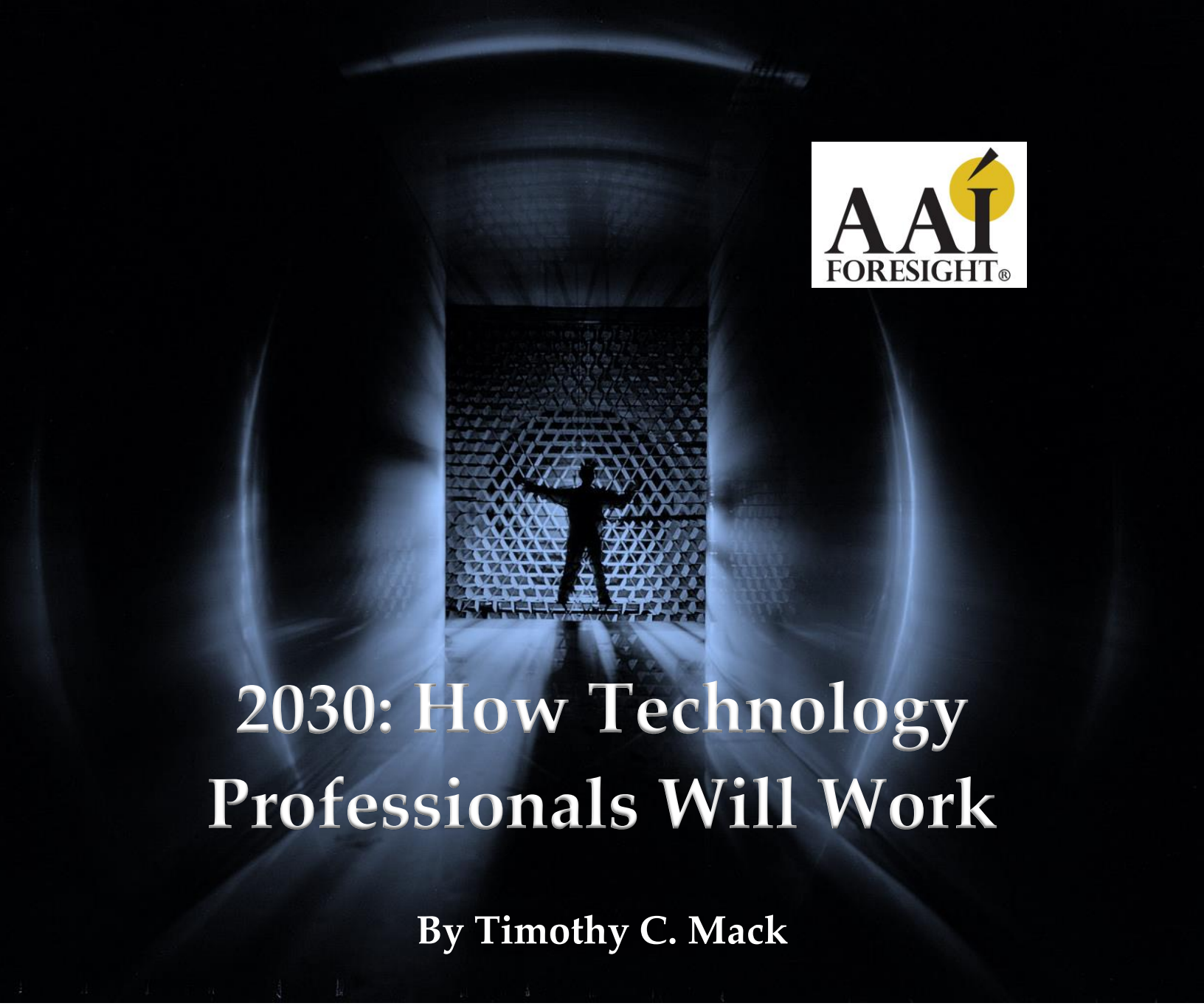

2030: How Technology Professionals Will Work

By Timothy C. Mack

ABSTRACT: The 2030 workplace will be driven not just by new technologies, but also by cultural change, the global economy, and the manner in which coming generations look at the nature of their work and how it interfaces with their professional, social, and personal lives. This report addresses the critical questions of how we'll work, how we'll be trained for that work, and what tools we'll have for that work, as well as trends in workplace communication, collaboration, new arenas of employment, and new workplace locations worldwide.

2030 Technology Professionals

By Timothy C. Mack

How the Technology Workplace Is Changing

The workplace of 2030 will be a multilateral universe. Much as individual countries have their own character and culture, so will companies and other organizations. Some will be open, collaborative, and innovative, and others will focus on past triumphs, leaving innovation to others. Across countries, companies, and economic sectors, there will be many variations.

As private, governmental, and NGO boundaries fade, the business of technology professionals will be increasingly impacted by global policy matters, as well as by the implementation of those policies. Global innovation will encompass new products and services, but also better health, public safety, global resource strategies, and quality of life issues. Global growth and vitality in 2030 will depend on the health of that globe economically, environmentally, and epidemiologically. And with expanding travel and transportation has also come additional environmental and resource-based viability issues.

In many developed and developing countries, more than 30 percent of all workers will utilize flextime schedules, thus working from home or other locations at least two to three days a week. Studies have already found increased

Foresight Report
Fall 2015

• • •

About the Author

Timothy C. Mack is managing principal of AAI Foresight Inc. and former president of the World Future Society. He may be contacted by email at tcmack333@gmail.com.

• • •

AAI Foresight Inc. provides issues identification and tracking, strategic planning, organizational development, messaging, marketing, technological assessment, and strategic services for a broad range of clients.

• • •

Foresight Reports are published periodically by AAI Foresight Inc.

1619 Main Street #1172
Freeland, WA 98249
www.aaiforesight.com

Editor: Cynthia G. Wagner
CynthiaGWagner@gmail.com

productivity of as much as 15–20 percent for flextime workers, so this work pattern is likely to continue to increase, especially due to the increasing cost, risk, and logistic challenges of daily commuting.

Virtual collaboration technology use in the workplace will be much broader than the 3-D holographic presence of science fiction. Cisco Systems' TelePresence product already provides both the sense of "in-the-same-room" participation and the opportunity for third parties elsewhere to observe the holographic interaction as if it were a conventional meeting. Microsoft, which has been rumored to be working on a competitive technology for decades, is beta-testing a Skype base for its Viewpoint product development effort in partnership with Digital Video Enterprises (DVE), which brings eye-contact simulation to the conference experience.

Just as important will be the distance sharing of work content, which will increasingly be done on encrypted touch tables and 3-D CAD systems that greatly enhance the communal design capabilities of today. The home office will not be far behind with high-definition video conferencing and even telepresence robot interfaces in the home as well as in medical, educational, and retail settings.

A question for 2030 is whether the physical decentralization of the workplace will result in a disconnected workforce. Actually, employers and fellow employees will be building a connected office culture of constant employee/employer feedback regarding collaborative content production. Real-time tracking of individual employee productivity standings, workplace sentiment (think anonymous digital suggestion boxes), and even employee reputation rankings will no longer be personal apps in a bring-your-own-device (BYOD) setting, but rather a formal part of the workplace personnel system.

Such systems will document ongoing individual employee skill levels and project contributions to date and will perhaps even publicly assign individual employee value levels within their work groups. Ratings concerning cultural dynamics such as office "thought leaders" and "social influencers" will be the stuff of these formalized networks rather than informal gossip networks. Therefore, these ratings will not be collections of personal opinions, but instead will be built upon algorithmic quantitative values. They will be analyzed by software systems that constantly collect and visually provide the outcomes to the workplace community (either publicly or privately). The process is most likely to be peer-based rather than hierarchical evaluations and will assess both an employee's productivity and his or her level of engagement with relevant teams.

Based on ongoing trends in collaborative behavior, those companies that adopt or continue to endorse a "Citadel" mode of extreme competition will not prosper as effectively as highly collaborative ones, as many business networks will be both within

and between organizations, utilizing universal dashboard applications and virtual collaboration tools.

Another response to the challenges of a distributed workforce and globally distributed patterns of collaboration will be the pop-up workplace—open spaces of modular work pods, sound-absorbing cubicles, mobile workstations that roll about the general workspace, and "pink noise" systems that neutralize nearby conversations in order to compensate for lack of private offices. These modules will be interchangeable but fully flexible resources with personally coded digital desks to be utilized for short periods in for-hire environments that meet the need for necessary in-person interaction better than past organizational real estate patterns.

The greatest concern in the growing use of casual or temporary office space is a tendency to overlook the serious but often unaddressed ergonomic challenges of modern computer work. That concern centers on what long hours of sitting and staring at screens can do to the human body. Innovations such as standing furniture, chair-based exercise systems, and treadmill workstations will hopefully be what we will find in the healthy office of 2030, as well as viable strategies to address computer vision syndrome.

One response to the challenges of a distributed workforce and globally distributed patterns of collaboration will be the pop-up workplace—open spaces of modular work pods, sound-absorbing cubicles, and mobile workstations.

How Jobs in the Technology Workplace May Evolve

When considering the evolution of the technology workplace, we should look at where new jobs and job transformations come from. One common job evolution dynamic is simplification. Employment functions are combined to increase effectiveness or efficiency. This happens when new needs arise, when new enabling technologies allow functions to be merged (or replaced), or when new problems demand creative solutions. As well, shifting social dynamics can shape new product development by stimulating new markets and creating new employment solutions. For example:

• Increasing corporate and government surveillance is likely to stimulate the development of more privacy products.

• Widening income gaps may lead to a growing security industry, as the "haves" protect their holdings and citizens protect their data.

• As new technological capabilities make augmented or virtual-reality alternatives commercially viable, this will further boost wearable computing tools and personalized learning markets.

• Communications technology enhancement will stimulate the increase of effective digital agents, or buyer bots, on the Internet.

• Advances in sleep psychology and neuroscience are going to facilitate an industry of sleep and rest-enabling tools, thus moving beyond solely pharmaceutical approaches.

New job creation can also be seen as job retrofitting, which involves adding new parts to older tasks or moving them to new settings, such as into outer space—e.g., lunar waste management—while existing job descriptions shift and blend to match new conditions.

According to McKinsey & Company, 85 percent of new jobs involving knowledge work also require new problem-solving and strategic skills. These skills are likely to include greater creativity, analytical skills, collegiality, and team building, as well as enhanced mental flexibility, increased decision speed, and the ability to test and validate both complex assumptions and interactive dynamics.

What Sort of Workers Will Be Recruited for the 2030 Technology Workplace?

One category sure to be desired in the workplace of the future is people good at team building and leadership. Organizations preparing for 2030 need high-performing employees who meet the following guidelines:

• Demonstrable intelligence, or the capacity to learn new skills quickly, rather than a résumé outline of past experience.

• Loyalty to the organization and a committed ownership of tasks.

• A strong work ethic, including the desire to lead.

• Personal integrity—particularly when facing difficult ethical dilemmas.

• Teamwork and likability—or smart, hard-working people who like to work with other smart, hard-working people.

While this sounds like a guide to résumé padding, by 2030 it is very likely that it describes what most technology workplace personnel worldwide have become. On that transformational note, it seems appropriate to ask what is likely to be the most disruptive (and transformative) technology of 2030.

How Expert Systems May Change the Work of Technologists

The specter of automation has haunted the workplaces of the future since the first 19th-century workers threw their wooden shoes (or *sabots*) into the gears of new manufacturing devices to protest layoffs (thus becoming *saboteurs*). These issues will be even more complex for the knowledge worker of 2030.

A persistent contemporary meme called the *technological Singularity* asserts that by 2030 a global explosion of superintelligence capabilities will exceed the intelligence level of any human alive today. Whether this is ultimately achieved through computer AI alone, through human biological enhancement, or by utilizing machine–human interfaces is still in question. The consequences of this development are expected to be unique in human history.

Metcalf's law states that communication networks increase in user value as they grow, especially where the capabilities of the whole prove to be far beyond that of their individual units. Accordingly, such enhanced computer networks can come to exhibit abilities not part of their original design. As system complexity increases, predictability may decline. One potential poster child of these enhancement possibilities is a prototype computer system utilizing sensory nodes less than a cubic millimeter (about the size of a grain of sand). Designated the Michigan Micro Mote (M3) and developed at the University of Michigan, it is Wi-Fi-enabled and solar powered, with dispersed data storage and sensors. This is the first working application of the "smart dust" concept at the center of a range of numerous disaster scenarios in science fiction.

The Digital Universe in 2020 report states that by 2020 more than 40 percent of all digital communications will be entirely machine-generated or M2M (machine to machine). One impact is that interpretation and response cycles in digital decision making will be much faster than typical human discussion and accordingly an oversight nightmare.

One ongoing question here related to the projected growth of artificial intelligence is the rate at which it will be able to replace mid- and upper-level tech workers—not if, but how soon and at what levels? One of the initial areas of growth (beyond phone banks) has been in the life sciences, where IBM's Watson Discovery Advisor (part of that company's new cognitive computing division) will soon be capable of reading medical papers and analyzing their contents at a rate of a new research paper every 30 seconds.

As a result, that system will perhaps be able to identify emerging implication patterns across research hypotheses before the researchers themselves. Even more impressive is the growing potential for Watson and its spawn in areas of national security, DNA analysis, highlighting of suspicious patterns of public behavior, identifying most-wanted faces in very large crowds, and even diagnosing and suggesting treatments for post-traumatic stress disorder in military personnel.

The automation-driven decline of human employment might not be completely inevitable. Harvard economist Lawrence Katz refers to the power of human imagination, creativity, intuition, and, above all, passion to overcome formidable obstacles.

It has long been conventional wisdom that innovation would always find new ways to employ workers faster than they were being rendered obsolete by automation. However, as new technology creates ever more substitutes for human labor, even white-collar professions like accountancy, legal work, and technical writing will begin to feel the pain. Some analysts peg the automation-driven unemployment rate a decade from now at one in seven, and they believe that automation could ultimately take over some 47 percent of all present white-collar job categories, including those of technology workers.

Industry disruption and career transitions continue to be closely related and to accelerate. Although lower wages have kept repetitive manufacturing tasks in human hands in some countries, it is expected that China will soon be a major global purchaser (and manufacturer) of robotic equipment. This is not just because of rising wages (which are likely to hit India soon after), but also because of the general decoupling of productivity (which continues to rise) and employment (which does not).

On the other side of this debate, the automation-driven decline of human employment might not be completely inevitable. Harvard economist Lawrence Katz refers to the power of human imagination, creativity, intuition, and, above all, passion to overcome formidable obstacles. But at present, it is not clear how much this stance falls into the category of normative foresight (what we want to happen) versus that of descriptive foresight (what is most likely to happen). The future is usually some combination of the two.

This also means that the human-enhancement industry, also technology-based, may present a moving target in the race for full machine replacement. Transhumanism, as it is also called, advocates developing and making widely available technologies to greatly enhance human intellectual, physical, and psychological capacities. Even wearable tech is a form of enhancement, and permanent implants are clearly not far behind. In the world of work in 2030, humans are much more likely to share the workplace with machines than be dominated by them.

One example is the drone-monitoring sector, where applications are likely to skyrocket, including forest resources monitoring, inventory, and management; mile-by-mile electric transmission line inspection; and building security. In those cases, an interactive relationship between machine and human is retained, at least for the next decade or two.

A question that arises when visioning the future of automation is how it will affect the culture of the 2030 workplace. Any significant change in workplace structures often faces the challenge of integrating with legacy systems, whether social, technological, or regulatory. How will "capacity-plus" computer-enhanced human workers fit into office cultures and HR structures? Will they form a leadership cadre, or will they be treated merely as high-paid computing devices that need health care?

While the answer in large part is, "We don't know," it is also likely that a significant portion of the potential change-phobic responses in the workplace will be generational in nature, with ongoing acculturation reducing resistance. Accordingly, each succeeding year finds more employees comfortable with the shifting role of machines in their lives (or their bodies). And naturally, new occupational specialties will arise to address automation-driven change-management challenges.

Holographic Technologies in the 2030 Workplace

Workplace conferencing technology, including holographic or virtual-reality tools, undoubtedly will improve markedly by 2030, and fully attending out-of-town events without actually traveling will become an effort-free, lower-risk, and effective way to communicate and negotiate from afar.

The growing political, epidemiological, and even cultural risks of travel over the coming 15 years will leave traditional business conferences too expensive, too time-consuming, and too dangerous to attend, unless their return on investment is dramatically enhanced. But no matter how much time and expense is saved by virtual telepresence, it is unlikely that social animals such as humans will ever completely abandon opportunities to press the flesh and mingle among their fellows.

However, effective networking software, education tools, and business activity enhancers yield more-effective distance communications if they clearly improve message visualization (through interactive graphics or animation) and content translation (a restatement in terms more comprehensible to the listener), since messages are often ignored if they are not fully perceived and understood.

Remote conferencing is only the beginning of the transformational effect that holographic telepresence will have on the workplace. In medicine, telepresence can allow physicians to more effectively advise and assist colleagues in real time thousands of miles away. Other potential applications include enhanced 3-D mapping, aerospace navigation, more-refined robotic controls, and a wide variety of simulation technologies. What is clear is that, when IPv9 Internet standards are finally introduced, the level of possibility in this area will increase exponentially, as it did for the earlier IPv6 upgrade.

Effective Worker Connectivity in 2030

The value of person-to-person workplace connections is increasing, and their utility is likely to be further enhanced by the following impending innovations:

• Improved software that encourages worker engagement through *workplace gamification*—entertaining problem-solving exercises—and *hackathons*—group development of new solutions for existing problems.

• Enhanced engagement of all the senses (sight, hearing, taste, smell, and touch) during organizational conferences and training and maximized use of more flexible, open-space organizing approaches.

Although technologists have not heavily utilized the soft or social sciences in the past, this is very likely to change, as our quantitative understanding of how social mechanics actually work increases.

Tools built around neuroscience breakthroughs concerning how humans learn—thus expanding the range of workplace training—can enhance focused repetition and quality skill-building activities.

Another arena where the impact of soft sciences is dramatically improving is attention mechanics—a mix of psychology, epistemology, and system dynamics approaches. When tied to training efforts, the attention process proceeds as follows:

1. Educational or business content enters the field of attention of an individual, a training classroom, or other audience.

2. The attention of that audience is grabbed and held.

3. Finally, some level of understanding and possible retention occurs, ideally accompanied by a desired response or set of actions.

This attention-related process is tied to the audience-related factors of interest, desire, and action, but it is most effective if the communication or networking content is perceived by that audience to offer one or more of the following benefits: immediacy (or relevance), interpretation (or effective issue translation), authenticity (or building trust relationships), accessibility (or ease of understanding and application), or findability (of desired objects or valued information). As a result, the content of a work-related communication or education program is likely to be accepted if it is perceived as being essential to achieving workplace goals, acquiring needed professional skills, or assuring financial success for those utilizing those materials. In a 2030 workplace environment where continuous learning will be almost mandatory, this approach could be enormously useful.

Challenges Tech Workers May Face in Building Workplace Value

While technology workers, among all the employment categories, are most likely to be fluent in the latest digital connectively and networking tools, those systems will not always meet user expectations. Although increasing levels of connection capability have led to higher volumes of connectivity, this can be accompanied by lower levels of relevant interactivity and message sharing, especially in such content-sensitive areas as strategic policies, business intelligence, and environmental analysis.

In what has been called a white-noise environment, too many voices will pretend to speak with equal authority and authenticity, resulting in a reduction of viable workplace dialogue. This in turn can lead to a growing loss of mutual trust in that workplace. It is not likely that the marketing visions of the connectivity software giants of the next 15 years will provide the most accurate vision of seamless connectivity and ubiquitous networked systems for the future, if only because of the steep rise of global complexity. To illustrate how steep this data acquisition slope is, KPMG International's *Future State 2030* report asserts that 90 percent of all digital data in the world of 2015 will have been created within the past two years.

At present, there are 10 billion devices connected to the Internet of Things (IoT) alone, which will be a growing intermediary for worker awareness of minute-to-minute change in the workplace and the world at large. Looking at a projected estimate of 26 billion IoT devices by 2020, the ongoing transition of the Internet Protocols from IPv4 to IPv6's

capacity of 340 trillion trillion trillion Internet addresses will be just in time, with accumulating IoT data already reaching zettabyte levels.

In the arena of team-building challenges, a number of apps are likely to focus on enhancing the trust levels of any communication. This could be especially useful in efficiently building teams in new companies. College students might be matched up with tech startups during schooling, enabling them to learn about the company, take classes in relevant skills, and work on projects as part of intern programs. Other approaches may include virtual learning libraries, where third-party entrepreneurial experts can contribute advice to student interns and new hires in written and video formats, along with skills marketplaces built with social tools that also allow employers to quickly get a handle on applicants' skill sets.

But the "hire young and cheap and train in-house" approach is not the most challenging arena for workplace team building. More challenging is identifying and acquiring mid-career employees from the global employee market with the goal of reshaping specific workforce capabilities. This will require more effectively searching for candidates who meet project or work-group needs through assessment of past performance in comparable environments or cultures, rather than searching for previously utilized skill or experience sets.

Performance profiles might also offer more-accurate indicators of job success and assist the more effective mining of internal and extended talent networks. A 360-degree search is one that interfaces with the building of dynamic talent communities using a pre-qualified positions approach. Proactive employee referral programs (PERPs) are a first stage in broad-based employee participation in job candidate identification, recommendation, and even candidate review and hiring, as is already done in such companies as Whole Foods. And certainly, worldwide talent searches are becoming the rule rather than exception.

Technologies That Affect How Technologists Work

The tools of technology, especially workplace-related ones, have become increasingly critical in productivity, efficiency, and effectiveness, and this will definitely be even truer in 2030. Wearable technologies, which inform wearers about their larger environment in increasing detail, are likely to be highly transformative in both the workplace and society generally. Industry sectors such as clothing design, which were previously manufacturing-focused, are becoming technology frontiers. They are exploring medical monitoring and reporting, self-heating clothing, magnetic (one-handed and self-closing) zippers, all of which assist in getting the job done more efficiently.

Still in beta development are designs for fully flexible, stretchable, and deformable energy sources integrated into clothing, including lithium-ion batteries based on substrates such as fullerene-impregnated paper or other inexpensive materials, and then compacted using origami-folding techniques to increase energy density while keeping weight low. This allows the manufacture of electrical devices on a larger, less-expensive scale, followed by a final, very-small-scale folded product for use in a wide range of workplace settings. The only remaining challenge is getting your new electronic clothing dry-cleaned.

In spite of early market pushback against the intrusive and awkward nature of face-wearables like Google Glass, one only has to look back to other early disasters such as Apple's Newton to see that failed starts do not discredit the potential of a category in general. Forests of startups are pursuing avenues parallel to Google Glass, such as contact lenses, LED micro-displays, and even printable thermoelectric batteries recharging on body heat, all with some success. Each year will bring new innovations in participatory problem solving, including open-data resources, crowdsourcing, AI-based expert systems, human-based expert networks, and even a myriad of challenge competitions, such as Son of X-Prize. To quote an ancient aphorism, "The trick is not to know the answers to all questions, but just where to find them."

Each year will bring new innovations in participatory problem solving, including open data resources, crowdsourcing, AI-based expert systems, human-based expert networks, and even a myriad of challenge competitions.

How Trends in Tech Education Might Shape the Next Generation of Tech Professions

Education has always been a major factor in an individual's ability to enter the technology workplace, and in the future it will be central to staying gainfully employed. But higher education itself is in a state of transformation. A number of training and education experts argue that the college lecture hall, with students sitting in neat rows like cornstalks, is no longer relevant, as humans in the future will learn best from doing, not listening. Cultural shifts have also reduced accepted models for full-attention presentations down to a maximum of 10 minutes (around the TED-talk limit). As well, there is a continued growth of classroom flipping (which began in secondary public schools, but is now reaching the university levels), where homework involves watching videos and doing reading assignments

outside class, while face-to-face classrooms are reserved for doing exercises, testing, and conducting in-person discussion and group work. One ideal is for flexible learning at each student's pace, which has demonstrably increased retention and productivity at such demanding environments as MIT. That august institution will soon be expanding a blended model involving a mix of instant in-person feedback and online assessments.

One criticism of MOOCs (massive open online courses) is that as much as 90 percent of students who signed up don't complete courses. But this ignores the fact that many institutions offer them at no cost, leading to casual shopping (and at least half of those making it past the second session actually stay till the end).

Many changes are still to come, but an influential contrarian conclusion (supported by recent research) is that instructors are actually essential for one-on-one assistance and support and that homework (although always less than popular with students) actually does increase retention and testing scores. Although some instructional videos can now last as little as a minute, they can still run up to an hour at such international MOOCs as edX. The question is whether students in 2030 will actually watch anything.

In spite of critics who point to early missteps, MOOCs will continue to move from colleges into secondary schools and corporate training. As well, the MOOC platform is likely to prove a treasure trove of new education research on how students (and, increasingly, teachers) learn online, leading to innovative approaches to presenting, sequencing, and assessing online learning across a range of subject areas. Finally, the possibilities for AI-driven personalization of training materials based on the strengths and weaknesses of individual students are just beginning. While on-campus learning continues to have its detractors, many of the most innovative promoters of MOOC programs will be using hybrid or blended approaches to facilitate campus-based learning, versus eliminating in-person connections altogether.

However, MOOCs are relatively traditional in the organization of learning content in comparison with competency-based or direct-assessment learning approaches, which divide course material into skill sets of specialized knowledge and higher-order cognitive skills. Accordingly, some competency elements can be credited and skipped over if the learner can demonstrate mastery, similar to other courses of self-guided independent study.

As the population of nontraditional students (i.e., not 18–22 years old and on-campus full time) continues to grow worldwide, and the lifelong-learning worker becomes the norm, traditional higher education will need to continue to evolve or quietly fade away as virtual and direct assessment education steps to the fore. This is especially true since a number of companies have gone back to developing employee skills in-house in

internally developed training institutes. Some analysts see dramatic decreases in the total number of players in the educational sector over the coming decade.

The goal of many business educators is to produce a new breed of technologists by 2030 who are not only technically accomplished, but also adaptable, nimble, and broadly knowledgeable. Besides technical expertise, their training would therefore include leadership, innovation, entrepreneurship, and change-management skills. In practice, this means mixing technological expertise with societal and business know-how in such areas as manufacturing, logistics, and marketing and how they interface with one another.

While technology-related skills will continue to be essential, the indicators for the potential value of a future employee will broaden. There will be a greater premium placed on knowledge workers who also ask constructive questions concerning an employer's mission and who can dialogue well about customers, market values, desired results, and evolving marketing plans, especially in areas where shortages of such workers are dire.

While technology-related skills will continue to be essential, there will be a greater premium placed on knowledge workers who also ask constructive questions concerning an employer's mission.

How the Evolution of Digital Business Will Shape New Workplace Opportunities

A major setting for technology workers for decades has been the digital business workplace, but some signs suggest that its long-term vitality as a workplace option may be declining. It is increasingly difficult to separate marketing hype about breakthrough products from their real impact on economic vitality and overall productivity. A number of analysts assert that worldwide game-changing breakthroughs have been relatively few in recent years, and ongoing growth of the global innovation economy may be facing headwinds.

The digital software economy will not be the economic powerhouse that hardware industries were in the late 20th century. Carl Benedikt Frey of Oxford and Lund University in Sweden noted that only about 0.5 percent of the U.S. workforce is employed by new companies created since 2000. On the other hand, the low entry costs for these new software companies does encourage entrepreneurial activity, in spite of

the lower number of new jobs they actually create. For example, WhatsApp, which was bought in late 2014 by Facebook for a closing price of $22 billion, was launched on an investment of $250,000 and had only 70 employees at the time of that closing.

Will Traditional or Transformative Workplaces Attract More Workers by 2030?

While the levels of organizational resources offered workers might be attractive, not all technology workers will aspire to the highest salary or biggest desk. Substantial numbers of 2030 workers are likely to opt for smaller versus larger organizational formats that offer opportunities to make a difference. This pattern will extend to that classic job-hunting ground, the technology conference. There will be a robust growth of informal conference formats that allow participants to create their unique learning schedule based on relevance and personal interest. This structure is a spin-off of open-space approaches, with the appeal being the ability to combine a range of activities (voting, gaming, etc.) with the interests and abilities of those conference participants by utilizing what was once described by futurist John Naisbitt as high tech *and* high touch.

The poster child of this open-conference approach is the BarCamp conference model, where participants supply and then transform the content of the conference. Initiated as a Web design event in 2005 at Stanford University, it has spread worldwide; the largest BarCamp to date was held in January 2013 in Yangon, Myanmar, with 6,400 participants addressing an extraordinary range of subjects. Occasionally held in temporary facilities, it follows an informal agenda where participants are encouraged to both present a session and become actively involved in producing the active Web content of the conference, creating a hybrid face-to-face and virtual global community. Informal lodgings and sponsored funding allow a lower overhead, and in-person attendance is limited only by available space.

What is interesting is that this work ethic closely resembles the format of many tech entrepreneurs, who often trade their early salary and workplace comforts for cutting-edge tech and creative, intelligent co-workers. Another parallel is the focus on social problem solving, where the measure of success is not just ROI or share price. It is not yet clear whether technology development will continue to outrun demographic pressures, including the projected annual increases of 80 million souls globally. Engineers and related technologists are clearly problem solvers.

[continued on page 17]

TECHNOLOGY WORKPLACE 2030: ISSUES SUMMARY

This grid comparing 2015 and 2030 workplace issues attempts to clarify the contrasts between the present and likely outcomes of current trends. While choosing the most probable results of present trends is always a matter of opinion, it also provides sufficient clarity to stimulate dialogic responses: *Agree* or *disagree,* and *why*.

Keeping in mind the caveats and the "what if" elements within this Foresight Report, use this grid as a starting "place to stand upon" when initiating discussions of critical trends and their likely consequences.

2015	2030
1. Flextime is adopted by 30% of workplaces in developed countries.	1. Flextime is adopted by 70% of workplaces in developing counties.
2. Cisco TelePresence is in use.	2. Virtual 3-D holographic collaboration is common.
3. Some workplace disconnection is present.	3. Greatly enhanced social, professional, and virtual connectivity is now in workplaces.
4. Some peer-hiring prototypes are present.	4. Peer rating and evaluation systems are common in the workplace.
5. Global team building and management is in place in the workplace.	5. Full workplace integration regardless of geographic decentralization is common.
6. Physical offices and home offices are both utilized.	6. Temporary, modular, and virtual workspaces are all common worldwide.
7. Tech workplace ergonomic and health issues commonly trouble workers.	7. Tech workplace regulatory standards and enforcement are common worldwide.
8. Worker education is moving toward a lifelong model and is especially innovative in military (soldier-training) settings.	8. Neural implants for worker training and 3-D virtual gaming are common in lifelong education, but other unenhanced workers continue to learn just to stay employed.
9. AI systems are in development and entering the white-collar and tech workforces.	9. Over 50% of 2015-level of knowledge work and tech jobs are now automated.
10. Robotics and drones are now entering the tech workplace.	10. Autonomous drones, automobiles, and middle-range robots are the "new normal."

2015	2030
11. Broader holographic technology is in continued development.	11. Holographic tech is fully operational in medicine, national security, and public safety, with some human displacement.
12. Private-sector space industries, including those with launch capability, are growing.	12. Moon-waste disposal, orbital junk cleanup, and space tourism are in full swing.
13. Internet "white noise" is driving reduction in levels of workplace trust.	13. Enhanced message authenticity-assurance software within organizational networks (Intranets) enhances effective connectivity within tech workplaces.
14. Internet of Things is in development, moving toward ubiquitous computing.	14. Unconnected and unaware devices are antiques, and global workplace tech truly is ubiquitous.
15. Wearable computing is in early stages.	15. Implants powered by human electromechanics have supplemented wearable computing devices.
16. Education online is in a growth curve.	16. Very expensive in-person education is now largely for the well-to-do and the sponsored student, while online education is largely for the mid-level technology workforce.
17. Digital companies are still experiencing healthy stock growth.	17. Economic tech growth is largely driven by broadly based and fully integrated digital, additive manufacturing, and strategic problem-solving entities.
18. Global resource and political challenges continue to mount.	18. As strategic technology solutions address past challenges, new problem-driven crises continue to appear.
19. Use of foresight techniques is developing among international organizations.	19. Foresight is now a critical tool in strategic and tactical management.
20. Developed countries continue to lead the global economy, with developing countries closing the gap.	20. Some nations lag behind the global political and economic standard, but cutting-edge technology workplaces are much more evenly distributed globally.

Global Trends Likely to Shape Technology Workplaces

The technology workplace is increasingly impacted by a range of factors, including political stability, sustainable environments, and economic viability. Each of those arenas will be under stress over the next 15 years, thus influencing who technologists will be working for, in what setting, and facing which challenges.

The world urban population is likely to double by 2030, and there will be at least nine cities with populations over 20 million. As a result, by 2030, two-thirds of the world's population will live and work in urban areas. By 2025, 2.75 billion people will live within 60 miles of an ocean (a 30 percent increase over the present), making the possibility of a 1 meter or more increase in sea level a very sobering one—spurred by a commonly cited 2- to 4-degree Centigrade increase in average global temperature this century.

Accordingly, climate change has definitely moved from scientific debate to actual policy implementation in many locations. These climate conditions are very likely to increase resource stresses in workplace settings as well, especially in developing countries, with energy, food, and even water likely to be in increasingly short supply.

Climate change has definitely moved from scientific debate to actual policy implementation in many locations. These climate conditions are very likely to increase resource stresses in workplace settings as well, especially in developing countries.

It is important to reaffirm that global crisis resolution can also provide arenas of robust vocational opportunity. Areas of such opportunity include international electric power transmission, where smart meters, appliances, and grids may assist in meeting the challenges of securing clean power from renewables, balancing supply and demand, and absorbing the costs of erratically used peak generation plants, but are not likely to match the skyrocketing energy usage demands created by global economic and population growth. Multiple full load-bearing transmission pathways will need to be designed, approved, and built (with approval as the most challenging of the three tasks).

Desalination and related technologies will also need regular breakthroughs to pace urban population growth, as nano-filtration and water-cooled batteries alone are not going succeed where the pressures of climate-change-driven drought and the exhaustion of fossil aquifers continue to raise the intensity of

that crisis. In all of these resource-sensitive areas, the opportunity to enter into global problem-solving employment will be a significant choice for technologists.

Where Technologists Might Find Workplace Opportunities

While it is always interesting to consider exotic workplace assignments in 2030, one of the most likely answers to this question will be "right at home."

As we have seen, the physical workplace will become almost irrelevant by 2030, except in those areas where intense interpersonal and hands-on collaboration is essential. Irrelevant as well will be the physical base of your business or team partners, whether they are in Russia, Brazil, or Central Asia. What will be essential is how the team is built and run.

The trends of collaborative workplace intelligence and agility mitigate against a permanent set of facilities, except for the housing of individual workers, but any home-based work facilities will need to be up to global standards, not just for mass collaboration of a global nature but for just checking in at the office.

In the formal workplace, the adoption of telepresence systems will allow worker log-in through an office-based haptic droid, thus enabling offsite workers to traverse their office in their personal robot, locating needed tools or documents, dialoging with co-workers, managing facility security, etc.

The "workplace" in many employment categories will be increasingly spread over multiple time zones or even continents, with workers connecting from home base through a growing range of media channels. The geographic centers of employment may shift as well, moving at times to where problems or opportunities are arising.

Much has been written about the rise of Asia and the fact that Asia's share of global exports in 2030 would total 39 percent of the world total (or double that of today). Certainly the rise of the BRIC countries (Brazil, Russia, India, China) can almost be certain to continue. But what of the less-discussed possibilities for the powerhouses of 2030?

One regional development arena seldom considered is the northern portion of the continent of Africa. This is not a total surprise, as it has been strongly asserted that developing countries as a whole will account for 57 percent of global GDP by 2030. Between now and then, demographic growth rates in Africa will be greater than for any other country, including China. Africa is expected to quadruple in population by 2100, with its greatest economic and political growth likely in North Africa, specifically in

Nigeria, Tanzania, Ethiopia, and the Democratic Republic of the Congo. To date, what has brought the highest levels of economic return in these countries has been privatization, and with China as Africa's largest investor and trading partner, this is likely to continue to enhance African gains.

At present, only 25 percent of Africans are connected to the Internet (50 percent in cities), but Africa will have the largest working-age population in the world by 2035. What is critical is education and skill building for this massive workforce, so that these new workers will be designing or inventing new technologies rather than merely repairing and servicing them.

That economic and political growth will be driven by the substantial oil, mineral, and other resource reserves of sub-Saharan Africa, but it would also need to be enabled by stable governmental and resource management structures (including better management of the basics of food, water, and electricity). A 2013 McKinsey Global Institute in Africa report on the impact of Internet and e-commerce technologies suggests that Africa is now approaching tipping points in its financial systems, education structures, health systems, retail infrastructure, agriculture, and governmental effectiveness. This means that some or all of these sectors are on the edge of positive growth of a dramatic nature.

Innovative solutions have the potential to leapfrog the change-resistant legacy infrastructure systems that slow innovation in much of the developed world. The potential of global urban centers in emerging markets is enormous, but one wonders how dramatic shifts in global strength will affect political, economic, and cultural patterns that have been in place for many decades.

Moving from Vision to Strategy and Logistics

Developing a vision for the future of the technology workplace is a complex process. Imagination can help, but so can clear sight and looking closely at where change is occurring or where opportunities might arise. Change can come slowly or quite fast, depending on whether there is change resistance or the accelerating convergence of mutually supportive developments, as has occurred in the nanotech, biotech, and information arenas. Visioning the future is a dance of give and take. Present shortfalls may be corrected or they may worsen, and resources may become more abundant through technological breakthrough or they may prove irreplaceable. The nightmares of one generation may be the bad jokes of the next, and cultural change is as potent an influence on the future as new technologies can be.

But as any futurist knows, normative futures (the preferable ones) are not likely to become probable futures without a strong grounding in the science and technology

needed to reach them, as well as in the economic and even political realities necessary to make visions real. It is this intermix of vision with the practical that makes examination of what may lie ahead so fascinating.

At times, innovative solutions to global challenges can generate what are termed unintended consequences—that is, new and sometimes worse disorders arising from a poorly considered solution. The goal then is to begin to identify threats and opportunities early enough to conceptualize, develop, and integrate well-thought-out responses, using such techniques as weak-signal analysis. This can assist in understanding change and how change occurs within systems, then prioritizing the most-probable changes—i.e., which to pay attention to and prepare for. It also means sorting out the possible, the probable, and the preferable elements—the last one being the most complex, as it requires achieving working consensus on values (which becomes more challenging each day that we proceed further into the increasingly contentious 21st century).

If foresight analysis is focused and relevant, as well as original and imaginative, it can offer content that provides experiential education and skills learning for personal, cultural, and economic assessment. By combining both strategic and logistic approaches, good foresight can point out productive new directions for organizations and provide valuable detail on how to reach those goals.

References

Barber, Michael, Katelyn Donnelley, and Saad Rizvi, "An Avalanche Is Coming: Higher Education and the Coming Revolution," Institute for Public Policy Research (March 2013).

Bristol, Terry, *Freewill and the Engineering Worldview,* Institute for Science, Engineering and Public Policy, Portland State University (2013).

Fisher, Max, "The Amazing, Surprising, Africa-Driven Demographic Future of the Earth," *Washington Post* (July 16, 2013).

Frey, Carl Benedikt, "How to Prevent the End of Economic Growth," *Scientific American* (December 16, 2014).

Future State 2030, KPMG International (2014).

Lund, Susan, James Manyika, and Sree Ramaswamy, "Preparing for a New Era of Work," *McKinsey Quarterly* (2012).

McAfee, Andrew, "Mapping the Future: The Future of Work," Outlook on the Global Agenda 2015, World Economic Forum.

Needleman, Sarah, "Jobs Go Unfilled Amid Skills Shortage," *Wall Street Journal* (July 10, 2014).

Predictions for the State of AI and Robotics in 2025, Pew Research Internet Project (2014).

Schoemaker, Paul, and George Day, "How to Make Sense of Weak Signals," *MIT Sloan Management Review* (Spring 2009).

The Future of Work, PSFK Labs (2013).

The Smart Workplace in 2030, Johnson Controls (2009).

Vest, Charles, "Educating Engineers for 2020 and Beyond," National Academy of Engineering.

Wall Street Journal, "Nontraditional Students Are Majority on College Campuses" (July 6, 2013).

Weise, Michelle, and Clayton Christensen, *Hire Education: Mastery, Modularization and the Workforce Revolution,* Institute for Disruptive Innovation (2014).

| AAI |

AAI Foresight Inc. provides issues identification and tracking, strategic planning, organizational development, messaging, marketing, technological assessment, and strategic services for a broad range of clients.

1619 Main Street #1172
Freeland, WA 98249, USA
www.aaiforesight.com

Contact: Timothy C. Mack, managing principal, tcmack333@gmail.com

Cover: Skeeze, Pixabay.com (Creative Commons)