskills/downloads/IFTF_FutureSkills_Map.pdf

IFTF Beyond Organizations: New Models for Getting Things Done

The map is a tool for matching new opportunities to the challenges an organization faces, for developing strategies that will lead to a thriving and sustainable operating environment, and for building future skills that will enable an organization to make the best use of these new technologies.

The map can be downloaded here: http://www.iftf.org/fileadmin/user_upload/images/Work_Learn/SR_2027_IFTF_GoogleCloud_Beyonganizations__map_Reader_6.8.18_6.pdf

Alternative Futures: Four Scenarios of a Possible Future Generated by IFTF

Institute for the Future wrote four scenarios for AI workshop participants to engage with. The task for each scenario was to 1. Create a persona, 2. Describe the implications of the scenario for each persona, and 3. List actions that should be taken today in light of this scenario.

Alternative Future #1: Cog in the Wheel Scenario

By 2030, AI is a background condition of everyday life. Machines are smart, fast, and able to manage increasingly complex tasks. AI-based systems have far surpassed the pattern recognition and data analytics of the early 2020s. Now, machines use "cognitive intelligence" to draw inferences from imperfect information, understand semantic meaning, take actions, and learn from their experiences as well as the experiences of other AI programs. These expanded competencies and functions of AI have displaced and disrupted human labor in finance, retail, law, medicine. In fact, no industry has been immune to the impacts of the "second machine age."

There are still jobs in most parts of the country. Even with an increase in home robots and smart home technologies, aging boomers and millennial parents sustain a high demand for jobs in the caregiving economy. And there is still a role for humans in creative work, mid-tech jobs, and in what's thought of as "the last mile" part of highly automated systems. In many cases, it is still a human carrying the package from the autonomous delivery vehicle to the doorstep, and it is still a human, in partnership with a machine, who is troubleshooting problems related to antiquated physical spaces and public infrastructure.

Important to note, however, is that most of the jobs in 2030 are designed and overseen by AI systems. Very few jobs allow workers to use their ingenuity and creative drive. Rather, their job is to execute tasks that have been generated by algorithms. Whether it's through the AR interface, haptic computing, or an old-fashioned checklist, every decision made and action taken is algorithmically guided. And all tasks are monitored, rated, and evaluated. In many ways, 2030 depicts the future Rodney Brooks described in 2018 when he wrote, "The bad news is that those jobs may well not seem satisfying, that they will not seem as status admirable as many of the jobs that have disappeared, and that many of the jobs would, in our current circumstances, pay much less than many of the jobs that will have disappeared."

Alternative Future #2: Bespoke or "Custom-Made" Economy Scenario

By 2030, there are very few tasks involving data-rich decision-making that an AI system cannot do. The systems are smart, fast, and able to manage highly complex tasks. They have far surpassed the pattern recognition and data analytics of the early 2020s and can now use "cognitive intelligence" to draw inferences from imperfect information, understand semantic meaning, take actions, and learn from their experiences as well as the experiences of other AI programs. These expanded competencies and functions of AI have bolstered productivity for large U.S. companies and disrupted human labor across all industries. Most experts (human and machine) predict that it is highly unlikely that most displaced workers will find full-time work again.

As a result, state and federal cash transfer programs have expanded to serve the high numbers of qualified professionals who are considered long-term unemployed. In states in which large AI systems are headquartered, policy changes have enacted new taxation schemes, requiring high-tech companies to distribute profits to the displaced workers as a form of salary. Other municipalities and states are classifying robots as citizens, granting them all the human rights of protection and accessibility to move freely across public spaces, but also levying taxes on companies who use them in lieu of employing human labor. Sadly, many communities have taken no meaningful action to respond to the high levels of unemployment, and their systems of social and economic support are at their breaking points.

With so many aspects of daily life now in the hands of machines (driving, working, logistics, transactions), communities have had to reinvent what daily life looks and feels like in this "second machine age." As Kai-Fu Lee anticipated in 2018, "The issue is the people losing the jobs used to feel their existence was work ethic, working hard, getting that house, and providing for the family." Dignity and self-actualization are no longer attained through paid work, so people and institutions are seeking out other ways to make meaning, find purpose, and create value. In some communities, this has inspired a high interest in "returning to the land," cultivating a rich peer-to-peer exchange of locally-made food, clothes, and crafts. In others, religion has grown in importance, with people

allocating more of their leisure time to their spiritual practice. And, in others, a mix of boredom and frustration has infected the majority of people, resulting in high levels of insecurity and distrust.

Alternative Future #3: Work in Search of People Scenario

By 2030, AI is a background condition of everyday life. Machines are smart, fast, and able to manage increasingly complex tasks. AI-based systems have far surpassed the pattern recognition and data analytics of the early 2020s. Now, machines use "cognitive intelligence" to draw inferences from imperfect information, understand semantic meaning, take actions, and learn from their experiences as well as the experiences of other AI programs.

However, these expanded competencies and functions of AI have not displaced and disrupted human labor as many economists, labor experts, and technologists forewarned. Instead, the same affordances of the sophisticated systems have flipped the promise of finding work on its head and enabled thousands of qualified candidates to be "found" by work. Digital matchmaking systems, as they have come to be known, connect people to teams, people to work, teams to work, teams to teams, teams to bots, and so on, significantly reducing the friction associated with finding work and finding talent. This has resulted in work, particularly digital work, searching for and finding top talent and innovative ideas from people in the United States and in regions of the globe who historically have not had equal visibility in job searches.

Algorithmically-designed teams and algorithmically-assigned work has made working independently a preferred work experience for most people. Being a full-time employee for a large organization in which humans form teams and assign work seems limiting to many who prefer to leverage their personal brand on the digital matchmaking system. They feel that they have more control over the work they do and with whom they work, and many feel an algorithm is a fairer delegation and evaluation tool than a human boss. Others, however, have not transitioned to the new ways of finding work. Lacking digital fluency, they are structurally displaced in the modern work marketplace. With no personal brand and no digital presence, they are algorithmically difficult to find in the pool of workers, making them reliant on old-fashioned, human-led word-of-mouth strategies to find work.

Alternative Future #4: Don't Believe the Hype Scenario

By 2030, machines are smart, fast, and able to manage increasingly complex tasks. AI-based systems have far surpassed the pattern recognition and data analytics of the early 2020s, and they can now use "cognitive intelligence" to draw inferences from imperfect information, understand semantic meaning, take actions, and learn from their experiences, as well as the experiences of other AI programs. Yet, their collective impact has not had the transformative and life-altering effect promised by technologists and futurists during the first 20 years of the 21st century. They are neither taking care of all our basic human needs nor are they displacing millions of workers from their jobs. In truth, like many technological advances that came before them, they have become a tool that humans have shaped and keep shaping to complement our strengths.
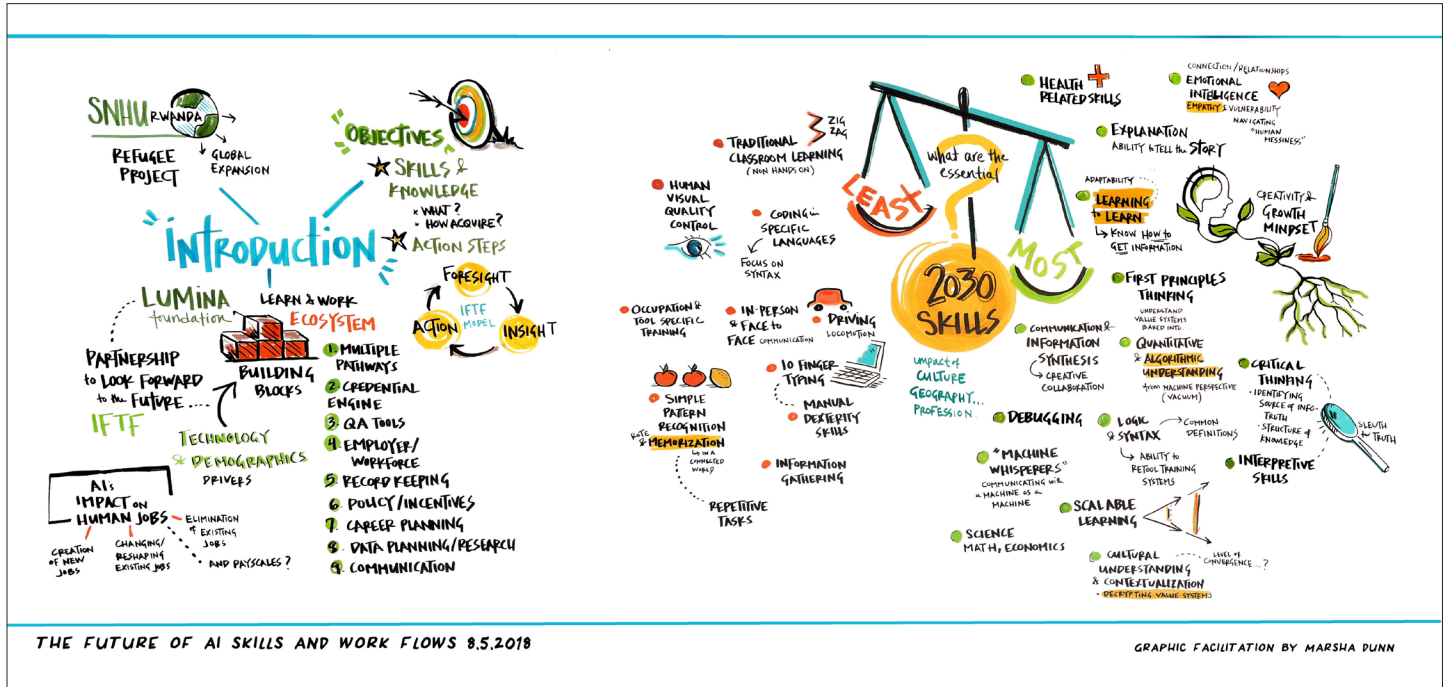
This wasn't the future outlook that Big Tech foresaw in the early part of the century. By 2015, the rapid pace of technological advancements had intensified the belief that AI systems could do the work associated with most jobs in the economy. Yet, right or wrong, too many technical failures, including pedestrian fatalities caused by autonomous vehicles and machine-learned system failures leading to city-wide power outages and erratic financial markets, weakened the public's trust in the technology.

This led to more regulatory oversight and interference. Investigative journalism exposed racial and gender-based assumptions embedded in computational models that were informing large AI systems, making people question the moral and ethical standards of the companies. And with the heightened attention, promising young talent began leaving tech in search of more mission-oriented work. Some went to computational neuroscience and genomic medicine, and others invested their time and skills to create safe, open-sourced artificial general intelligence systems.

Spreading the skills and knowledge that were formerly housed in Big Tech has diversified the economy, but it has not dramatically improved the experience of working for many people in the United States. Contingent workers now make up more than half of the U.S. labor force, and most working families rely on the gig economy for more than one-fifth of their monthly income. And while AI hasn't recast our society as we know it in 2030, it has had the tangible effect of reducing both hourly wages and the number of hours most people are paid to work.

Graphic Recordings

A collection of graphic representations illustrated in real time during the AI expert workshops in Palo Alto, CA and Manchester, NH.

April 23, 2018, Palo Alto, CA

www.iftf.org/AIforces2030

August 5-6, 2018, Manchester, NH (continued)

www.iftf.org/AIforces2030

THE FUTURE OF AI SKILLS AND WORK FLOWS 8.5.2018
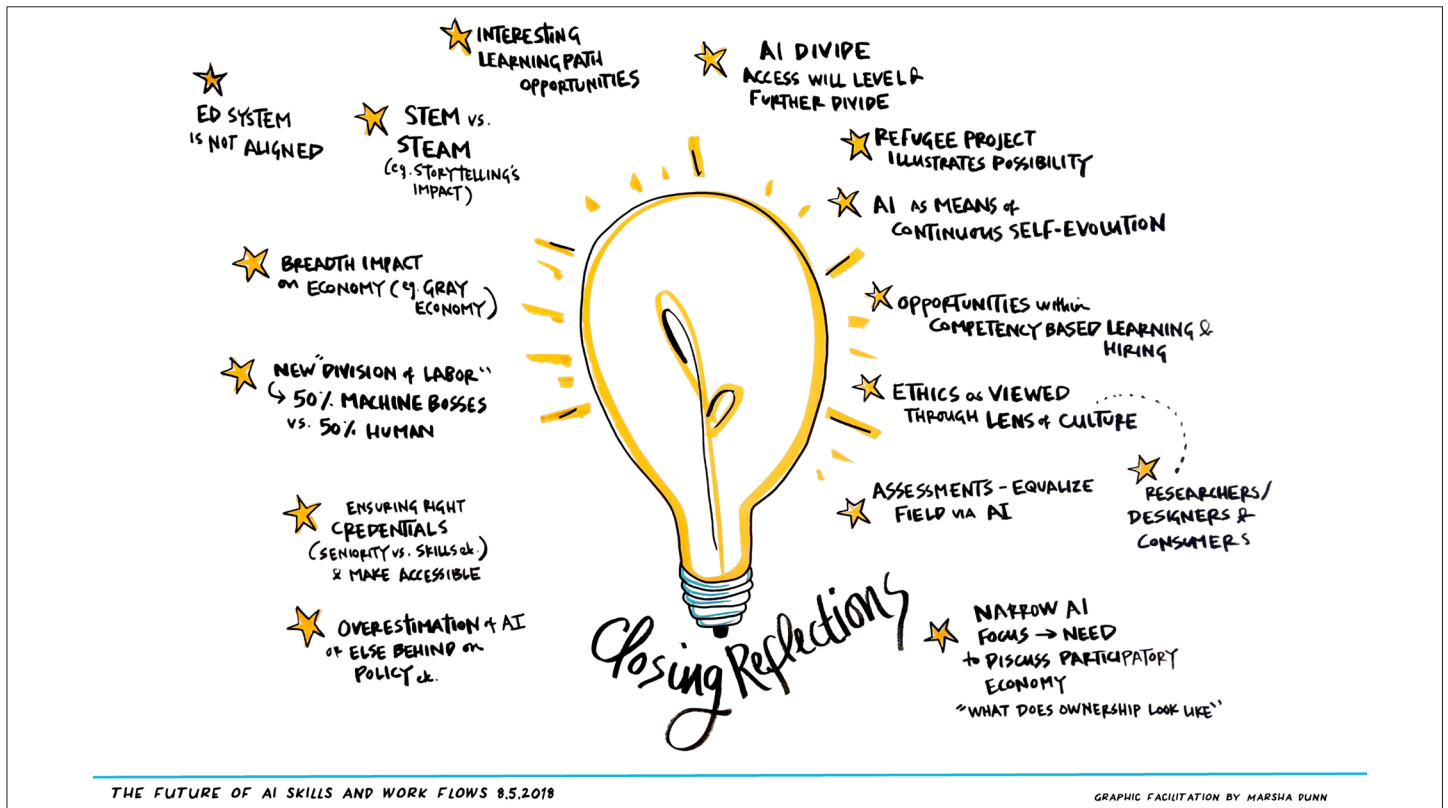
GRAPHIC FACILITATION BY MARSHA DUNN

August 5-6, 2018, Manchester, NH (continued)

www.iftf.org/AIforces2030

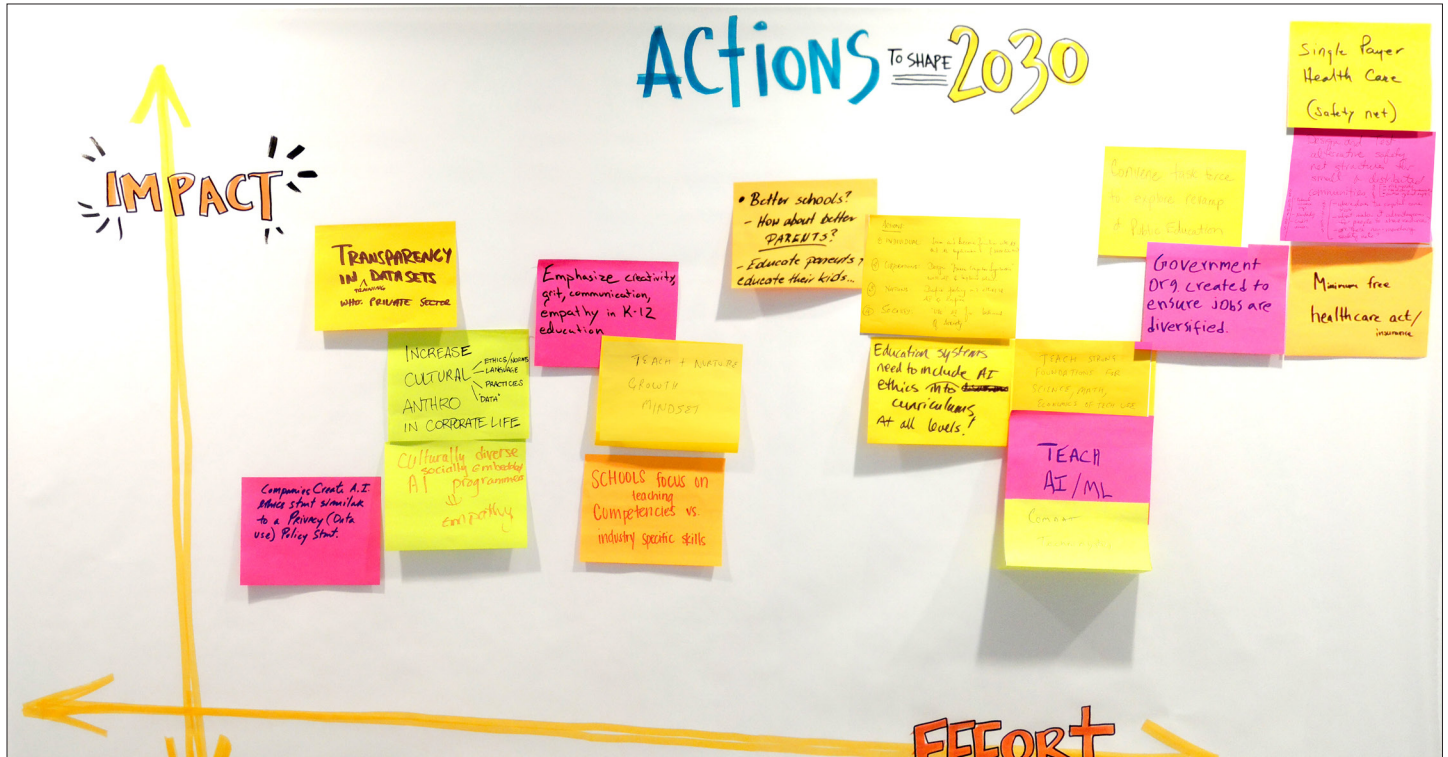August 5-6, 2018, Manchester, NH (continued)

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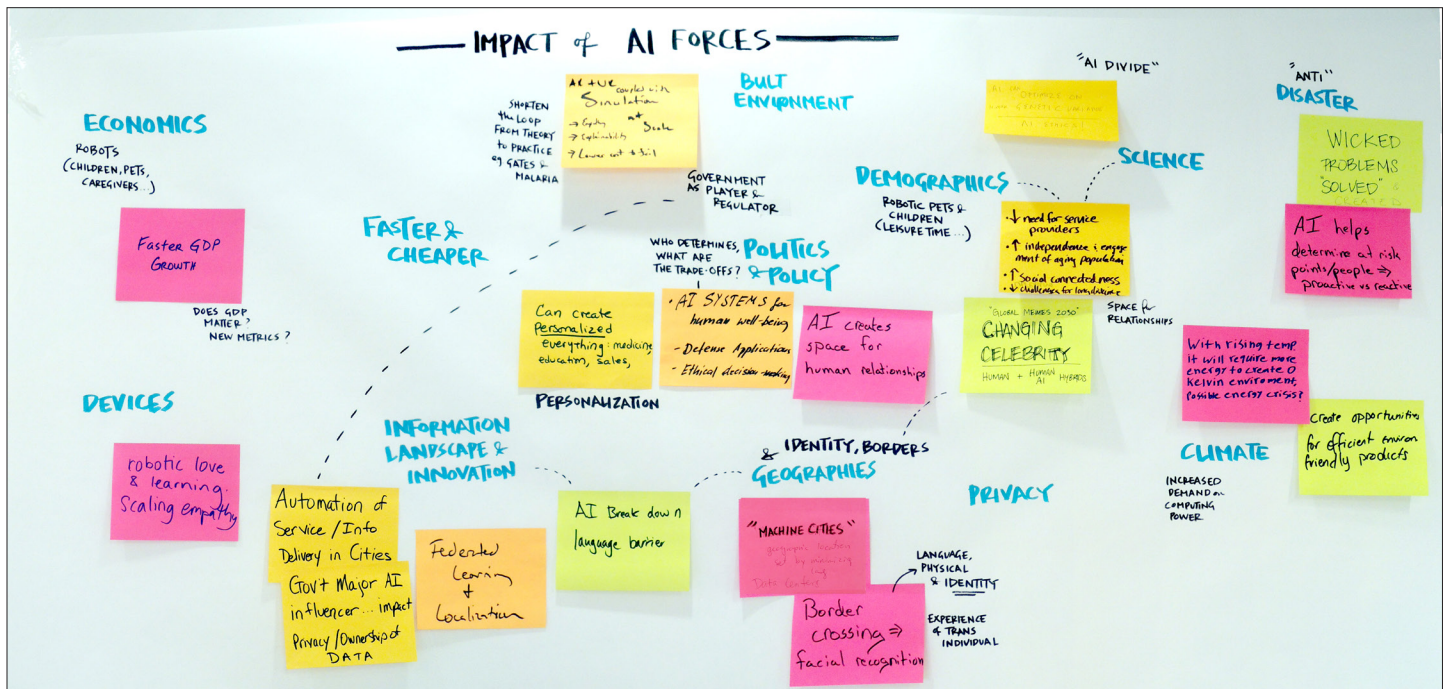
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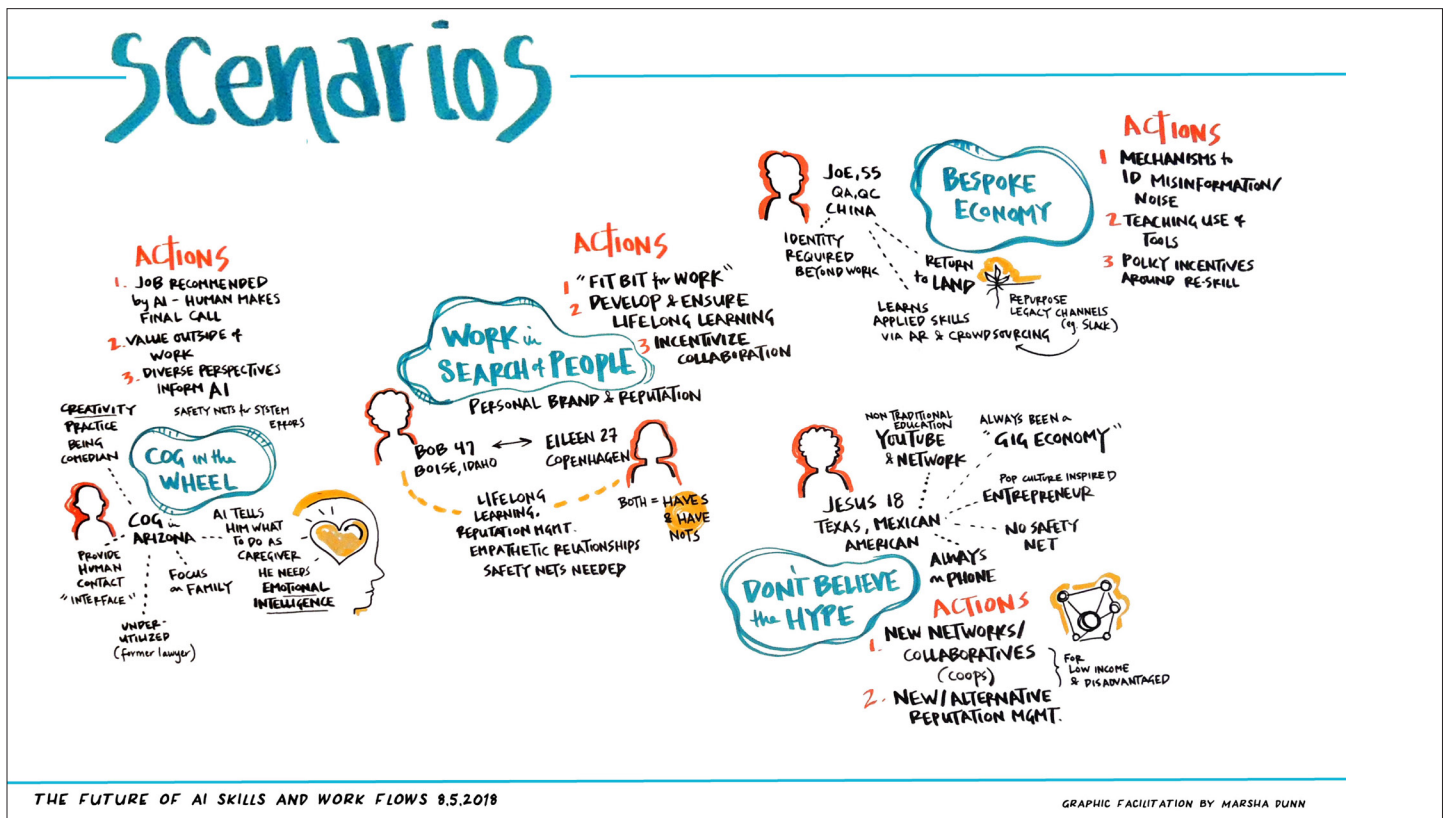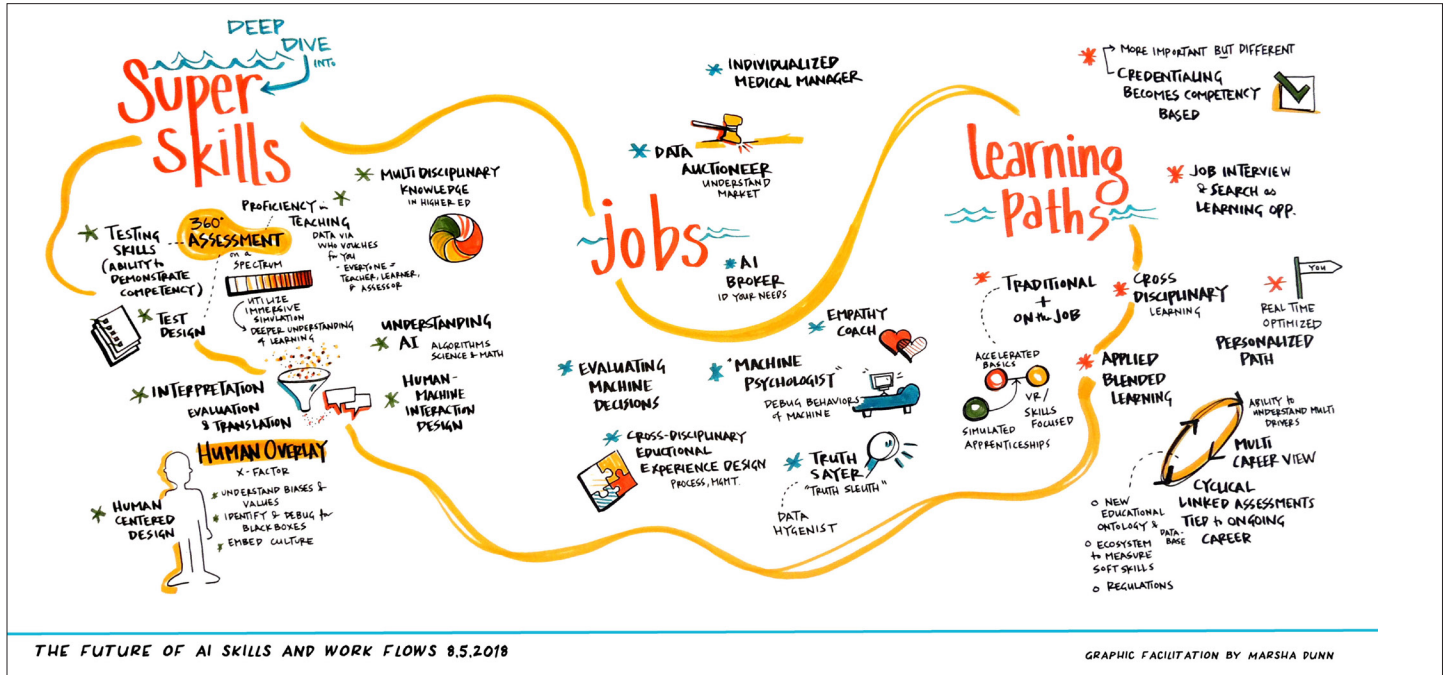
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August 5-6, 2018, Manchester, NH (continued)

www.iftf.org/AIforces2030

AI Expert Perspectives

Each AI attendee was asked to submit a future-focused AI perspective as part of their application to participate in the expert workshop. Here is a list of their submissions.

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1. For the full report, see: http://www.futurefit2030.org/

2. https://www.newyorker.com/tech/elements/diy-artificial-intelligence-comes-to-a-japanese-family-farm

3. https://www.technologyreview.com/s/609556/lawyer-bots-are-shaking-up-jobs/

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