Thinking about the Future of Work to Make Better Decisions about Learning Today

By Marina Gorbis

If you’ve participated in recent discussions about the future of higher education, inevitably you have heard people argue about the purpose of education. “It should be about preparing students to be good, educated, and engaged citizens,” some argue. “We shouldn’t bend education to suit today’s needs of acquiring specific work skills. These may quickly change, leaving graduates with little to fall back on as demand for their particular skills wanes. Instead, we should equip people with basic critical thinking skills and a desire to learn. A curious mind is a much greater asset than specific content knowledge.”
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Others respond: “That is all nice and good, but in an era of rising tuitions and high student debt, it is more important than ever for graduates to be able to earn good incomes, not only to repay their debts but also to lead sustainable lives. To ensure this, we need to more tightly connect education and work preparation.”

Such debates are not new; they’ve been around for decades if not longer. What is new are the ways that both the nature of work and the tools and processes for learning are changing. These fundamental transformations are making distinctions between work, learning, and living ever more artificial. The Institute for the Future (IFTF), in partnership with ACT Foundation, recently published Learning Is Earning in the National Learning Economy—a visual synthesis of future forces that are shaping this transformation. The work shows how the proliferation of online learning resources (free and for pay), rise of alternative learning and making spaces (from TechShop to General Assembly and makerspaces), and the diffusion of mobile technologies and peer-to-peer communities allow every moment of the day to become a learning moment. At the same time, the way we have come to think about work—that is, 9-to-5 predictable jobs in formal organizations—is less and less a reality for the growing number of working-age adults. So in thinking about the future, we need to understand the forces that are reshaping both work and learning, and we need to make linkages between the two. Instead of debating whether learning is for learning’s sake or as a means for earning a living, we need to think about the forces and signals of transformation and what they mean for higher education today and tomorrow.

So let’s explore these deeper transformations. From our experience of doing forecasting work for nearly fifty years, we at IFTF believe that it is usually not one technology or one trend that drives transformative shifts. Rather, a cluster of interrelated technologies, often acting in concert with demographic and cultural changes, is responsible for dramatic changes and disruptions. Technologies coevolve with society and cultural norms—or as Marshall McLuhan is often quoted as having said: “We shape our tools and our tools shape us.” Nowhere does this apply more critically today than in the world of work and labor. Here, I focus on four clusters of technologies that are particularly important in shaping the changes in the world of work and labor: smart machines; coordination economies; immersive collaboration; and the maker mindset.

Smart Machines: A New Era of Human-Machine Symbiosis

We’re on the cusp of a major transformation in our relationship with our tools, analogous to the transformation humanity underwent during the agrarian revolution. As agrarian cultural production became mechanized, farm labor shrank, with many rural families moving into cities and new generations finding employment in factories and construction. Over time, the consolidation of urban labor produced a managerial class, and the latest phases of development have built out this layer of labor in cities around the world.

Now, a new generation of smart software and machines is emerging to once again redefine our relationship to work.

Replacing Routine, Repetitive Work

We will continue to outsource to machines any task that can be routinized, decoded, and programmed. We have been doing this in manufacturing and are increasingly doing so in services. David Autor, an MIT economist who studies U.S. labor trends, concluded in a 2010 study that there has been a dramatic decline in mid-skill white-collar clerical, administrative, and sales occupations and mid-skill blue-collar production, craft, and operative occupations. The shift is not sudden but, rather, has been occurring over several decades. The result is what Autor calls “polarization” of
jobs, with job opportunities concentrated in relatively high-skill, high-wage jobs and low-skill, low-wage jobs. In other words, tasks that are predictable, routine, and easily codifiable are increasingly being automated. This impacts not only physical work in manufacturing but also routine knowledge and service work.

We see this shift even in today’s classrooms. Already, thousands of robots are assisting with repetitive language instruction (correcting pronunciation) in Korean schools, and new prototypes of automated food preparation are beginning to enter fast food restaurant chains and supermarkets. For example, Momentum Machines created the world’s first fully automatic hamburger machine. This hamburger machine can prepare, cook, and serve freshly ground, custom-made burgers—at a rate of 400 per hour—without a single human hand being involved. The makers claim that at their invention “does everything employees can do except better” in what they call “the most labor intensive industry in the country.” In addition, the machine can add the requested toppings (e.g., slicing tomatoes directly onto the burger) and top the burger out to a neatly wrapped sandwich ready for human consumption.

Augmenting Human Abilities
Since time immemorial, our tools have extended our abilities to manipulate our environment and to do things that individuals can’t do alone (e.g., lift large stones). A new generation of smart machines will extend our reach even further beyond human abilities, enabling us to go into places that are too dangerous or simply too hard to reach. For example, robots have played a key role in helping to contain the BP oil spill in the Gulf of Mexico. BP used remotely operated vehicles (ROVs) to conduct underwater observations and repair work. ROVs are operated by human controllers who, sitting in a command center, see what the ROV is seeing (along with data from other sensors) and control the ROV with a joystick. Similarly, we’re now using drones for warfare, a practice that raises questions about the ethics of remote warfare. But as we substitute humans with machines in direct combat, we’re also prototyping systems to help care for humans in the battlefield. Trauma Pod, a system developed by a consortium of organizations led by SRI International, makes it possible to retrieve wounded soldiers from the battlefield, diagnose them remotely, and even perform lifesaving procedures en route to a hospital. Inside the prototype theater is a team of robots, led by a robotic surgeon remotely controlled by a human surgeon.

Similarly, in the recent Ebola outbreak, robotics emerged as a possible solution to caregiving in hospitals and infected areas. Robotic tasks include everything from managing contaminated waste to “zapping” contaminated environments with ultraviolet pulses to providing care for infected and quarantined babies. This deployment of robots builds on the field of telemedicine and telepresence robots, one of the early test cases in which robots are building other robots in conditions that are inhospitable to humans. Already, the Japanese robotics company FANUC is operating a factory remotely controlled by a robot where workers are building other robots at a rate of about 50 per 24-hour shift and can run unsupervised for 30 days at a time—with no lights, air conditioning, or heat required. Humans are also not suited to manipulate things on a very small scale. Here again, machines will be recruited to do things that previously couldn’t be done. Today, nanorobots in pill form can diagnose cancer or deliver highly targeted chemotherapy. Machines will enable us to reach hidden places in the body and assemble objects molecule by molecule in new manufacturing facilities.

And thanks to advances in neuroscience and behavioral economics, we’ve come to realize that humans generally aren’t very good at thinking through probabilities and risks and making rational economic choices based on those probabilities. Whereas we likely don’t want to use pure rationality when making moral or ethical decisions, more rationality would be helpful in situations such as when making financial decisions. We’re already relying on softw are to help us make many complex decisions—including modeling climate change scenarios, impacts of financial market interventions, and optimal oil-drilling locations—but what happens when every decision, large or small, incorporates decision support from our machine helpers? This is beginning to happen: we routinely check Amazon ratings before buying a pr oduct or scan Yelp reviews before deciding where to eat. Imagine a future in which every decision we make incorporates rational analysis of risks and probabilities. We’ll outsource some decisions completely to machines, while also assimilating computational rationality into our own decision processes.

Human-Machine Symbiosis
While smart machines will replace human labor in some areas and enable humans to do new things in other areas, the most profound impact of smart machines is the new level of symbiosis or interconnectedness we will establish between ourselves and such machines. What this means is that most of our interactions—whether at work, in learning, or in health—we will involve some level of combined machine and human effort. In fact, a recent McKinsey & Company study claims that fewer than 5 percent of occupations can be entirely automated using current technology. However, about 60 percent of occupations could have 30 percent or more of their constituent activities automated. In other words, automation is likely to change the vast majority of occupations—at least to some degree—which will necessitate significant job redefinition and a transformation of business processes. BMW
is testing “collaborative robots” that can glue together parts held in place by (more precise) human fingers. The da Vinci Surgical System from Intuitive Surgical can perform laparoscopy, prostate, and other surgeries with a level of accuracy that’s difficult for human surgeons to achieve alone. Rethink Robotics has introduced an industrial robot, “Baxter,” designed to safely interact with humans, who can easily program it for simple tasks. Baxter is intended for sale to small businesses and is being promoted as the robotic analog of the personal computer. IBM’s Watson supercomputer is being used to evaluate evidence-based cancer treatment options for physicians, driving the decision-making process down to a matter of seconds.

Lawyers are using text-mining techniques to perform automated analyses of vast amounts of documents. Similarly, Narrative Science makes it possible to convert data into stories—taking sports scores or financial data and delivering written narratives that are often hard to distinguish from those produced by human journalists. Increasingly, journalists are using such writings as drafts to which they add personalized flourishes and points of view.

The machine-human symbiosis is also transforming the learning process. Just look at the new generation of smart toys from CogniToys: toy dinosaurs with Internet connectivity, backed by IBM’s Watson artificial intelligence platform, and with speech-processing capabilities. Children can ask their Dino myriads of questions and have various language-based interactions with the toy. As a child begins to play, CogniToys Dino will slowly adjust its content and experience based on how the child is using the toy and on the child’s vocabulary levels, interests, etc. The toy will literally “grow” with the child. This latest generation of toys shows all the important features of symbiotic learning: highly personalized learning, constant feedback loops, integration of learning and play, flexibility and adaptability. What will the generation of kids who are growing up with such learning and play companions expect from their work and educational settings? As artificial intelligence and connectivity become embedded in physical objects and spaces around us, we will have to fundamentally rethink the nature and structures of our educational institutions.

**Coordination Economies:**
**Socialstructured Value Creation**

The automation and the diffusion of smart machines are accompanied by another development—the emergence of coordination platforms such as Uber, Shyp, and Airbnb. A decade ago, workers in the United States and Europe worried about jobs being outsourced overseas.
Today, companies such as Upwork and LiveOps can assemble and coordinate teams “in the cloud” to provide sales and customer support, help with editorial work, conduct research, design and prototype products, and perform many other tasks and organizational functions. New digital platforms are beginning to act like real-time online staffing agencies: bridging borders, orchestrating complex tasks across teams of micro-workers, and integrating the global workforce at levels and speeds never seen before. As a result, many workers in the United States are feeling the impact of global labor arbitrage more keenly than ever before. It is easy to find the best programmers, best editors, and best designers from anywhere in the world.

These companies are transforming not only what people do to earn their livelihoods but also, at a much deeper level, how we organize to create value. New types of workers are emerging—micro-taskers—people who are signed up on multiple digital coordination platforms such as Uber, Lyft, Gigwalk, and MobileWorks and whose work experience doesn’t involve stable 9-to-5 jobs but, rather, a stitching together of various tasks performed in flexible niches of time.

The growth of these online task-coordination platforms is reshaping the formal organization of labor built up over the last century, with an accompanying decline in traditional managerial structures as more flexible and adaptive structures take advantage of new technologies to create value outside of formal organizations. I call this type of value production socialstructing. At its core is the ability to divide larger tasks into smaller pieces (micro-tasks), divvy them up among a large network of people according to their availability and expertise, and aggregate the resulting micro-contributions using social tools and technologies.

The growth of these online task-coordination platforms is reshaping the formal organization of labor built up over the last century. Wikipedia is probably the best example of this form of production, but the number of socialstructs—in fields from health to science to finance—is growing rapidly. We are seeing this in publishing, music, and broadcasting: bloggers, amateur musicians, and YouTube stars can reach audiences larger than those of many established media channels. This new form of economic activity is very different from institutional production because it often happens on an ad hoc basis without clearly assigned roles, hierarchies, or additional management structures. Algorithms, rather than managers, often distribute tasks and coordinate work. In addition to per-pay contributions to socialstructured work, many contributions are provided at no pay, disrupting traditional notions of monetary incentives and enabling individuals or small groups to use networks of volunteers or micro-taskers and create value comparable to or greater than that produced by paid employees within institutions.

Indeed, the socialstructuring of organizations will fundamentally challenge many longstanding working relationships and structures. As production methods increasingly shift to micro-contributions, algorithmic coordination of tasks, nonmonetary incentives, and reputation metrics, many firms will be forced to reexamine their fundamental operating principles. This adaptation process is likely to include reevaluations of management hierarchies, rewards, physical space use, and even the nature of employment itself. Overtime, pressure will increase for or organizations to crowdsourcing, or cloud sources, many functions and to focus their efforts on aggregating these functions into add value. Socialstructured organizations are likely to resemble fluid subcultures more than rigid pyramids. Organizing, coordinating, participating in, and navigating these fluid networks will be vital competencies for making a living in the future.

Socialstructured value creation will reshape how we think about work and labor and about the skills people will need in order to sustain their livelihoods.

From Jobs to Tasks
At the core of socialstructing is our ability to break down many large tasks into smaller pieces and assign those smaller tasks to many different people, wherever they might be, quickly and effectively. Such micro-tasks or micro-contributions may take different forms: conducting basic calculations, searching for data, or delivering a packet of medications to a house-bound patient. This new form of coordination not only can help solve the thorniest problems faced by organizations and communities but also can create manageable, accessible jobs for people all around the world. Already, micro-work is beginning to engage the underused talents of people from a variety of geographical areas and from a variety of educational and professional backgrounds.

According to some estimates, almost 54 million Americans—approximately 34 percent of workers—did freelance work in 2015. This number is expected to grow significantly in the next twenty years as more people embrace new online platforms and tools that allow people to create and sell their services. The platform can evaluate the contractors applying for the job and, once a contractor is selected, serve as a channel for communications and exchanges of work deliverables between contractors and requestors. Payment for jobs, which can be either hourly-rate or project-based, is made by the client through Upwork’s system. Each freelancer can post a project displaying past jobs and feedback, a portfolio, and specific skill and educational-background information. Another platform is LiveOps, an on-demand contact and call center that enables outsourcing of services for hundreds of companies through its network of over 20,000 independent at-home agents.
LiveOps tracks the performance of each call center representative in minute detail, displaying results on a dashboard and automatically matching callers with those agents who have the highest performance ratings. One more recent innovator in this space is Samasource, a micro-work platform that focuses on providing enterprise services worldwide by tapping poor women and youth in developing regions of the world. It began with a focus on women in refugee camps but has expanded to become a global matchmaker for tasks and people who may not have access to traditional job markets.

Algorithmic Coordination
A key piece of effective social structuring is the use of software to route or manage crowd contributions. In some cases, this is simply a matter of matching a task to the most qualified person available. However, the approach can also be used to tightly coordinate a complex series of tasks so that they come together in an on-demand fashion. This mechanism will be a foundation for co-ordinating any activity in the coming years and will be a potent force for amplifying and disrupting existing institutions, since the co-ordination of activities has been the primary role of management. ReThinkery Labs, a recently announced venture by Devin Fidler, one of my colleagues at the IFTF, makes it possible to automate a variety of organizational processes, including the peer access of research report writing. In a recent project, its software broke down the research process into discrete tasks, used an algorithm or a set of automated instructions to recruit people on a variety of existing digital work platforms (e.g., Upwork, TaskRabbit, Mechanical Turk), and then managed the work of qualified people on these platforms. The final report involved the work of hundreds of human contributors, aided by machine intelligence and managed by software algorithms—the ultimate example of human-machine symbiosis. This kind of symbiotic relationship is likely to transform most jobs, from entry-level to the most sophisticated ones, including those in research and C-suites.

Rise of Alternative Currencies and Reputation Markers
In his essay “On Money and Magic,” the game researcher Edward Castronova argues that in order to give money or any currency its magical power, a group needs to collectively agree and believe that a particular thing—a piece of paper, an ounce of gold, or the U.S. dollar—has value and that it can be exchanged for goods and services within the group. It is precisely because we are the ones who imbue money with value, and because the creation and circulation of money requires a social contract (a social agreement of its value), that a group of any size can potentially create a currency. The existence of paricipatory technologies makes it relatively easy to create social currencies and alternative reputation systems within online groups, whether as in-game currencies (in-gaming communities), reputational badges (alternatives to degrees and grades), or local currencies (valid for local trades). Thus, the proliferation of online paricipatory platforms will inevitably lead to the proliferation of new types of reputation and reward currencies. This trend will impact both the world of work and the world of learning.

In the business and technology circles, substantial resources are being invested in the creation of alternative currencies such as the bitcoin and its underlying blockchain technologies. Although much is still not clear about such technologies, their main impact is the disintermediation of traditional structures of authority and gatekeeping, from central financial regulators to various types of educational certification agencies. The promise of blockchain technologies is to enable true peer-to-peer verifiable transactions, making it easy to track contracts, levels of expertise, and knowledge acquisition.

Even in the absence of such technologies, a growing number of platforms are aiming to replace degrees, resumes, and other traditional markers of experience and skill with more fine-grained and personalized systems. GitHub, an open-source social programming platform, has enabled many developers to use their creations on the platform in lieu of résumés. Developers’ profiles and contributions are considered their work portfolios. For those wanting to find a job as a programer, what they’ve created on Git Hub is often a more direct pathway to a job than a college degree. Mozilla Open Badges allows users to track skills that they teach and learn informally by issuing verifiable digital badges that are stored and displayed in a “digital backpack.” Degreed, a recently launched start-up, argues that how someone got expertise—whether through informal means or via formal educational institutions—doesn’t matter. Degreed measures and validates all types of educational inputs, whether they are from formal institutions or from more informal learning platforms such as Khan Academy or Udacity, and then works with employers to use these scores in hiring and promotion processes.

Technology creates new ways to track and acknowledge learning that happens anywhere—in school, on the job, and in informal settings. Reputation and digital performance trails will increasingly weigh more than college degrees, attendance, or other proxies for assessing knowledge and competency levels. Indeed some employers, including Google, have begun to deemphasize traditionally dominant metrics such as Ivy League diplomas in favor of a more direct analysis of an applicant’s unique personal style and background. Whereas the logistics of this kind of approach would have been prohibitively difficult in the past, the greater visibility of one’s body of work today makes this an ever-easier strategy to use. Clearly, the assessment of skills or suitability for a particular task or job, particularly digital work, will become more varied, complex, and nuanced than ever.
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To see how such reputation systems might evolve in the future, the IFTF and ACT Foundation ran a forcasting game centered on the idea of a blockchain-based platform. The Ledger tracks everything you've ever learned, every one you've learned from, and every one who has learned from you. The Ledger tracks not only what you know but also all the projects, jobs, gigs, and challenges you've used that knowledge to complete.

**Immersive Collaboration: From Face-to Face to Blended Reality**

We are creating a new kind of reality, one in which physical and digital environments, media, and interactions are woven together throughout our daily lives. In this world, the virtual and the physical are seamlessly integrated. Cyberspace is not a destination but is, rather, a layer of experience that is tightly integrated into the world around us. The proliferation of mobile and sensing devices, advances in virtual and augmented reality, and the explosion of various types of lightweight collaboration platforms are making it easier than ever to work, share ideas, and be a part of a global team while still being physically separated. In fact, being a part of a geographically distributed workforce is quickly becoming a de facto standard in today’s work environment.

Although the amount of information that can be transmitted via typical online video platforms is currently limited, it is poised to jump dramatically as a new generation of gigabit telecommunications networks is deployed and even rural areas get connected with mesh wireless communication tools. Virtual reality devices, once the purview of science fiction or high-cost research labs, are entering retail markets with the introduction of Oculus Rift, which consumers can pur chase for about $300. These devices are poised to enter not only entertainment spaces but also learning and work environments, enabling people to create shared “realities” independent of geography.

At the same time, the online social networking industry has seen enormous growth over the last decade. These sites have so far largely filled a recreational or contact-directory role. At the same time, social network infrastructures are permeating the work domain with team productivity and coordination tools, such as Google Docs and Google Hangouts, Asana, and Slack. Meeting augmentation platforms such as MindMeld promise to deliver critical information flows in the context of online meetings. These systems seek to repurpose the communications tools used by Facebook and others to facilitate a deeper coordination of professional teams. The ability to deftly manage and apply social networking tools—in order to both communicate effectively and facilitate the accomplishment of practical tasks—will be increasingly valued. Many entrepreneurs are also using online platforms to create showrooms and storefronts to sell their products.

This world of immersive virtual collaboration will drive new work patterns, will further support entrepreneurial efforts in countries with high unemployment, and will create new dilemmas at individuals and governments will need to navigate.

**24/7 Global Teams**

Putting together global teams that can undertake tasks continuously, using time differences as a competitive advantage in the provision of goods and services, has become an efficient and often highly desirable practice in several industries. It is already playing out in the world of finance, where traders operating in global and integrated teams can use minute advantages in timing to create greater profits. Increasingly, this global advantage works for the worlds of programming, selling, and many other areas as well and will drive requirements for a new kind of team literacy in labor markets around the world.

**Digital Work Trails**

As virtual collaboration across borders becomes ever easier, those workers with the ability to orchestrate, shape, and productively participate in ad hoc value networks will be greatly prized. Virtual collaboration requires that those involved leave digital trails of their work so that others know where the gaps are, what needs to be done, and where they need to contribute. Google Docs, wikis, and many other collaboration platforms will enable the creation and management of such digital trails. Curating these trails may become micro-tasks for people with local, on-the-ground knowledge as well as those dedicated to and skilled in a new kind of work management. Asana is a web and mobile application designed to enable teamwork without email. Each team gets a workspace that contains projects and tasks. In each task, users can add notes, comments, attachments, and tags. Users can follow projects and tasks, and when the state of a project or task changes, followers receive updates about the changes. Another example is Trello—a free, online, and mobile collaboration tool that organizes projects into boards. At one glance, Trello users can see what’s being worked on, who’s working on what, and where something is in a process.

**Quantified Work**

With so much work being done through digital technologies and with the proliferation of digital trails, it becomes easy to create exceedingly precise individual and team performance and productivity metrics. Having this type of data is essential to creating algorithms for efficiently allocating tasks. Such measurement can be done at an individual level and also aggregated across workers. When this data is collected and used at an individual level, however, it creates concerns about new kind of Taylorism, potentially increasing individual stress levels and raising concerns about privacy and coercion. We are already beginning to see this issue emerging among package delivery workers, many of whom resent continuous monitoring of their vehicles. Online task platforms such as Upwork can see at what time of day what type of workers are most...
productive anywhere in the world or what type of coding is most efficiently done in a particular country. LiveOps measures time spent by each freelance agent on a task; time spent with a customer can be logged in and correlated with an outcome such as making a sale.

**Maker Mindset: Democratizing Production and Creation**

The diffusion of mobile technologies and personalized tools for creation—from cheap video cameras to music- and video-editing tools—has gone hand in hand with the rise of digital manufacturing techniques, particularly the maturation of 3D printing technology. This technology, a digitally guided additive approach to manufacturing, enables operators to assemble products layer by layer, allowing variations to be built into individual units. Although remarkable uses of 3D printing have already been developed, from replaceable machine parts to viable human organs, the technology is still in its infancy. It will reach its full potential in the coming decades as it is combined with emerging biotechnology and nanotechnology applications. The rise of more customizable materials will allow manufacturers to more precisely tailor the material properties of a product to its function.

These technologies and tools are contributing to the rise of global “maker” and “hacker” movements—not just in developed economies like North America and Europe but also in small thriving pockets on every continent. These movements are offering new pathways to education, work, and livelihoods. Bottom-up learning communities connect people who want to learn how to make and build things. Formal and informal community workshops and co-working and co-creating spaces give them a place to use expensive equipment and learn skills from one another. Crowdfunding platforms provide a small-scale funding boost, a source of feedback, and viral marketing. This world of open making is poised to fundamentally reshape many of our basic assumptions about production itself. The manufacturing industry and, by extension, the nature of many economies will be transformed in the process.

**Growth of Maker/DIY Movements**

Maker and DIY (do-it-yourself) communities are growing around the world, resulting in what some are calling a **hardware renaissance**. In just the last few years, an entire ecosystem has developed to support entrepreneurial hardware development and hardware start-ups. A support infrastructure of tools, manuals, and instructions for makers is growing. Alchematter is just one example. It is an experimental platform that attempts to organize manufacturing and making knowledge into tools, materials, people, and processes. Kind of a Wikipedia for making, this platform for modular, sequential procedures hopes to create a universal language for making.

The maker mindset is fostering new cross-border relationships and partnerships among engineers, entrepreneurs, designers, and open source enthusiasts who are connecting through this broad movement. Small entrepreneurs operating out of Tech Shops—membership-based maker spaces—are linking up with small flexible manufacturers in China to produce products at various scales. For example, the creators of OpenROV, a mini underwater robot that is used for exploration on ocean floors, designed the prototype at the TechShop in San Francisco and quickly turned to Chinese suppliers to produce early models.

The maker mindset is reshaping how people approach many arenas, from actual design and manufacturing to how we approach social issues, including issues influencing cities and education. Increasingly, people adopting the maker mindset are less likely to accept existing institutions and approaches as immutable. Instead, they are likely to view these institutions and approaches as hackable—as something that can be taken apart and reconfigured and remixed in new ways.

**Community Labs and Maker Spaces**

To accommodate the growing DIY movement, the number of community labs (such as BioCurious) and manufacturing clubs (such as TechShop) has grown over the past few years. These spaces, for which members pay a monthly membership fee, serve multiple purposes. They function as research communities, and they provide places for prototyping new ideas, meeting like-minded individuals, taking classes, learning from mentors, and even starting companies. Such spaces blur the boundaries between work, learning, and social communities. BioCurious, for example, is a hackerspace for people interested in synthetic biology. Participants range from academics doing advanced biology research at universities to teenagers wanting to learn and to engineers and programmers eager to apply their engineering expertise to biological systems. A small membership fee enables participants to take classes, work and learn from others, and collaborate on various projects. A recent much-publicized project coming out of BioCurious aims to create phosphorescent trees that can absorb sunlight during the day and phosphoresce at night, thus saving on electricity.

**Crowdfunding Platforms**

With the rise of maker spaces and maker mindsets, the domains of consumption and production, which we used to think of as being completely different, are becoming increasingly blurred. Crowdfunding plays a key role, enabling maker spaces to serve as giant experimental labs for creating new kinds of relationships between the people who make things and the people who consume them. Crowdfunding is creating new expectations on the part of the people who back campaigns. They are discovering how much more meaningful it is to buy a product (or service) when their dollars actually matter in bringing it to life and when they get a direct emotional connection with the people who are providing it. In the process, instead of simply buying
and consuming products, people become investors and learn many of the details of how the product is produced, the manufacturing processes behind it, the people involved, and the materials used. The process of production is transformed into a highly social and educational experience.

Betabrand is a fashion company that is structuring its interactions with buyers through a crowdfunding model. Designers and fans submit ideas for products—such as a “hoodzer,” which is a suit jacket and a hoodie at the same time—and then people vote on whether or not they’re going to fund the idea for production. So consumption is blending with an investing mentality in a new kind of impact shopping.

Implications
The core set of technologies outlined above will reshape work and the labor force over the next decades, but not necessarily in the same way under all circumstances in all parts of the world. When these technologies combine with external economic, social, and environmental factors, they are likely to produce different outcomes.

For example, these four technology clusters will create unprecedented opportunities for integrating people from developing countries into global production networks and flows of work. While automation will continuously replace many rote and repetitive manufacturing and service jobs, online platforms such as Upwork will enable workers from anywhere in the world to bid on tasks and become members of extended teams. We are already seeing this global labor arbitrage in action as workers from the Philippines, India, and Pakistan are increasingly engaged in editorial, software development, and sales tasks using online work platforms. At the same time, many people from around the world are able to access capital through various crowdfunding and peer-to-peer mobile online platforms as well as create storefronts, attract customers outside of any formal channels, and take advantage of distribution and promotion channels online.

There is no doubt that the new generation of technologies will open up opportunities to those who have the basic literacy and media savvy to turn these connections into paid work. In this sense, continued investment in a basic communications infrastructure that ensures access to the widest possible number of people should be a continued priority for governments and development orizations. This should be coupled with an emphasis on developing literacy and media skills. One particularly important avenue for achieving this is creating online content that can be accessed in local languages as well as providing access to a rich ecology of content via local sources such as Coursera and edX.

Even though many of the emerging platforms and tools are likely to engage the more educated and connected people, there is a great opportunity to use the platforms and tools to integrate those who have traditionally been excluded from participation in formal organizational structures: those with disabilities, young people, the elderly. Much of the online work can be done on a task basis, opening up opportunities for those with different backgrounds and needs to commit to 9-to-5 or other rigid schedules (e.g., those with caretaking responsibilities). Engagement and allocation of tasks is done on the basis of skill assessment and reputation rather than being based on in-built social hierarchies and biases, opening up opportunities to previously disenfranchised populations.

Finally, a lot of the work can be done in place, thus minimizing the costs associated with commuting to places of work, usually in cities, and again opening up opportunities: for those in rural areas or the elderly. Here again, the focus is on digital access and inclusion, coupled with investments in education, can result in substantial advances in integrating previously disadvantaged populations into global labor flows.

At the IFTF, we firmly believe that the purpose of systematically thinking about the future is not to predict the future but to help people make better decisions today. There is no data about the future. The only data we have is about the past. Historical patterns are important because they give us frameworks for thinking. By looking at historical patterns and identifying signals of change around us today, we can better prepare for the transformations occurring in both work and learning.

Notes
1. For an exploration of what these transformations tell us about the skills that students will need in order to successfully navigate the new landscape, see my article, “New Workers, New Skills” in the online edition of EDUCAUSE Review.

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