

Forecasts of AI and Future Jobs in 2030: Muddling Through Likely, with Two Alternative Scenarios

William Halal
George Washington University
USA

Jonathan Kolber
A Celebration Society
USA

Owen Davies
TechCast Global
USA

Takeaways

- Advance of AI likely to accelerate automation and displace routine work.
- Experts estimate the world is likely to muddle through the threat of massive unemployment.
- Variation in results also suggest alternative scenarios of “growth” and “crisis.”

Introduction

After decades of failed promises, artificial intelligence (AI) is now taking off. Yesterday’s doubters have been silenced, and the only current debate is about how deep and how fast intelligent machines will automate jobs, and whether the same technological forces will generate enough new work.

Several forecasts suggest AI is likely to eliminate almost half of present jobs by 2025, resulting in massive unemployment (Rutkin, 2013). Ray Kurzweil, now at Google, extrapolates the growth of computer power to estimate that a US\$1000 PC will match the human brain about 2020, and powerful AI systems will soon follow (Frey, 2016). Ben Goertzel, leader of the OpenCog project said “I am confident that we will have human-level AI by 2025. Maybe sooner” (Olson, 2013, p.1).

Advanced AI systems are being introduced even now. IBM’s Watson Division is partnering with hundreds of companies to automate entire fields of work. The partnership with Cleveland Clinic is developing a medical diagnosis system that promises accuracy surpassing all but the best doctors. Another partnership promises to automate legal work. Google’s Deep Mind is a “deep learning” system that needs no training as it learns by itself. It recently beat a human master at Go much faster than anticipated by AI researchers, and it taught itself to recognize speech.

This study addresses the looming issue of unemployment by forecasting the future distribution of jobs in categories across the occupational spectrum. We first summarize background data from the literature and present two alternative perspectives for consideration. Then results of a TechCast survey of experts concludes that a “Muddling Through” period of turmoil but relatively few net job losses is most likely. We also present two alternative scenarios.

TechCast’s Approach to Forecasting

TechCast Global forecasts emerging technologies, social trends and wild cards to cover the entire strategic landscape for planners and decision-makers. The TechCast research method uses collective intelligence to pool background data and the knowledge and judgment of 150 experts worldwide. This work is validated for accuracy, showing an average error band of approximately $\pm 1/3$ years at 10 years out (Halal, 2013).

Our approach strives to be science-based because it draws on empirical background data to guide expert judgments. Researchers gather information on progress underway, examples, adoption levels, and other relevant facts, which are organized into a succinct analysis of trends. We make a point of including opposing trends that hinder development, such as political obstacles, high costs, or social resistance, to ensure that the analysis is balanced. But some uncertainty always remains, and the experts’ role is to resolve the remaining uncertainty.

Experts are taken through these analyses online and instructed to integrate the background data and their judgment to estimate answers to survey questions of interest. The experts are not all world-renowned, but they are innovative thought leaders who represent the leading edge of knowledge. The raw data is automatically aggregated for distribution to clients over the site in real time.

For this study, our method of collective intelligence resulted in the background information below on four job categories covering the occupational spectrum. The job categories are defined, with explanations of how they are likely to be affected by AI and supporting bullets of empirical data, forecasts, and expert opinion. The Growth and Crisis perspectives below are also provided to offer a balanced analysis of this impending threat. The Growth view argues the case for optimism while the Crisis perspective focuses on the looming threat of mass unemployment.

After reviewing this background data and the two alternative perspectives, TechCast experts were asked to estimate the distribution of jobs in 2030 among five categories. Results of the expert survey are then presented along with conclusions.

Background Data: An Occupational Analysis

Following is a list of the major employment options using a conceptual framework of Complex Manual Work, Routine Work, Service/Knowledge Work, and Creative Work, as well as the options of a Guaranteed Minimum Income and traditional Unemployment. This analysis and the supporting data outline the categories of work that are likely to occupy the labor force in OECD nations today.

Please note that this is simply background data used to frame the problem for the expert survey. The employment percentages below are estimated from various articles noted in the supporting bullets below. Since there is variation in reported data, we do our best to estimate the most accurate percentage as an average, and we normalize to total 100 percent. The survey results are presented later.

This occupational analysis is a general framework commonly used to analyze work (Rotman, 2015). It should apply to any economic system, and the categories seek to distinguish between jobs that can and cannot be easily automated. For instance, automation threatens undeveloped nations even more severely than developed ones. But China, India, and other developing countries face a different situation at a lower level of development. In these nations, manual work is yielding to service/knowledge work as they develop a consumer economy.

Complex Manual Work Hard to Automate ~ 19 Percent and Stable

Though much manual work has been automated, there remains a significant portion of complex manual jobs that are hard to automate—barbers, janitors, farm workers, house cleaners, cooks, gardeners, repairmen, carpenters, care givers, etc. As noted below, this “residual” category of complex manual jobs employs about 19 percent of workers in OECD states now, and is considered likely to remain at roughly this level. Here are supporting data:

- **Modest Increase** From 1982 to 2012, non-routine manual work in the US increased from 15 percent of employment to 19 percent (Rotman, 2015).
- **Job Complexity** Prof. Erik Brynjolfsson at MIT said these jobs “...are not about to be replaced by machines [because they] involve sensory motor work, the skills of ideation, large-frame pattern recognition, and complex communication.” (Heath, 2015, p.1)

Routine Work Now Being Automated ~ About 35 Percent and Decreasing

Advanced AI and robotics are successfully automating this large group of routine, well-structured jobs that involve manual and service tasks—factory work, most clerical jobs, driving trucks, etc. Relevant data below shows that this group comprises about 44 percent of the labor force and is decreasing rapidly now. After normalizing the data to a total of 100 percent, we estimate this category to be about 35 percent for OECD nations.

- **Recent Decrease from 55 to 44 percent** Routine jobs fell from 56 percent of the US labor force in 1982 to 44 percent in 2012, and that proportion is likely to decrease over the next few decades (Rotman, 2015).
- **Forecast 30 Percent Decrease by 2025** TechCast estimates AI and robotics will replace 30 percent of routine knowledge work about 2025 (TechCastGlobal.com).

Service/Knowledge Work ~ About 34 Percent and Stable

Teaching, law, medicine, management, the arts, and other professional work can be automated, but these jobs are likely to be transformed rather than eliminated or even reduced. They increasingly use AI to replace routine tasks and focus instead on the subjective, more complex tasks that machines can’t yet do. The bullets below indicate this category makes up about 34 percent of all work and seems fairly stable.

- **Cognitive Jobs Increasing** This type of work grew from 29 percent in 1982 to 38 percent in 2012 for the US (Rotman, 2015).
- **Most Jobs Only Revised** A McKinsey study finds 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 (Chui, 2015).
- **Computerization Increases Jobs** Studies show that occupations becoming more computerized can be eliminated, upgraded, and have new jobs created. Overall, automation actually can grow some occupations faster (Bessen, 2016).

Creative Work ~ 4 Percent and Increasing

The new “creative economy” of leadership, entrepreneurship, innovation, collaboration, vision, etc., could grow dramatically because that is thought to comprise the next frontier—everything beyond knowledge. The sources below suggest this group comprises about four percent of work and is increasing.

- **Hard to Automate** A McKinsey study finds that capabilities involving creativity make up 4 percent of jobs in the US, but that is likely to grow. Creative work is central to the human experience and also difficult to automate (Chui, 2015). These jobs involve abstract tasks in which workers have a comparative advantage of interpersonal interaction, adaptability,

- and problem-solving professional work, skilled labor (plumbers, builders, electricians, auto mechanics), customer-service relations, etc (Weisenthal, 2013).
- **New Industries** The tech revolution is creating a flood of new products, services, and industries that are taking off—e-commerce, alternative energy, green economy, Internet of Things, hi-tech homes, climate control, intelligent cars, etc. The field of energy, climate change, and environment alone is likely to create a US\$10- to US\$20-trillion global industry. TechCast estimates market saturation for about 50 technologies at an average of about US\$1 trillion each, for a total of about US\$50 trillion in new economic growth over the next few decades. That’s as big as the present global economy. All of these industries may create lots of new jobs (TechCastGlobal.com).

Guaranteed Minimum Income (GMI) ~0 Percent and being tested

Some propose to ease the unemployment problem by having governments guarantee everyone a minimum income. Added costs would be offset by savings from eliminating welfare, unemployment, and other benefits, and studies suggest that only a few people will leave the workforce due to a GMI.

Note that GMI benefits can be either “means-tested” or “universal.” Means-tested limits benefits to those below a minimal income, while “universal” pays benefits to all citizens. In most nations, the political resolve to pay everybody may not be feasible. For instance, giving all adults in the US\$10K/year (below the minimum wage and the poverty line) would cost about US\$2 trillion—almost as much as the entire Federal budget. For this study, the GMI can be either means tested or universal, and it is considered an alternative to traditional unemployment with minimal benefits. Here are experiments underway:

- A pilot study in Canada showed that a “Mincome” not only ended poverty but also reduced hospital visits and raised high-school completions (Luedi, 2016).
- Experiments in Namibia cut poverty from 76 percent to 37 percent, raised education and health standards, and cut crime levels. One involving 6,000 people in India paid people US\$7 month—about a third of subsistence levels. It, too, proved successful (Schiller, 2015).
- Switzerland held a referendum on a basic income of about US\$2,800/month for all Swiss. It was decisively defeated, but it is unclear whether the voters rejected the concept or its proposed implementation (*BBC News*, 2016).

Unemployed ~8 Percent and slightly rising

Without some form of GMI, the remainder of the labor force will be unemployed in the traditional sense of receiving only time-limited benefits.

- **Global Unemployment Rates** Measures vary widely, ranging among OECD countries in 2014 from 3.6 percent in South Korea to 26.5 percent in Greece. The average was 7.3 percent, down from a peak of 8.3 percent in 2010 but still well above the 5.7 percent seen in 2007 (The World Bank, 2016).
- **Global WorkForce** The most reasonable figures suggest a workforce of 3.36 billion people in 2014, of whom about 279 million were unemployed (8 percent) At current growth rates, the labor force is expected to reach about 4 billion by 2025. At the rate seen in 2014, that would leave 330 million unemployed (Futurehtrends, 2015).
- **Forecast of 10% Unemployed by 2021** TechCast covers a Social Trend called Job Failure, which forecasts “Unemployment rises to 10 percent in OECD Nations” by 2021 +/- 3 years. The experts also estimate a social impact of -4, which is severe, and are 61 percent confident in their forecast (TechCastGlobal.com).

A Growth Perspective

New Jobs in a Higher-Order Frontier of Growth

William Halal, George Washington University and TechCast Global

Fears of mass unemployment by automation have been a constant throughout industrialization, but they are seldom realized. The evidence shows that automation reduces costs and frees up labor, which allows further economic growth and new jobs in areas of demand that were unexpected. Today’s fears that AI will eliminate masses of jobs does not recognize how this dynamic will play out in the new economy that is emerging. They are somewhat reminiscent of the Y2K crisis that never materialized.

The key is to recognize that AI can automate knowledge work, but there exists a huge unexplored economic domain beyond knowledge—creativity, entrepreneurship, vision, collaboration, diplomacy, marketing, supervision, and other higher-order functions that are uniquely human. See the figure, “Structure of Consciousness (Bessen, 2016) Advanced AI may be able to solve tough problems, but it cannot provide vision, purpose, imagination, values, wisdom, and other capabilities that are essential for sound leadership and tough choices.

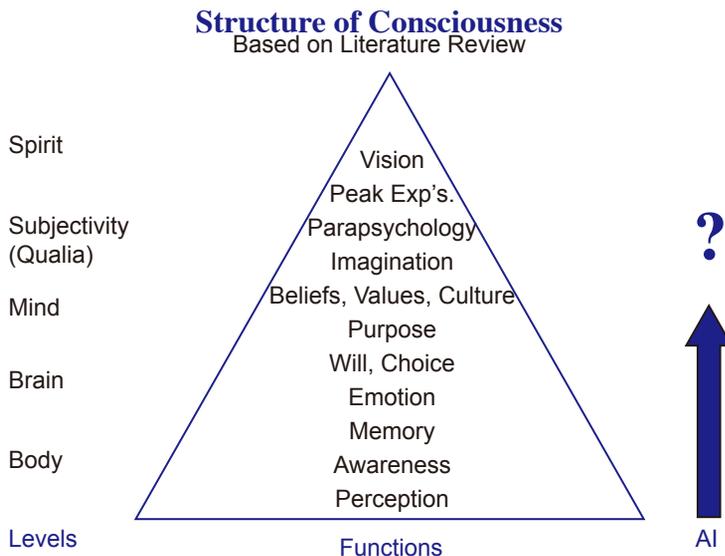


Figure 1. Structure of Consciousness

Yes, we can expect good virtual assistants to take over routine service tasks, but people will always want a real person to provide human contact. Staff is growing rapidly in universities, hospitals, research institutes, and other advanced settings for these reasons. The service and knowledge work sector could grow dramatically to 50–60 percent by 2030.

AI will mature in time, like all technologies, while society’s demands are likely to escalate. The crises of IT system failures that damaged the US government, Sony and many other organizations could become move severe. IT systems even now frustrate people, and having advanced machines everywhere will pose far greater problems as the limits of AI press in. I can imagine a common experience of yelling at some “dumb machine.”

The problem is that we have a hard time knowing what lies ahead in this new frontier. Who would have thought a few decades ago that most people today would do their work by staring into PC monitors, laptops, and mobile devices? There is no fixed amount of human endeavor, and

work of different kinds will always appear to fill new economic demands. See the bullets in the Occupational Analysis above for examples of high-order work that will be done in a wave of new industries.

People on the lower end of the normal IQ distribution may not be well-suited for this transition. But they could do well among the 20 percent of the labor force that serve useful roles in the complex manual jobs that are hard to automate. Effective employers will use knowledge-on-demand, online tutors, and other technologies to help those needing information. In principle, anyone can have special talents, and some low-IQ employees could prove adept at service and creative work. With help from the new breed of employers who treat people as resources to be nurtured, “marginal people” of all types can be absorbed throughout the work force.

The value of machine intelligence pales in comparison to the utter complexity of human challenges looming ahead. A major frontier lies in addressing the massive global crises forming what TechCast has called a Global MegaCrisis—climate, energy, water, terrorism, financial instability, etc. These historic changes may be assisted by AI, but they will challenge humans to adapt for decades.

As always, this coming transformation is an opportunity in disguise as humanity is forced to create new institutions, learn to collaborate, and generally grow to an advanced state of global maturity. This will be a difficult transition, with global unemployment rising beyond 10 percent, possibly for years. The prevailing “profit-centered model” of business may have to be broadened to include all stakeholders in collaborative partnerships that work better for all. Some nations will do better than others, depending on how well they address this challenge.

In the end, however, rather than diminishing people, the net effect of AI may be to enhance the value of these higher-order talents that are a unique gift to humanity.

A Crisis Perspective

Employment Will Plummet as Human Jobs Are Automated

Jonathan Kolber, author of *A Celebration Society* and TechCast Global Expert, and Owen Davies, TechCast Global Editor

Recent studies by Bank of America and the University of Oxford warn that in the next decade or so, 35%+ percent of occupations could be automated out of existence (Stewart, 2015). Nomura Research estimates that 49 percent of jobs in Japan could be lost (Lewontin, 2015). These findings rely only on technology now available or clearly on its way. No Singularity is required to cause such massive job losses.

According to one estimate, half of major companies already are experimenting with AI. We believe this latest wave of automation strikes so deeply at human abilities that it will bring no compensating burst of job creation. The net effect is likely to be at least a 20-percent reduction in employment. Losses could be much greater.

Routine occupations are going away quickly. For example, China’s Foxconn has a factory that recently automated 90% of its jobs—and 2/3 of the remaining jobs are also being eyed for automation (Forrest, 2015). When autonomous vehicles are certified for travel, driving jobs will disappear. In the USA alone, there are about 3 million people who drive trucks for a living. This does not count taxi, limo and Uber drivers, nor does it other countries (American Trucking Associations). In Japan, companies are developing robots to replace RNs and home health workers (Stanford University, 2016). Guided by AI, there is little robots won’t soon be able to do.

More ominously, automation is taking jobs that once required human versatility. Software manages huge investment portfolios. IBM’s Watson diagnoses illness as well as professional diagnosticians, and is capable of performing the research that employs 20 percent of lawyers’

billable hours (IBM, 2016). Narrative Science’s computers write business and sports stories for 30 major news outlets (Hudson, 2012). AIs have found new mathematical proofs (Wolchover, 2013) and even made at least one important scientific discovery that human researchers had missed (Lobo, 2015). None of these activities qualifies as routine. Some require abilities that, in a human being, would be considered creativity.

AI becomes more capable by the day. Software recently has learned complex games simply by reading the rules, and the latest AI programs mimic human reasoning to beat flesh-and-blood competitors at chess and go. Microsoft has released new software that recognizes human emotions (Demmitt, 2015) and Amelia responds to emotional cues in speech; Fortune 1000 companies use these tools to deliver better customer service (IPsoft, 2014). AI may not experience emotion, but it deals with emotions well enough to replace human workers in many functions.

We agree; there is a fundamental difference between human intelligence and the AI we know today. Yet, what matters are the results, not the means by which they are achieved. Devastating the job market does not require “general” AI that can replace every human function. It is enough that “narrow” AI can replace specific functions within limited domains of expertise.

Watson is carefully marketed as an “assistant.” The surest way for employers to increase profits is by cutting costs. This reality means that Watson will assist only those humans who remain after it has replaced the rest.

Optimists frequently cite Google as a hive of high-tech creativity and a promising example of things to come. Companies like Google, and even high-tech manufacturers like Tesla, need nowhere near as many human workers as old-line companies like GM to generate comparable revenues (Colvin, 2015). They cannot be counted on to replace the millions of jobs now at risk—certainly not in the few years available before unemployment increases exponentially. Also, most “creative” professions, such as those at Google, require advanced mathematical and technical skills. Few of us have what it takes to prosper in such fields.

Some new jobs may appear, but they will not last for long. Machines have begun to learn by observation, by trial and error, and even from other machines—as we do, but much faster. They are likely to master most new occupations before we humans ever have the chance. We face a time when humans will hop from one career to the next, struggling to stay ahead of automation. Saddled by debt and discouraged by a broken social contract, many may succumb to despair unless we find an alternative to endless retraining.

There is, of course, an alternative. The United States can develop the kind of social safety programs common in Europe, and especially the Nordic countries, so displaced workers have an alternative to permanent immiseration. Unfortunately, paying for such programs will require legal and regulatory changes. Business law will need to recognize that companies must further social goals beyond simply maximizing shareholder profits, and tax laws will require a comprehensive overhaul to capture funds now lost to loopholes and the “offshoring” of corporate profits. We doubt that such reforms can gain the support needed to enact them in the face of politically influential opposition (Kolber, 2016).

We are not entirely pessimistic about careers and employment. The best of us will still work in 2030 as inventors, researchers, artists, and in whatever new occupations do emerge. Exceptional work will be rewarded in the professions. However, truly creative people within any field are always an elite. Most merely follow their lead, and machines soon will do most non-elite work better than people.

Superstars will do fine in any system, and their creativity and leadership will be essential to any vibrant society. Yet, they are largely beside our current point. It is the inessential majority that concerns us. The rise of intelligent machines will undermine a basic tenet of modern life, that steady jobs give most people their living. In the years ahead, we will need a new economic and social system to replace the one we are about to lose. For so long as capitalism exists, investors will still

need a fair return on their capital; everyone else will need a viable income and a satisfying life when their labor is no longer needed. Devising a system that can provide both is one of the most urgent tasks for the years ahead.

Results and Conclusions; Muddling Through

Results of our expert survey are tabulated below, augmented by comments from the 53 TechCast Experts who completed the survey. As we will show, the majority of experts believe that a reasonable path can be found through this difficult transition. We call this the “Muddling Through Scenario.” This is a “middle” scenario in which adaptation to the new technologies occurs organically through a combination of market forces producing new “creative jobs” and government support offering GMI benefits, containing unemployment to tolerable levels.

Table 1. *Expert Survey Results for OECD Nations in 2030 (N = 53)*

Job Category	2012 Background Data	2030 Expert Data	Standard Deviation	2030 - 2012
Complex Manual	19 %	18 %	5 %	-1 %
Routine	35	17	8	-18
Service/Knowledge	34	31	9	- 3
Creative	4	15	12	+ 11
GMI	0	8	11	+ 8
Unemployment	8	11	6	+ 3
TOTAL	100%	100%		0%

Although the “Muddling Through” scenario is more likely, the standard deviations show wide variation in the data. Some respondents at both extremes do not agree with the most likely estimate represented in the mean figures, and this is captured in the two alternative scenarios. Overall, the collective responses from TechCast’s thought leaders suggest a few major conclusions that stand out with some clarity:

Complex Manual-Social Jobs Stable ~ 18 Percent

About 18 percent of all jobs are expected to remain comprised of an interplay of various manual and social tasks that remain too complex to be automated, at least by 2030, so they are likely to remain done by humans. Robots may do some of this work, but integrating it into useful personal service requires complex human skills like empathy, and many clients will always prefer to have humans available instead. The 18-percent forecast of jobs in this group is largely unchanged from today and appears likely to remain stable at this level.

Routine Job Losses ~ 22 Percent

Fears of 40–50 percent job losses seem too high, according to TechCast experts, who expect total job losses at 22% in this time frame from 2016 to 2030. The main losses are expected to be in this category of “Routine Work.” Here’s what one expert said in response to the survey:

“AI will evolve to produce machines that most people will find it hard or impossible to distinguish from most other humans during some sets of circumstances.”

Service/Knowledge Jobs Stable ~ 31 Percent

These complex professions are expected to become more sophisticated rather than eliminated. It is believed that applications of AI will do the grunt work allowing professionals to focus on the “human work.” Service/Knowledge work is predicted to remain the largest category of jobs. An expert saw it this way:

“An updated AI “Matrix Management” process will be necessary to manage millions of people’s on-line participation in multiple projects.”

Gains in Creative Work ~ 11 Percent

The lost jobs should be offset by an expected 11% gain in “Creative Work” -- entrepreneurs, leaders, managers, collaborators, artists, etc. This is expected to be the new frontier of growth beyond knowledge. Some of our experts justified this forecast as follows:

“Computerization will continue to create more new jobs, at a faster and faster rate.”

“By current standards, the average individual in 2030 will be a genius in their field and life.”

“Even the current low-skilled “dumb” workers will develop into bright skilled workers.”

Unemployment Rise of Three Percent

Unemployment is forecast to rise modestly by about 3 percent to reach 11 percent or so in 2030. In the consensus view of our experts, this will be serious but not a major crisis.

Guaranteed Minimum Income (GMI) ~ 8 Percent

The political pressures are expected to force governments to reduce social pain by introducing GMI benefits. To date, GMI has only been offered in small pilot projects by Finland, India, Canada, and a few other nations. Many of our experts thought that a GMI would be beneficial:

“A guaranteed Minimum Income ... would encourage people to move to lower cost regions of the country. ... employees would need lower wages ... thus creating more jobs. And people could take jobs that were more meaningful to them even though those jobs did not pay as much.”

“Looks to be a dire future but with the right legislative environment and encouraging disruption we may have enough wealth, if it is shared more equally.”

“Everyone will need to find their ‘Life Purpose’ to get fully engaged.”

“Who says we all need to work, or have a job? We need a new sustainability model.”

“The machines are becoming ever better at creativity ... However, we humans are rapidly becoming cyborgs ... The current growth based econometrics will go away for sustainability and because folks can, going forward, live wholly DIY (do-it-yourself).”

Recommended Government Policies

In response to a fixed choice question, respondents indicated the following preferences on government policies to alleviate unemployment:

Table 2. *Unemployment Policy Options Ranked by Popularity*

Improve education and training	56%
Assist entrepreneurs and innovators	45%
Study the problem and plan ahead	37%
Set bold goals and a compelling vision	35%
Restructure business and government to foster change	33%
Find strong leadership	32%
Reduce taxes and regulations	18%

However, there is great uncertainty involved. Here's how some experts expressed their doubt:

"I don't really think any policy will reduce unemployment. The goal is to make it endurable by finding other ways to occupy ourselves that we will feel are meaningful."

"This issue requires a serious discussion about income inequality and wealth re-distribution, and the political will that is necessary to effectuate the goals of providing a minimum decent standard of living."

Two Alternative Scenarios

The Muddling Through Scenario may be most likely, but the spread of data indicates that there remain possibilities for more extreme outcomes along the lines described previously. Below we provide "Growth" and "Crisis" scenarios in light of this study's results by the same authors who provided the corresponding perspectives.

Higher-Order Growth Scenario by William Halal

I think there is a 20–30 percent chance that the transition to a new social order will go well and produce a boom period of full employment in challenging work. The global economy entered a new 35-year growth cycle about 2015, and the TechCast forecasts above outline the industries that are likely to fuel this coming boom with about US\$50 Trillion in demand, roughly doubling global GDP. Progressive CEOs are reforming business into a more collaborative coalition that serves social needs as well as economic gains, and politicians are being forced to streamline governments. Institutional change of this type will go a long way to foster sound growth. The 11% gain in Creative work reported here could easily reach 20-30 percent with a flood of important new jobs leading small teams, starting new ventures, forming collaborative alliances, and other tasks we can barely imagine in the new frontier beyond knowledge. After all, with the globe teetering on multiple threats of climate shift, energy, financial instability, a looming water crisis, cyberwar, terrorism, and other massive challenges, there is certainly no shortage of problems to solve and good work to be done.

Unemployment Crisis Scenario by Owen Davies and Jonathan Kolber

While muddling through may be the most likely outcome based on this study, the wide variation in our results suggests there remains a strong possibility that accelerating automation will provoke a crisis for many millions whose jobs it displaces, their families, and the entire global economy. We doubt that either new jobs or massive retraining will suffice to provide adequate employment as AI eliminates complex skills faster than people can adapt. Further, relatively few people possess significant creativity, leadership, or entrepreneurship skills at a high level required to form a career,

and AI is rapidly encroaching into these domains as well. By 2030, AI should be capable of feats that would now seem fantastic. We may not see 40 percent job losses by 2025, but the threat of such extreme disruption demands preparation for this contingency.

Final Thoughts

This is a preliminary study with a modest sample, so these results are tentative and require confirmation from follow-up studies. The original study and survey data can be accessed at the TechCast Global website (TechCastGlobal.com). But the data show stable trends, and the expert consensus is that a Muddling Through Scenario is most likely to emerge by 2030 in OECD Nations.

The TechCast Global Experts collectively think it is likely that humanity will find its way safely through the coming AI/robotics crisis. The world is moving toward an almost fully automated stage of development that should be well underway by 2030. The consensus view among our experts appears to be that widespread adoption of a GMI, along with an expected proliferation of new creative jobs, will keep unemployment at tolerable levels. This conclusion may seem contrary to many who are convinced a disaster looms ahead, but we respectfully suggest this study may provide the outline of a solution.

Whether we agree or disagree with this expert consensus, we should all hope that they prove to be right. Accelerating automation, and the resulting technological unemployment, has the potential to be socially disruptive on a huge scale. Muddling through would be a prudent way for humanity to proceed through the exponentially changing decades ahead.

Correspondence

William Halal
George Washington University
Bangkok University
TechCast Global
USA
Email: William.Halal@techcastglobal.com

Jonathan Kolber
TechCast Global
A Celebration Society
USA
Email: jonathan.kolber@gmail.com

Owen Davies
TechCast Global
USA
Email: Owen5819@comcast.net

References

- BBC News. (2016). Switzerland's voters reject basic income plan. *BBC News*. Retrieved August 18, 2016, from <http://www.bbc.com/news/world-europe-36454060>
- Bessen, J. (2016). The automation paradox. *The Atlantic*. Retrieved August 18, 2016, from <http://www.theatlantic.com/business/archive/2016/01/automation-paradox/424437/>
- Chui, M., Manyika, J., & Miremadi, M. (2015). Four fundamentals of workplace automation. *McKinsey Quarterly*. Retrieved August 18, 2016, from <http://www.mckinsey.com/business-functions/business-technology/our-insights/four-fundamentals-of-workplace-automation>
- Colvin, G. (2015). Why every aspect of your business is about to change. *Fortune*. Retrieved August 18, 2016, from <http://fortune.com/2015/10/22/the-21st-century-corporation-new-business-models/>
- Demmitt, J. (2015). Microsoft's new "emotion-sensing platform" can recognize human feelings by analyzing photos. *Geekwire*. Retrieved August 18, 2016, from <http://www.geekwire.com/2015/microsoft-releases-tool-to-sense-human-emotion-by-analyzing-photos/>
- Forrest, C. (2015). Chinese factory replaces 90% of humans with robots, production soars. *Tech Republic*. Retrieved August 18, 2016, from <http://www.techrepublic.com/article/chinese-factory-replaces-90-of-humans-with-robots-production-soars/>
- Frey, K. B., Osborne, M. A., Holmes, C., Rahbari, E., Curmi, E., Garlick, R., ... Wilkie, M. (2016). *Technology at work v2.0*. Citi GPS: Global perspectives & solutions. Retrieved August 18, 2016, from http://www.oxfordmartin.ox.ac.uk/downloads/reports/Citi_GPS_Technology_Work_2.pdf
- Futurehrtrends. (2016). *Profile of the global workforce: Present and future*. Retrieved from June 2016, from <http://futurehrtrends.eiu.com/report-2015/profile-of-the-global-workforce-present-and-future/>
- Halal, W. E. (2013) Forecasting the technology revolution: Results and learnings from the TechCast project. *Technological Forecasting & Social Change*, 80(8),1635-1643.
- Heath, N. (2015). Why AI could destroy more jobs than it creates, and how to save them. *Tech Republic*. Retrieved August 18, 2016, from <http://www.techrepublic.com/article/ai-is-destroying-more-jobs-than-it-creates-what-it-means-and-how-we-can-stop-it/>
- Hudson, A. (2012). Man or machine – can robots really write novels? *British broadcasting corporation*. Retrieved August 18, 2016, from http://news.bbc.co.uk/2/hi/programmes/click_online/9764416.stm
- IBM. (n.d.). Machine learning applications. Retrieved August 18, 2016, from <http://research.ibm.com/cognitive-computing/machine-learning-applications/>
- IPsoft. (2014). Meet Amelia: IPsoft's new artificial intelligence platform interacts like a human. *IPsoft*. Retrieved August 18, 2016, from <http://www.ipsoft.com/2014/09/29/meet-amelia-new-artificial-intelligence-platform-interacts-like-a-human/>
- Kolber, J. (2016). Guaranteed mirage income? *Journal of evolution and technology*. Retrieved August 18, 2016, from <http://ieet.org/index.php/IEET/more/Kolber20160514>
- Lewontin, M. (2015). Robots could fill nearly half of all jobs in Japan within 20 years, study says. *Christian science monitor*. Retrieved August 18, 2016, from <http://www.csmonitor.com/Technology/2015/1204/Robots-could-fill-nearly-half-of-all-jobs-in-Japan-within-20-years-study-says>
- Lobo, D., & Levin, M. (2015). Inferring regulatory networks from experimental morphological phenotypes: A computational method reverse-engineers planarian regeneration. *PLOS computational biology*. Retrieved August 18, 2016, from <http://dx.doi.org/10.1371/journal.pcbi.1004295>
- Luedi, J. (2016). Canada to trial guaranteed minimum income. *Global Risk Insights*. Retrieved

- August 18, 2016, from <http://globalriskinsights.com/2016/05/canada-to-trial-guaranteed-minimum-income/>
- Olson, S. (2013). Ben Goertzel is on a mission to build an “AI toddler”. *Next Big Future*. Retrieved August 18, 2016, from <http://www.nextbigfuture.com/2013/07/ben-goertzel-is-on-mission-to-build-ai.html>
- Rotman, D. (2015). Who will own the robots? *MIT Technology Review*. Retrieved August 18, 2016, from <https://www.technologyreview.com/s/538401/who-will-own-the-robots/>
- Rutkin, A. H. (2013). Report suggests nearly half of u.s. jobs are vulnerable to computerization. *MIT Technology Review*. Retrieved August 18, 2016, from <https://www.technologyreview.com/s/519241/report-suggests-nearly-half-of-us-jobs-are-vulnerable-to-computerization/>
- Schiller, B. (2015). A Universal basic income is the bipartisan solution to poverty we’ve been waiting for. *Co.Exist*. Retrieved August 18, 2016, from <http://www.fastcoexist.com/3040832/world-changing-ideas/a-universal-basic-income-is-the-bipartisan-solution-to-poverty-weve-bee>
- Stanford University. (2016). *Robotic nurses*. Retrieved August 18, 2016, from <https://cs.stanford.edu/people/eroberts/cs201/projects/2010-11/ComputersMakingDecisions/robotic-nurses/index.html>
- Stewart, H. (2015). Robot revolution: Rise of ‘thinking’ machines could exacerbate inequality. *The Guardian*. Retrieved August 18, 2016, from <https://www.theguardian.com/technology/2015/nov/05/robot-revolution-rise-machines-could-displace-third-of-uk-jobs>
- TechCast Global. (2016). AI and future jobs: estimates of employment for 2030. Retrieved August 18, 2016, from <https://www.techcastglobal.com/-/ai-and-future-jobs>
- The World Bank. (2016). Unemployment, total (% of total labor force) (modeled ILO estimate). Retrieved August 18, 2016, from <http://data.worldbank.org/indicator/SL.UEM.TOTL.ZS>
- Weisenthal, J. (2013). Here are the jobs that will survive the robot revolution. *Business Insider*. Retrieved August 18, 2016, from <http://www.businessinsider.com/middle-class-jobs-that-will-survive-the-robotics-revolution-2013-8>
- Wolchover, N. (2013). In computers we trust? *Quanta Magazine*. Retrieved August 18, 2016, from <https://www.quantamagazine.org/20130222-in-computers-we-trust/>

