PewResearchCenter

NUMBERS, FACTS AND TRENDS SHAPING THE WORLD

FOR RELEASE AUGU.S.T 6, 2014

Digital Life in 2025

AI, Robotics, and the Future of Jobs

Experts envision automation and intelligent digital agents permeating vast areas of our work and personal lives by 2025, but they are divided on whether these advances will displace more jobs than they create.

FOR FURTHER INFORMATION ON THIS REPORT:

Aaron Smith, Senior Researcher, Internet Project
Janna Anderson, Director, Elon University's Imagining the Internet Center

202.419.4372

www.pewresearch.org

RECOMMENDED CITATION: Pew Research Center, August 2014, "AI, Robotics, and the Future of Jobs"
Available at: http://www.pewinternet.org/2014/08/06/future-of-jobs/

About This Report

This report is the latest in a sustained effort throughout 2014 by the Pew Research Center's Internet Project to mark the 25th anniversary of the creation of the World Wide Web by Sir Tim Berners-Lee (The Web at 25).

The report covers experts' views about advances in artificial intelligence (AI) and robotics, and their impact on jobs and employment. The previous reports in this series include:

- A February 2014 report from the Pew Research Center's Internet Project tied to the Web's anniversary looking at the strikingly fast adoption of the Internet and the generally positive attitudes users have about its role in their social environment.
- A March 2014 *Digital Life in 2025* report issued by the Internet Project in association with Elon University's Imagining the Internet Center focusing on the Internet's future more broadly. Some 1,867 experts and stakeholders responded to an open-ended question about the future of the Internet by 2025. One common opinion: the Internet would become such an ingrained part of the environment that it would be "like electricity"—less visible even as it becomes more important in people's daily lives.
- A May 2014 *Digital Life in 2025* report on the Internet of Things from Pew Research and Elon University examining the likely impacts of the Internet of Things and wearable and embedded networked devices. A majority of the more than 1,600 respondents said they expect significant expansion of the Internet of Things, including connected devices, appliances, vehicles, wearables, and sensor-laden aspects of the environment.
- A July 2014 report on Threats to the Open Internet from Pew Research and Elon University canvassing a number of experts and other stakeholders on what they see as the major threats to the free flow of information online. A majority of these experts expect the Internet to remain a place where people can freely access and share content, even as they anticipate a number of potential threats to this freedom in the coming years.

This report is a collaborative effort based on the input and analysis of the following individuals.

Aaron Smith, *Senior Researcher, Pew Research Center's Internet Project*
Prof. Janna Anderson, *Director, Elon University's Imagining the Internet Center*
Lee Rainie, *Director, Pew Research Center's Internet Project*

Find related reports about the future of the Internet at
http://www.pewInternet.org/topics/future-of-the-Internet/

About Pew Research Center

Pew Research Center is a nonpartisan fact tank that informs the public about the issues, attitudes and trends shaping America and the world. It does not take policy positions. It conducts public opinion polling, demographic research, media content analysis and other empirical social science research. The center studies U.S. politics and policy views; media and journalism; Internet and technology; religion and public life; Hispanic trends; global attitudes and U.S. social and demographic trends. All of the center's reports are available at www.pewresearch.org. Pew Research Center is a subsidiary of The Pew Charitable Trusts.

About the Imagining the Internet Center at Elon University

The Imagining the Internet Center's mission is to explore and provide insights into emerging network innovations, global development, dynamics, diffusion and governance. Its research holds a mirror to humanity's use of communications technologies, informs policy development, exposes potential futures and provides a historic record. It works to illuminate issues in order to serve the greater good, making its work public, free and open. The center is a network of Elon University faculty, students, staff, alumni, advisers, and friends working to identify, explore and engage with the challenges and opportunities of evolving communications forms and issues. They investigate the tangible and potential pros and cons of new-media channels through active research. The Imagining the Internet Center sponsors work that brings people together to share their visions for the future of communications and the future of the world.

Table of Contents

Key Findings

The vast majority of respondents to the 2014 Future of the Internet canvassing anticipate that robotics and artificial intelligence will permeate wide segments of daily life by 2025, with huge implications for a range of industries such as health care, transport and logistics, customer service, and home maintenance. But even as they are largely consistent in their predictions for the evolution of technology itself, they are deeply divided on how advances in AI and robotics will impact the economic and employment picture over the next decade.

We call this a canvassing because it is not a representative, randomized survey. Its findings emerge from an "opt in" invitation to experts who have been identified by researching those who are widely quoted as technology builders and analysts and those who have made insightful predictions to our previous queries about the future of the Internet. (For more details, please see the section "About this Canvassing of Experts.")

Key themes: reasons to be hopeful

1) Advances in technology may displace certain types of work, but historically they have been a net creator of jobs.
2) We will adapt to these changes by inventing entirely new types of work, and by taking advantage of uniquely human capabilities.
3) Technology will free us from day-to-day drudgery, and allow us to define our relationship with "work" in a more positive and socially beneficial way.
4) Ultimately, we as a society control our own destiny through the choices we make.

Key themes: reasons to be concerned

1) Impacts from automation have thus far impacted mostly blue-collar employment; the coming wave of innovation threatens to upend white-collar work as well.
2) Certain highly-skilled workers will succeed wildly in this new environment—but far more may be displaced into lower paying service industry jobs at best, or permanent unemployment at worst.
3) Our educational system is not adequately preparing us for work of the future, and our political and economic institutions are poorly equipped to handle these hard choices.

Some 1,896 experts responded to the following question:

> ***The economic impact of robotic advances and AI***—Self-driving cars, intelligent digital agents that can act for you, and robots are advancing rapidly. Will networked,

automated, artificial intelligence (AI) applications and robotic devices have displaced more jobs than they have created by 2025?

Half of these experts (48%) envision a future in which robots and digital agents have displaced significant numbers of both blue- and white-collar workers—with many expressing concern that this will lead to vast increases in income inequality, masses of people who are effectively unemployable, and breakdowns in the social order.

The other half of the experts who responded to this survey (52%) expect that technology will *not* displace more jobs than it creates by 2025. To be sure, this group anticipates that many jobs currently performed by humans will be substantially taken over by robots or digital agents by 2025. But they have faith that human ingenuity will create new jobs, industries, and ways to make a living, just as it has been doing since the dawn of the Industrial Revolution.

These two groups also share certain hopes and concerns about the impact of technology on employment. For instance, many are concerned that our existing social structures—and especially our educational institutions—are not adequately preparing people for the skills that will be needed in the job market of the future. Conversely, others have hope that the coming changes will be an opportunity to reassess our society's relationship to employment itself—by returning to a focus on small-scale or artisanal modes of production, or by giving people more time to spend on leisure, self-improvement, or time with loved ones.

A number of themes ran through the responses to this question: those that are unique to either group, and those that were mentioned by members of both groups.

The view from those who expect AI and robotics to have a positive or neutral impact on jobs by 2025

JP Rangaswami, chief scientist for Salesforce.com, offered a number of reasons for his belief that automation will *not* be a net displacer of jobs in the next decade: "The effects will be different in different economies (which themselves may look different from today's political boundaries). Driven by revolutions in education and in technology, the very nature of work will have changed radically—but only in economies that have chosen to invest in education, technology, and related infrastructure. Some classes of jobs will be handed over to the 'immigrants' of AI and Robotics, but more will have been generated in creative and curating activities as demand for their services grows exponentially while barriers to entry continue to fall. For many classes of jobs, robots will continue to be poor labor substitutes."

Rangaswami's prediction incorporates a number of arguments made by those in this canvassing who took his side of this question.

Argument #1: Throughout history, technology has been a job creator—not a job destroyer

Vint Cerf, vice president and chief Internet evangelist for Google, said, "Historically, technology has created more jobs than it destroys and there is no reason to think otherwise in this case. Someone has to make and service all these advanced devices."

Jonathan Grudin, principal researcher for Microsoft, concurred: "Technology will continue to disrupt jobs, but more jobs seem likely to be created. When the world population was a few hundred million people there were hundreds of millions of jobs. Although there have always been unemployed people, when we reached a few billion people there were billions of jobs. There is no shortage of things that need to be done and that will not change."

Michael Kende, the economist for a major Internet-oriented nonprofit organization, wrote, "In general, every wave of automation and computerization has increased productivity without depressing employment, and there is no reason to think the same will not be true this time. In particular, the new wave is likely to increase our personal or professional productivity (e.g. self-driving car) but not necessarily directly displace a job (e.g. chauffeur). While robots may displace some manual jobs, the impact should not be different than previous waves of automation in factories and elsewhere. On the other hand, someone will have to code and build the new tools, which will also likely lead to a new wave of innovations and jobs."

Fred Baker, Internet pioneer, longtime leader in the IETF and Cisco Systems Fellow, responded, "My observation of advances in automation has been that they change jobs, but they don't reduce them. A car that can guide itself on a striped street has more difficulty with an unstriped street, for example, and any automated system can handle events that it is designed for, but not events (such as a child chasing a ball into a street) for which it is not designed. Yes, I expect a lot of change. I don't think the human race can retire en masse by 2025."

Argument #2: Advances in technology create new jobs and industries even as they displace some of the older ones

Ben Shneiderman, professor of computer science at the University of Maryland, wrote, "Robots and AI make compelling stories for journalists, but they are a false vision of the major economic changes. Journalists lost their jobs because of changes to advertising, professors are threatened by MOOCs, and store salespeople are losing jobs to Internet sales people. Improved user interfaces, electronic delivery (videos, music, etc.), and more self-reliant customers reduce job needs. At the

same time someone is building new websites, managing corporate social media plans, creating new products, etc. Improved user interfaces, novel services, and fresh ideas will create more jobs."

Amy Webb, CEO of strategy firm Webbmedia Group, wrote, "There is a general concern that the robots are taking over. I disagree that our emerging technologies will permanently displace most of the workforce, though I'd argue that jobs will shift into other sectors. Now more than ever, an army of talented coders is needed to help our technology advance. But we will still need folks to do packaging, assembly, sales, and outreach. The collar of the future is a hoodie."

John Markoff, senior writer for the Science section of the New York Times, responded, "You didn't allow the answer that I feel strongly is accurate—too hard to predict. There will be a vast displacement of labor over the next decade. That is true. But, if we had gone back 15 years who would have thought that 'search engine optimization' would be a significant job category?"

Marjory Blumenthal, a science and technology policy analyst, wrote, "In a given context, automated devices like robots may displace more than they create. But they also generate new categories of work, giving rise to second- and third-order effects. Also, there is likely to be more human-robot collaboration—a change in the kind of work opportunities available. The wider impacts are the hardest to predict; they may not be strictly attributable to the uses of automation but they are related…what the middle of the 20th century shows us is how dramatic major economic changes are—like the 1970s OPEC-driven increases of the price of oil—and how those changes can dwarf the effects of technology."

Argument #3: There are certain jobs that only humans have the capacity to do

A number of respondents argued that many jobs require uniquely human characteristics such as empathy, creativity, judgment, or critical thinking—and that jobs of this nature will never succumb to widespread automation.

David Hughes, a retired U.S. Army Colonel who, from 1972, was a pioneer in individual to/from digital telecommunications, responded, "For all the automation and AI, I think the 'human hand' will have to be involved on a large scale. Just as aircraft have to have pilots and copilots, I don't think all 'self-driving' cars will be totally unmanned. The human's ability to detect unexpected circumstances, and take action overriding automatic driving will be needed as long and individually owned 'cars' are on the road."

Pamela Rutledge, PhD and director of the Media Psychology Research Center, responded, "There will be many things that machines can't do, such as services that require thinking,

creativity, synthesizing, problem-solving, and innovating…Advances in AI and robotics allow people to cognitively offload repetitive tasks and invest their attention and energy in things where humans can make a difference. We already have cars that talk to us, a phone we can talk to, robots that lift the elderly out of bed, and apps that remind us to call Mom. An app can dial Mom's number and even send flowers, but an app can't do that most human of all things: emotionally connect with her."

Michael Glassman, associate professor at the Ohio State University, wrote, "I think AI will do a few more things, but people are going to be surprised how limited it is. There will be greater differentiation between what AI does and what humans do, but also much more realization that AI will not be able to engage the critical tasks that humans do."

Argument #4: The technology will not advance enough in the next decade to substantially impact the job market

Another group of experts feels that the impact on employment is likely to be minimal for the simple reason that 10 years is too short a timeframe for automation to move substantially beyond the factory floor. **David Clark**, a senior research scientist at MIT's Computer Science and Artificial Intelligence Laboratory, noted, "The larger trend to consider is the penetration of automation into service jobs. This trend will require new skills for the service industry, which may challenge some of the lower-tier workers, but in 12 years I do not think autonomous devices will be truly autonomous. I think they will allow us to deliver a higher level of service with the same level of human involvement."

Jari Arkko, Internet expert for Ericsson and chair of the Internet Engineering Task Force, wrote, "There is no doubt that these technologies affect the types of jobs that need to be done. But there are only 12 years to 2025, some of these technologies will take a long time to deploy in significant scale…We've been living a relatively slow but certain progress in these fields from the 1960s."

Christopher Wilkinson, a retired European Union official, board member for EURid.eu, and Internet Society leader said, "The vast majority of the population will be untouched by these technologies for the foreseeable future. AI and robotics will be a niche, with a few leading applications such as banking, retailing, and transport. The risks of error and the imputation of liability remain major constraints to the application of these technologies to the ordinary landscape."

Argument #5: Our social, legal, and regulatory structures will minimize the impact on employment

A final group suspects that economic, political, and social concerns will prevent the widespread displacement of jobs. **Glenn Edens**, a director of research in networking, security, and distributed systems within the Computer Science Laboratory at PARC, a Xerox Company, wrote, "There are significant technical and policy issues yet to resolve, however there is a relentless march on the part of commercial interests (businesses) to increase productivity so if the technical advances are reliable and have a positive ROI then there is a risk that workers will be displaced. Ultimately we need a broad and large base of employed population, otherwise there will be no one to pay for all of this new world."

Andrew Rens, chief council at the Shuttleworth Foundation, wrote, "A fundamental insight of economics is that an entrepreneur will only supply goods or services if there is a demand, and those who demand the good can pay. Therefore any country that wants a competitive economy will ensure that most of its citizens are employed so that in turn they can pay for goods and services. If a country doesn't ensure employment driven demand it will become increasingly less competitive."

Geoff Livingston, author and president of Tenacity5 Media, wrote, "I see the movement towards AI and robotics as evolutionary, in large part because it is such a sociological leap. The technology may be ready, but we are not—at least, not yet."

The view from those who expect AI and robotics to displace more jobs than they create by 2025

An equally large group of experts takes a diametrically opposed view of technology's impact on employment. In their reading of history, job displacement as a result of technological advancement is clearly in evidence today, and can only be expected to get worse as automation comes to the white-collar world.

Argument #1: Displacement of workers from automation is already happening—and about to get much worse

Jerry Michalski, founder of REX, the Relationship Economy eXpedition, sees the logic of the slow and unrelenting movement in the direction of more automation: "Automation is Voldemort: the terrifying force nobody is willing to name. Oh sure, we talk about it now and then, but usually in passing. We hardly dwell on the fact that someone trying to pick a career path that is not likely to be automated will have a very hard time making that choice. X-ray technician? Outsourced already, and automation in progress. The race between automation and human work is won by

automation, and as long as we need fiat currency to pay the rent/mortgage, humans will fall out of the system in droves as this shift takes place…The safe zones are services that require local human effort (gardening, painting, babysitting), distant human effort (editing, coaching, coordinating), and high-level thinking/relationship building. Everything else falls in the target-rich environment of automation."

Mike Roberts, Internet pioneer and Hall of Fame member and longtime leader with ICANN and the Internet Society, shares this view: "Electronic human avatars with substantial work capability are years, not decades away. The situation is exacerbated by total failure of the economics community to address to any serious degree sustainability issues that are destroying the modern 'consumerist' model and undermining the early 20th century notion of 'a fair day's pay for a fair day's work.' There is great pain down the road for everyone as new realities are addressed. The only question is how soon."

Robert Cannon, Internet law and policy expert, predicts, "Everything that can be automated will be automated. Non-skilled jobs lacking in 'human contribution' will be replaced by automation when the economics are favorable. At the hardware store, the guy who used to cut keys has been replaced by a robot. In the law office, the clerks who used to prepare discovery have been replaced by software. IBM Watson is replacing researchers by reading every report ever written anywhere. This begs the question: What can the human contribute? The short answer is that if the job is one where that question cannot be answered positively, that job is not likely to exist."

Tom Standage, digital editor for *The Economist*, makes the point that the next wave of technology is likely to have a more profound impact than those that came before it: "Previous technological revolutions happened much more slowly, so people had longer to retrain, and [also] moved people from one kind of unskilled work to another. Robots and AI threaten to make even some kinds of skilled work obsolete (e.g., legal clerks). This will displace people into service roles, and the income gap between skilled workers whose jobs cannot be automated and everyone else will widen. This is a recipe for instability."

Mark Nall, a program manager for NASA, noted, "Unlike previous disruptions such as when farming machinery displaced farm workers but created factory jobs making the machines, robotics and AI are different. Due to their versatility and growing capabilities, not just a few economic sectors will be affected, but whole swaths will be. This is already being seen now in areas from robocalls to lights-out manufacturing. Economic efficiency will be the driver. The social consequence is that good-paying jobs will be increasingly scarce."

Argument #2: The consequences for income inequality will be profound

For those who expect AI and robotics to significantly displace human employment, these displacements seem certain to lead to an increase in income inequality, a continued hollowing out of the middle class, and even riots, social unrest, and/or the creation of a permanent, unemployable "underclass".

Justin Reich, a fellow at Harvard University's Berkman Center for Internet & Society, said, "Robots and AI will increasingly replace routine kinds of work—even the complex routines performed by artisans, factory workers, lawyers, and accountants. There will be a labor market in the service sector for non-routine tasks that can be performed interchangeably by just about anyone—and these will not pay a living wage—and there will be some new opportunities created for complex non-routine work, but the gains at this top of the labor market will not be offset by losses in the middle and gains of terrible jobs at the bottom. I'm not sure that jobs will disappear altogether, though that seems possible, but the jobs that are left will be lower paying and less secure than those that exist now. The middle is moving to the bottom."

Stowe Boyd, lead researcher at GigaOM Research, said, "As just one aspect of the rise of robots and AI, widespread use of autonomous cars and trucks will be the immediate end of taxi drivers and truck drivers; truck driver is the number-one occupation for men in the U.S.. Just as importantly, autonomous cars will radically decrease car ownership, which will impact the automotive industry. Perhaps 70% of cars in urban areas would go away. Autonomous robots and systems could impact up to 50% of jobs, according to recent analysis by Frey and Osborne at Oxford, leaving only jobs that require the 'application of heuristics' or creativity…An increasing proportion of the world's population will be outside of the world of work—either living on the dole, or benefiting from the dramatically decreased costs of goods to eke out a subsistence lifestyle. The central question of 2025 will be: What are people for in a world that does not need their labor, and where only a minority are needed to guide the 'bot-based economy?"

Nilofer Merchant, author of a book on new forms of advantage, wrote, "Just today, the guy who drives the service car I take to go to the airport [said that he] does this job because his last blue-collar job disappeared from automation. Driverless cars displace him. Where does he go? What does he do for society? The gaps between the haves and have-nots will grow larger. I'm reminded of the line from Henry Ford, who understood he does no good to his business if his own people can't afford to buy the car."

Alex Howard, a writer and editor based in Washington, D.C., said, "I expect that automation and AI will have had a substantial impact on white-collar jobs, particularly back-office functions in

clinics, in law firms, like medical secretaries, transcriptionists, or paralegals. Governments will have to collaborate effectively with technology companies and academic institutions to provide massive retraining efforts over the next decade to prevent massive social disruption from these changes."

Point of agreement: The educational system is doing a poor job of preparing the next generation of workers

A consistent theme among both groups is that our existing social institutions—especially the educational system—are not up to the challenge of preparing workers for the technology- and robotics-centric nature of employment in the future.

Howard Rheingold, a pioneering Internet sociologist and self-employed writer, consultant, and educator, noted, "The jobs that the robots will leave for humans will be those that require thought and knowledge. In other words, only the best-educated humans will compete with machines. And education systems in the U.S. and much of the rest of the world are still sitting students in rows and columns, teaching them to keep quiet and memorize what is told to them, preparing them for life in a 20th century factory."

Bryan Alexander, technology consultant, futurist, and senior fellow at the National Institute for Technology in Liberal Education, wrote, "The education system is not well positioned to transform itself to help shape graduates who can 'race against the machines.' Not in time, and not at scale. Autodidacts will do well, as they always have done, but the broad masses of people are being prepared for the wrong economy."

Point of agreement: The concept of "work" may change significantly in the coming decade

On a more hopeful note, a number of experts expressed a belief that the coming changes will allow us to renegotiate the existing social compact around work and employment.

Possibility #1: We will experience less drudgery and more leisure time

Hal Varian, chief economist for Google, envisions a future with fewer 'jobs' but a more equitable distribution of labor and leisure time: "If 'displace more jobs' means 'eliminate dull, repetitive, and unpleasant work,' the answer would be yes. How unhappy are you that your dishwasher has replaced washing dishes by hand, your washing machine has displaced washing clothes by hand, or your vacuum cleaner has replaced hand cleaning? My guess is this 'job displacement' has been very welcome, as will the 'job displacement' that will occur over the next 10 years. The work week

has fallen from 70 hours a week to about 37 hours now, and I expect that it will continue to fall. This is a good thing. Everyone wants more jobs and less work. Robots of various forms will result in less work, but the conventional work week will decrease, so there will be the same number of jobs (adjusted for demographics, of course). This is what has been going on for the last 300 years so I see no reason that it will stop in the decade."

Tiffany Shlain, filmmaker, host of the AOL series *The Future Starts Here*, and founder of The Webby Awards, responded, "Robots that collaborate with humans over the cloud will be in full realization by 2025. Robots will assist humans in tasks thus allowing humans to use their intelligence in new ways, freeing us up from menial tasks."

Francois-Dominique Armingaud, retired computer software engineer from IBM and now giving security courses to major engineering schools, responded, "The main purpose of progress now is to allow people to spend more life with their loved ones instead of spoiling it with overtime while others are struggling in order to access work."

Possibility #2: It will free us from the industrial age notion of what a "job" is

A notable number of experts take it for granted that many of tomorrow's jobs will be held by robots or digital agents—and express hope that this will inspire us as a society to completely redefine our notions of work and employment.

Peter and Trudy Johnson-Lenz, founders of the online community Awakening Technology, based in Portland, Oregon, wrote, "Many things need to be done to care for, teach, feed, and heal others that are difficult to monetize. If technologies replace people in some jobs and roles, what kinds of social support or safety nets will make it possible for them to contribute to the common good through other means? Think outside the job."

Bob Frankston, an Internet pioneer and technology innovator whose work helped allow people to have control of the networking (internet) within their homes, wrote, "We'll need to evolve the concept of a job as a means of wealth distribution as we did in response to the invention of the sewing machine displacing seamstressing as welfare."

Jim Hendler, an architect of the evolution of the World Wide Web and professor of computer science at Rensselaer Polytechnic Institute, wrote, "The notion of work as a necessity for life cannot be sustained if the great bulk of manufacturing and such moves to machines—but humans will adapt by finding new models of payment as they did in the industrial revolution (after much upheaval)."

Tim Bray, an active participant in the IETF and technology industry veteran, wrote, "It seems inevitable to me that the proportion of the population that needs to engage in traditional full-time employment, in order to keep us fed, supplied, healthy, and safe, will decrease. I hope this leads to a humane restructuring of the general social contract around employment."

Possibility #3: We will see a return to uniquely "human" forms of production

Another group of experts anticipates that pushback against expanding automation will lead to a revolution in small-scale, artisanal, and handmade modes of production.

Kevin Carson, a senior fellow at the Center for a Stateless Society and contributor to the P2P Foundation blog, wrote, "I believe the concept of 'jobs' and 'employment' will be far less meaningful, because the main direction of technological advance is toward cheap production tools (e.g., desktop information processing tools or open-source CNC garage machine tools) that undermine the material basis of the wage system. The real change will not be the stereotypical model of 'technological unemployment,' with robots displacing workers in the factories, but increased employment in small shops, increased project-based work on the construction industry model, and increased provisioning in the informal and household economies and production for gift, sharing, and barter."

Tony Siesfeld, director of the Monitor Institute, wrote, "I anticipate that there will be a backlash and we'll see a continued growth of artisanal products and small-scale [efforts], done myself or with a small group of others, that reject robotics and digital technology."

A network scientist for BBN Technologies wrote, "To some degree, this is already happening. In terms of the large-scale, mass-produced economy, the utility of low-skill human workers is rapidly diminishing, as many blue-collar jobs (e.g., in manufacturing) and white-collar jobs (e.g., processing insurance paperwork) can be handled much more cheaply by automated systems. And we can already see some hints of reaction to this trend in the current economy: entrepreneurially-minded unemployed and underemployed people are taking advantages of sites like Etsy and TaskRabbit to market quintessentially human skills. And in response, there is increasing demand for 'artisanal' or 'hand-crafted' products that were made by a human. In the long run this trend will actually push toward the re-localization and re-humanization of the economy, with the 19th- and 20th-century economies of scale exploited where they make sense (cheap, identical, disposable goods), and human-oriented techniques (both older and newer) increasingly accounting for goods and services that are valuable, customized, or long-lasting."

Point of agreement: Technology is not destiny … we control the future we will inhabit

In the end, a number of these experts took pains to note that none of these potential outcomes—from the most utopian to most dystopian—are etched in stone. Although technological advancement often seems to take on a mind of its own, humans are in control of the political, social, and economic systems that will ultimately determine whether the coming wave of technological change has a positive or negative impact on jobs and employment.

Seth Finkelstein, a programmer, consultant and EFF Pioneer of the Electronic Frontier Award winner, responded, "The technodeterminist-negative view, that automation means jobs loss, end of story, versus the technodeterminist-positive view, that more and better jobs will result, both seem to me to make the error of confusing potential outcomes with inevitability. Thus, a technological advance *by itself* can either be positive or negative for jobs, depending on the social structure as a whole….this is not a technological consequence; rather it's a political choice."

Jason Pontin, editor in chief and publisher of the MIT Technology Review, responded, "There's no economic law that says the jobs eliminated by new technologies will inevitably be replaced by new jobs in new markets… All of this is manageable by states and economies: but it will require wrestling with ideologically fraught solutions, such as a guaranteed minimum income, and a broadening of our social sense of what is valuable work."