

MIT

THE FUTURE



OF WORK

CAPITAL MARKETS, DIGITAL ASSETS,  
AND THE DISRUPTION OF LABOR

— EVENT REPORT —



MIT INITIATIVE ON THE DIGITAL ECONOMY

“Work is one way people share experiences, become part of a community, and feel fulfilled and purposeful.”

A number of MIT Sloan alumni were among the 350 attendees at the April 27, 2018 event in New York City.



**DAVID SCHMITTLEIN**  
John C. Head III,  
Dean, MIT Sloan  
School of  
Management

MIT

THE FUTURE  
OF WORK

03 / OVERVIEW 04 / WHAT CAN MACHINE LEARNING DO? 06 / THE IMPACT OF MACHINE LEARNING ON THE WORKFORCE  
08 / GOOD JOBS AND GIGS 10 / INTUITION, EXPERTISE, LEARNING, HUMANS, AND MACHINES  
12 / WHAT DOES THIS MEAN FOR FINANCIAL SERVICES? 15 / AN ECONOMIST'S VIEW OF TECHNOLOGY ON WALL STREET  
16 / THE BIASES OF HUMANS AND MACHINES 18 / THE TRUTH ABOUT FALSE NEWS  
20 / MIT INCLUSIVE INNOVATION SPOTLIGHT 21 / A DAY OF PARADOXES  
22 / FUTURE EVENTS 23 / THANKS + ACKNOWLEDGMENTS

## WHAT DOES THE FUTURE OF WORK HOLD?

The gig economy. The disruption of legacy companies. The rapid automation of tasks and processes. The advancement of artificial intelligence and machine learning.

These are just some of the ways that changes spawned by the Second Machine Age are dramatically upending the landscape of traditional jobs, industries, and business models. These advancements pose hard questions about what the future of work will look like 10, 20, or even 50 years from now.

How will automation augment or replace current jobs, and what is the particular outlook for the financial services sector?

On April 27, 2018, leaders from industry, academia, and public policy—along with more than 350 attendees—convened at The Times Center in New York City for *The Future of Work: 2018 Capital Markets, Digital Assets, and the Disruption of Labor*. The conference was hosted by the MIT Initiative on the Digital Economy (IDE) and MIT Sloan School of Management.

David Schmittlein, John C. Head III, Dean, MIT Sloan School of Management, opened the event by reminding attendees that it's up to us as a society to determine how we harness and use technological advancements to our advantage. “As human work is redefined,” he noted, “new structures will have to be created, not only with respect to technology, but also as a society, to fulfill those functions.”

Schmittlein also reminded attendees that the goal of the IDE is not only to be a source of new ideas, but to put ideas into action.



**Above** More than 350 thought leaders and curious minds came together at The Times Center in New York City for The Future of Work conference.

**Below** David Schmittlein welcomes attendees to the conference.



WATCH VIDEOS OF THE FUTURE OF WORK CONFERENCE  
[IDE.MIT.EDU/FUTUREOFWORK](http://IDE.MIT.EDU/FUTUREOFWORK)





MIT IDE Director Erik Brynjolfsson said the implications of ML for business are “staggering.”

## WHAT CAN MACHINE LEARNING DO?

**ERIK BRYNJOLFSSON**  
 Director, MIT IDE  
 Schussel Family Professor of Management Science

Artificial intelligence, or AI, is having a deep impact on society. “We are at the beginning of an even larger and more rapid technological transformation than in previous industrial revolutions because of advances in machine learning,” observed Erik Brynjolfsson, Director of the MIT Initiative on the Digital Economy, in his keynote address.

Machine learning (ML), a subset of AI, represents a fundamental change from the first wave of computerization by using neural networks to map tasks on their own. In the first wave, expert systems used massive, rule-based computers, but human software engineers had to codify knowledge into digital code. Today, in what we can consider the second wave, machines learn without explicit programming and we’re experiencing million-fold improvements. “We are crossing

thresholds in cognition, speech, and image recognition,” said Brynjolfsson. At the same time, there is a need to better understand how AI developments translate into business and economic value. As a general purpose technology, such as the steam engine or electricity, AI will spawn a plethora of additional innovations and capabilities over time. “We are not facing the imminent end of work, because there is still an enormous amount that only humans

can do,” he said. Nonetheless, the implications for the economy and the workforce going forward are profound. Brynjolfsson pointed to AI-based image recognition as one example of AI advancement. Just eight years ago, the best image recognition software was 70% accurate. Today, with neural networks, machines are better than humans in all visual recognition challenges. As a result, we may have to shift work to take advantage of these advancements.

### THE ECONOMIC GRAND CHALLENGE

# How can we create prosperity for the many, not just the few?

AI and other digital technologies continue to accelerate while skills, organizations, and institutions continue to lag.

*Business as usual won’t solve the problem.*

What do advances like these mean for business? The critical takeaway is that applications are on the rise, too. AI image readers scan pathology slides to detect disease patterns while cognitive tasks, such as estimating property values and appreciation rates, are performed by machines.

The implications for business are staggering, although it doesn’t mean all radiologists or real estate agents will disappear.

The extent of job displacement will depend on how well and how quickly machines can do specific tasks. To delve deeper, IDE researchers developed a rubric of what today’s ML systems can and cannot do. Although parts of many jobs may be what researchers term “suitable for ML,” tasks within these same jobs may not fit the criteria well. Therefore, ML effects on employment are more complex than the simple replacement and substitution story emphasized by some.

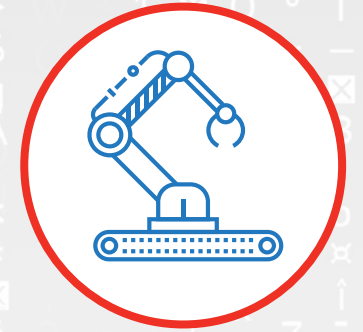
The IDE’s 23-question rubric shows interesting results for specific jobs: Truck drivers, for instance, do much more than drive, and massage therapists are

not likely to be replaced by robots any time soon, unlike their hotel concierge counterparts.

Surprisingly, suitability for ML is not correlated with wages, so pay level won’t determine which jobs can be automated or replaced. In sum, regional variations, types of ML, and subtle job distinctions will all drive how much human work a machine can do. The full effects of AI won’t be realized until waves of complementary innovations are developed and implemented.

More broadly, Brynjolfsson emphasized the need to bolster education, develop policies, and improve skill development, because organizations are lagging behind technology advances. That means, business-as-usual isn’t enough to integrate AI technologies.

We live in extremely paradoxical and contradictory times, he said. “Digital progress makes the economic pie bigger, but there’s no economic law that everyone, or even most people, will benefit,” said Brynjolfsson. “The grand challenge is to create prosperity for the many, not just the few.”



## THE SECOND WAVE OF THE SECOND MACHINE AGE MACHINES THAT LEARN

### ARTIFICIAL INTELLIGENCE

A set of techniques used to imitate human intelligence

### MACHINE LEARNING

Machines use large amounts of data to learn without explicit programming

### DEEP LEARNING

A type of machine learning that uses deep neural networks

## APPLICATIONS OF THE SECOND WAVE

### VISION + LANGUAGE

- Recognizing faces, real estate value, cancer cells
- Voice recognition

### INTERACTING WITH THE PHYSICAL WORLD

- Mobility
- Fine and gross motor control

### PROBLEM SOLVING

- Answering unstructured questions
- Pattern recognition classification



Panelists (from left) Hilary Mason, Claudia Perlich, and Michael Chui with moderator, Erik Brynjolfsson.

# THE IMPACT OF MACHINE LEARNING ON THE WORKFORCE

**ERIK BRYNJOLFSSON**  
 Director, MIT IDE  
 Schussel Family Professor  
 of Management Science

**MICHAEL CHUI**  
 Partner,  
 McKinsey Global Institute

**HILARY MASON**  
 Manager of Machine Learning,  
 Cloudera

**CLAUDIA PERLICH**  
 Senior Data Scientist,  
 Two Sigma

There have been remarkable breakthroughs in ML in recent years, matching or surpassing human-level performance. But experts agree that there's also misalignment between the advancement of technology and business outcomes. This panel explored the unique capabilities—and the many limitations—of humans and machines, and how employers can better prepare their workforce for the impact of AI and ML.

**\$3.5-\$5.8**  
 TRILLION

The aggregate annual economic value that could be driven by AI

**2055**

The year when 50% of jobs will be automated

**Erik Brynjolfsson:** What are you seeing in large companies as they start applying AI and ML?

**Hilary Mason:** There are amazing opportunities in AI right now thanks to huge data sets and domain knowledge, but they pose challenges, as well. Businesses are not set up to take full advantage of technology advancements; you need a robust understanding of the outcomes you want to achieve. Too many companies start off with AI only to save money and show profits; they're not usually creative about new product and revenue opportunities. You need to do both. If you constrain yourself only to ideas where you can prove ROI, you're missing out on many good ideas.

**Michael Chui:** While many people think of AI as legions of robo-workers, or HBO's *Westworld*, AI and ML are already at work in many mundane applications, performing fairly routine tasks. McKinsey researchers looked at 400 potential use cases—from airlines avoiding flight cancellations, to online retailers recommending purchases—across 19 industries. We project that in aggregate, AI could eventually drive between \$3.5 trillion and \$5.8 trillion of annual economic value in those industries. The vast majority of that potential is in increasing performance of existing applications—like sales and marketing—where analytics are already used.

I agree that tech adoption isn't accelerating at the same rate as technology advancement. McKinsey found that it can take eight to 28 years for business cases and adoption to be established and realized. We don't see the midpoint—where 50% of jobs are automated—until roughly the year 2055. Businesses have to decide how aggressive they will be with AI investments.

**Claudia Perlich:** When I was a data scientist in advertising there were lots of data and ML experimentation at scale. It's exciting to create new sets of applications that didn't exist before. We created billions of auctions that take place in 100 milliseconds every day to determine what ads customers will see. That's totally new and didn't replace any human jobs. At the same time, it can have unintended results, such as over-targeting people with advertising.

When AI works well, it disappears, and you stop noticing or thinking about it. However, it can be too easy to trust AI. When you have a probability of 73%, it is really random, and not that strong. People have to be educated about what it all means.

**Mason:** Most of us already use AI in search engines, navigation, and shopping, but apps still have a long way to go. Developers have the data and the capabilities, but we are just shifting intellectual labor around. We need better user interfaces, and a much better understanding of uses, too. We are still at the beginning of applied ML.

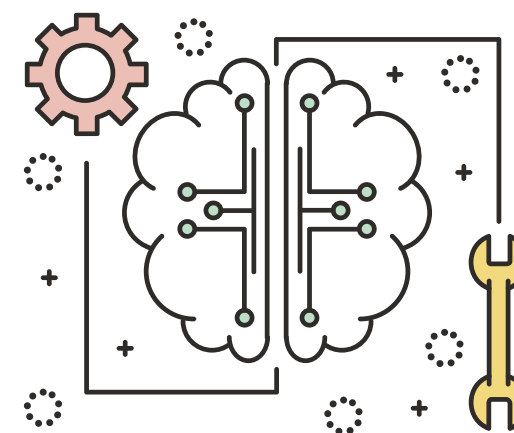
**Perlich:** We will see new players emerge as tools become more widespread. In a hospital, for instance, if you can predict risks of re-admission and prioritize those patients, you may actually add staff, save money, and improve care.

**Brynjolfsson:** Privacy is another moving target. In light of the Facebook testimony, and EU regulatory changes that will add restrictions to how data is used, AI may be hindered because it is so data-driven. We may need to make tradeoffs to have this layer of privacy protection. What are your views?

**Chui:** The General Data Protection Regulation (GDPR) requires explanations for certain types of data-based decisions—such as, why wasn't I hired, or why didn't I get that loan? Explainable AI guidelines are needed. Some large tech companies actually see compliance as a competitive advantage because they have the resources to comply, while a small startup does not.

**Mason:** Privacy should be a design concern in the construction of all systems. Guidelines are needed, but the cost of compliance is very high and the benefits to individuals aren't entirely clear; there are still unresolved issues about who owns every piece of data.

**Chui:** On the issue of training the future workforce, we don't have to worry about mass unemployment, as much as mass redeployment. HR investments are declining at both public and private organizations. As much as we complain about K-12 education, public spending exceeds private-sector investments. We are taxing labor and subsidizing capital.







“The gig economy today is not a choice of wanting to be a 1099 worker. It’s work on top of other employment.”



FRED GOFF

## GOOD JOBS AND GIGS

**ANDREW MCAFEE**

Co-Director, MIT IDE  
Senior Research Scientist, MIT Sloan School of Management

**LAVEA BRACHMAN**

Vice President of Programs,  
Ralph C. Wilson Jr. Foundation

**SARA HOROWITZ**

Founder Emeritus,  
Freelancers Union

**FRED GOFF**

CEO,  
Jobcase

Like it or not, we are hurtling into the on-demand, or gig, economy. Flexible, internet-driven jobs have shown tremendous growth, though they are still a relatively small part of the economy. What’s next? This panel focused on practical ways that employers and workers can navigate and prepare for the new world of work.

**Andrew McAfee:** The old-fashioned, stable, 40-hour-week, career-long, W-2-type employment—while not a thing of the past—is a decreasing share of Americans’ work lives. And we can’t bring it back. However, if we handle our Second Machine Age economy correctly, it can be a better economy, not just for the Silicon Valley capitalists and entrepreneurs, but for working Americans all over the country, as well. Help us understand what you’re seeing.

**Lavea Brachman:** Our perspective is on the workforce and workforce training, primarily in Southeast Michigan and Western New York. Those regions have been in economic transition for decades, and when you overlay the changes in technology, you start to see some really interesting changes. The recovery seems to be real this time. Yet, there’s still a much lower labor force participation rate than in other parts of the country, and that’s very disturbing.

Traditional, straight-ladder career paths have been replaced by something that we’ve termed rock climbing; where workers have to move adeptly from place to place. If people are going to keep up with twenty-first century jobs, not only do they need career training, they also need to learn problem solving, team building, and strategic thinking. We’re looking for training programs that marry the two.

**Fred Goff:** We have 84 million registered U.S. members on the Jobcase platform, and every day two million are on the site talking about their lives. For instance, a cashier may say, “I was recruited for medical billing because I’ve been entering numbers.” Or a hairdresser may be looking to start a new business. People are moving around more quickly, starting over all the time. According to the Department

of Labor, the average 25-year-old has already had seven jobs.

We see massive anxiety. We keep hearing about full employment; are you kidding me? Nearly half (47%) of households do not have enough savings to cover an unexpected \$400 expense. The gig economy today is not a choice of wanting to be a 1099 worker; it’s work on top of other employment. In a survey of our members, only 27% thought they were fairly paid. That’s why 40% were planning to take two or more jobs to try to make ends meet.

**Sara Horowitz:** There is anxiety among freelancers, too. The labor and employment laws in place since the New Deal and the Great Society are in tatters, but they still exist. We know that we need a safety net, but the transition hasn’t happened yet. We have to say, “This next safety net is going to be profoundly different.”

Hyper-individualism can be worse for people than any problems of AI and technology. The antidotes are human connections and significant funding for re-training. Workforce training is completely broken. Funding is just not there.

**Brachman:** The government-sanctioned pieces of training are pretty broken and fragmented, but there are many federal and state training programs that can be fixed. What’s required is a new dynamic between employers and employees, and among employers, colleges, and the private sector.

In Detroit, there are opportunities for employers to talk with community colleges to fill jobs, and some are starting to work with the UAW and others to ask, how do we solve this together?

We’re up against the global economy, and we’re all going to lose unless we find new ways to collaborate.

15%

of jobs in the U.S. are middle-skill and middle-wage

7

number of jobs the average 25-year-old has held

47%

of U.S. households that do not have enough savings to cover an unexpected \$400 expense



*Right* Lavea Brachman said that straight-ladder career paths have been replaced by “rock climbing” from place to place.



**Above** Nobel Laureate Daniel Kahneman joined us for a fireside chat with Erik Brynjolfsson about machine-based decision-making and the intersection of humans and AI.

**Below** Kahneman shared some of his concerns about the impact of AI and what the spread of new digital goods and AI services mean for human happiness in the future.



## INTUITION, EXPERTISE, LEARNING, HUMANS AND MACHINES

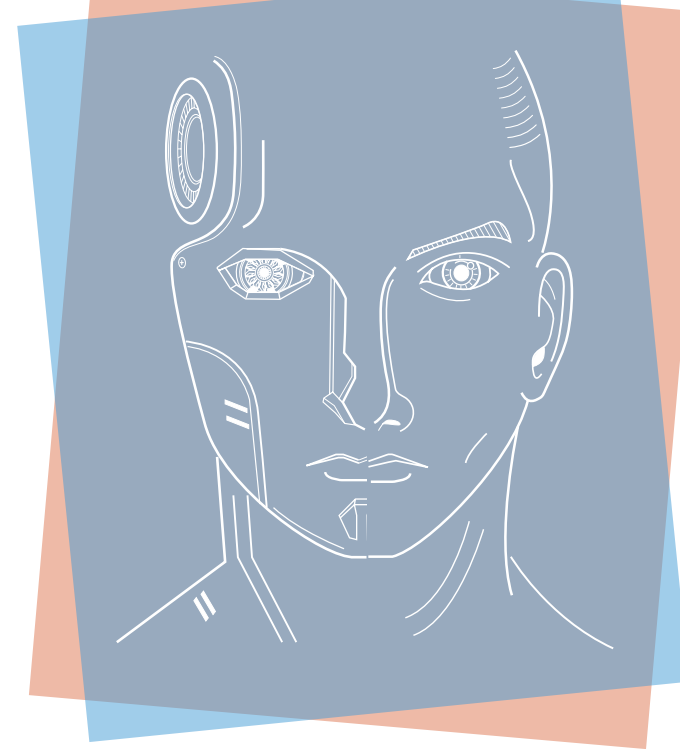
### ERIK BRYNJOLFSSON

Director, MIT IDE  
Schussel Family Professor of  
Management Science

### DANIEL KAHNEMAN

Professor Emeritus, Princeton  
Nobel Laureate

Professor Daniel Kahneman received a Nobel Prize for his work on the psychology of judgment and decision-making, as well as behavioral economics. In this age of human/machine collaboration and shared learning, IDE Director Erik Brynjolfsson asked Kahneman about the perils and the potential of machine-based decision-making.



“You can combine humans and machines, provided the machine has the last word.”



DANIEL KAHNEMAN

**Erik Brynjolfsson:** We heard today about algorithmic bias and about human biases. You are one of the world’s experts on human biases, and you’re writing a new book on the topic. What are the bigger risks: human or algorithmic biases?

**Daniel Kahneman:** It’s pretty obvious that it would be human biases, because you can trace and analyze algorithms.

In the example of sexist hiring, if you use a system that is predictively accurate, you are going to penalize women because in fact, they are penalized by the organization. The problem is really not the selection, it’s the organization. So something has to be done to make the organization less sexist. And then, as part of doing that, you would want to train your algorithm. But you certainly wouldn’t want just to train the algorithm and keep the organization as it is.

**Brynjolfsson:** Your new book, *Noise*, is about the different kinds of mistakes that people can make that are different than biases. Help us understand that a little bit.

**Kahneman:** At an insurance company, we measured what is technically called noise, and we did that in the following

way: We constructed a series of six completely realistic cases that were given to 50 underwriters. We wanted to determine how much variability there was in their funding decisions. We expected differences between 10% and 15%, but in fact, they disagreed about 56% of the time. That’s a lot of noise.

In many occupations a single person makes decisions on behalf of the organization, like a triage nurse in the emergency room. And if you have a lot of noise, it sets a ceiling about how accurate you can be. So noise is a mistake. You can measure noise more easily than bias. An algorithm could really do better than humans, because it filters out noise. If you present an algorithm the same problem twice, you’ll get the same output. That’s just not true of people.

You can combine humans and machines, provided the machine has the last word! Humans have a lot of valuable inputs. They have impressions, they have judgments. But humans are not very good at integrating information in a reliable and robust way. And that’s what algorithms are designed to do.

**Brynjolfsson:** How will AI change social science?

**Kahneman:** I have big worries about algorithms, but biases are not the main one. I’m more concerned about what AI will do to people, and whether they will create superfluous people, and whether it will destroy good jobs, and so on.

My guess is that AI is very, very good at decoding human interactions and human expressions. If you imagine a robot that sees you at home, and sees things over time; that robot will be learning. But what robots learn is learned by all, like self-driving cars. It’s not the experience of the single, individual self-driving car. So the accumulation of emotional intelligence will be very rapid once we start to have that kind of robot.

It’s really interesting to think about whether people are happier than they were. The question to consider about well-being and about providing various goods to people, is whether they’re going to get used to having those goods, and whether they will continue to enjoy those goods. It’s not apparent how valuable these things are, and it will be interesting to see how this changes in the future.





Bank of America CEO Brian Moynihan describes how new digital services are enhancing the consumer experience.

## WHAT DOES THIS MEAN FOR FINANCIAL SERVICES?

**CATHINKA WAHLSTROM**  
Senior Managing Director  
Accenture

**BRIAN MOYNIHAN**  
Chairman and CEO  
Bank of America

**ADENA FRIEDMAN**  
President and CEO  
Nasdaq

**GARY GENSLER**  
Senior Lecturer, MIT Sloan  
Senior Advisor to the Director  
of MIT Media Lab

The financial services sector is no stranger to leading-edge technology development, but to what extent will machines replace advisors, traders, analysts, and exchanges? In a highly regulated industry, what are the ethical and privacy implications of cryptocurrencies and digital markets? This panel of executives and experts offered a deep dive into how investors are accessing new tools to manage capital, conduct financial transactions, and optimize markets. Here are some excerpts of their conversation.

**Cathinka Wahlstrom:** Our focus is on four areas of AI and financial services: business growth and opportunities; client experience; workforce impact, and social impact. Let's start with the business opportunities that all these new technologies bring.

**Brian Moynihan:** We have a new voice-activated tool called Erica that is part of our mobile banking platform, and it's AI-driven, too. It is allowing people to speak what they want, and see immediate results. Think about how much easier that is for the customer.

We just launched an all-digital mortgage product for existing customers where we can pre-populate forms and save about 80% of the paperwork. On the auto side, customers can shop for cars from 2,000 dealers on our site, find a car, and while they're doing that we're underwriting the auto loan so they are already financed. It all happens digitally.

**Wahlstrom:** We understand that Blockchain can bring incredible efficiencies to capital markets, but it still feels kind of new. Tell us a bit about applications for Blockchain right now, and things that you're thinking about in the near future.

**Adena Friedman:** The Blockchain was uncovered through the creation of cryptocurrencies, but the underlying technology has many other applications and potential. The long-term promise of the Blockchain is creating much more efficiency in capital markets in terms of time-to-settlement. You can take capital out of the system and apply it back into markets to create more liquidity, as opposed to having it captured inside clearing houses, where it can't be used.

**Gary Gensler:** Blockchain is very much in the early stages, and the biggest changes will come in 10 or 15 years from now. Meanwhile, there is a \$400 billion market-capitalized business called crypto, and one exchange, Coinbase, has 13 million customers here in the U.S. Unfortunately, there's a

lot of activity that's illicit and ill-gotten, and there's market manipulation. It needs some public policy framework, but I think that will happen.

**Wahlstrom:** How do you view the impact of AI on the workforce--more evolutionary, as when ATMs or electronic trading were introduced, or more revolutionary?

**Gensler:** It's a bit of both. Large financial institutions will be around for quite some time, and customers still want human advice at some point. Back-office workers, however, will see jobs displaced by machines more quickly.

**Friedman:** There's definitely going to be a shift in the skill base in the financial industry. We have a growing workforce, not a shrinking one, especially for technology programmers and engineers. There may also be more blending of humans and machines in terms of formulating trading and investing strategies.

I do agree that on the back-office side, and on some really repetitive tasks, automation makes sense. But there's still this issue of creativity and judgment—and that's the domain of human brains for many years, hopefully, many decades—to come.

**Gensler:** The financial services sector is about 7% of our economy, but it's not 7% of the workforce. It's already highly automated and is becoming more efficient. The pace of change is picking up, however, and ultimately it will enhance the client experience. Automation and AI will probably mean fewer jobs of all types, long term.

**Moynihan:** We're seeing massive changes in what people do, and that will continue for a good while. BoA's investment in technology development is \$3 billion a year, that's probably doubled over the past six, eight, 10 years. So, we've got to train people to be ready to do those jobs.

I never use the term "robot advisor." It doesn't do justice to the sophistication of the team. But they use automated tools for consistent investment accounting and advice. There's still tremendous value in having a human use a tool with the client. The Emotional Quotient that's required to help somebody plan their legacy or their future, or what's really important to them, is very hard to get with a machine.

**Friedman:** Nasdaq has always been a technology company, so we're not suddenly shifting into something vastly different. When we do bring in technologies like Blockchain and machine intelligence, it's a combination of new talent and retraining existing technology talent. *(continued next page)*

30%

of Bank of America customers use digital services

7%

of U.S. economy comprised of financial services

\$3B

annual technology investment at Bank of America





Cathinka Wahlstrom moderates a panel of experts on AI in financial services.

**Gensler:** Universities are part of the solution, and we've done well, but never well enough, in reskilling the labor force. University education, on-campus or through MOOCs, are important, but it's the broader role of society to invest in education, retraining, and ensuring a fluid labor force.

**Moynihan:** Training is a big question. At Bank of America, we retrain developers on new tools. It takes six months, and it's worth the investment. On a broader scale, it's very difficult to

figure out this continuum from middle school education to meeting the needs of high-level manufacturing. We're trying to align our needs to education so we can get the skills we need. It would be great to say, "You train these people and we'll guarantee them a job." That's what companies need to do to help make this transition happen.

**Friedman:** There's an enormous amount of change going on. A lot of business models are being disrupted. Yet, it's an incredibly exciting time to be in the financial services industry

because of the power of technology and what it can do to unlock opportunity for investors. It's important for us to use technology to create a better client experience, to give people more tools, to be smarter in how we evaluate mortgage holders or other things, and open up opportunity for people to get access to credit. We also have to make sure we have the right protective layer in place and that we're using technology to protect the markets as much as we're using it to drive the markets forward.

“There’s definitely going to be a shift in the skill base in the financial industry.”



ADENA FRIEDMAN



Evercore Founder and Chairman Edward Hyman explains his informal economic survey methodology.

Wall Street may have lightning-fast computers and complex algorithms to help predict economic trends, but for Edward Hyman, the personal touch remains crucial to his competitive edge.

## AN ECONOMIST'S VIEW OF TECHNOLOGY ON WALL STREET

**ANDREW MCAFEE**  
Co-Director, MIT IDE  
Senior Research Scientist,  
MIT Sloan School of Management

**EDWARD S. HYMAN**  
Chairman, Evercore ISI



Andrew McAfee interviews Ed Hyman on his view of the economy and investment opportunities.

Edward Hyman, chairman of Evercore ISI and head of its economic research team, is considered one of the top economic prognosticators on Wall Street. *Institutional Investor's* annual poll has ranked him number-one for economics for 37 of the last 42 years. Hyman insists the basic job of predicting the economic future for investors hasn't changed over the years.

"I'm trying to help them figure out what's going on now, and what might be the most likely path for the next few weeks, the next few months, and into the next few years," Hyman told MIT's Andrew McAfee during a fireside chat.

Hyman's approach is what he considers bottom-up: Communicating with businesses to learn what's happening on the ground. Hyman takes the pulse of 350 companies on his watch list on a weekly basis. The informal survey is tightly focused. Evercore calls each of those companies, always asking the same person the same question: "How is your business this week compared to what you expected?"

Hyman told McAfee that these personal surveys by themselves have "absolutely no predictive power," but collectively, they allow him to see economic trends that everyone else is missing. He's convinced, for example, the U.S. economy is already growing at 3.5%—far faster than anyone else is predicting—and that this pace will be sustained going forward in what he calls "the Great Expansion," in contrast to the Great Recession of a few years ago.

This faster pace of growth is one reason to be optimistic about productivity, Hyman said. Slumping productivity has troubled economists and policy makers, who say it makes it harder to spread the benefits of new technology—and higher incomes—to all parts of the workforce.

Based on his surveys, Hyman believes we're turning the corner. In his view, companies will have to invest in more advanced technology. He acknowledged this will automate more jobs, but will also mark 2018 as a turnaround year for productivity.



# THE BIASES OF HUMANS AND MACHINES

## RENÉE RICHARDSON GOSLINE

Senior Lecturer, Research Scientist, MIT IDE and Sloan School of Management

## ARIANNA HUFFINGTON

Founder, *The Huffington Post*  
Founder and CEO, Thrive Global

## STEPHANIE LAMPKIN

Founder and CEO, Blendoor

## CATHY O'NEIL

CEO, O'Neil Risk Consulting & Algorithmic Auditing (ORCAA)



Renée Richardson Gosline asks panelists about the implications of algorithm bias.

Technology is a great enabler for news, social media, and personalization of services. While ML technology offers an opportunity to remove bias, automated segmentation algorithms also have the potential to exacerbate the problem, especially in areas such as hiring and financial decision-making, including loans and credit. This panel tackled the thorny issues around individual and collective responsibility for addressing the risks of algorithmic bias and raising awareness.

**Renée Richardson Gosline:** I'd love to start the conversation thinking about how algorithms impact us every day. How do you see them affecting our lives and becoming even more ubiquitous?

**Cathy O'Neil:** About five years ago I started to realize that every industry was using formulas to determine the winners and losers—and those labels were staying with us for life. For instance, insurance companies and credit card companies have used them for a long time. But now, teachers are getting assessed on their

performance, students are ranked for loans, and others are getting or keeping jobs, all based on formulaic scores. People didn't know they were being ranked, and they didn't know if their score was correct. Furthermore, there's no appeal system if it is incorrect.

**Gosline:** So people are being branded, if you will, in this way and they don't know it, nor do they have any recourse to say, "Hey, hang on. This doesn't really represent me." What are the implications for us as a society and for humanity?

**Arianna Huffington:** These are key questions, not from an anti-tech perspective—we are all here celebrating technology—but we are waking up to the fact that advances in technology are not all universally good. There is nothing wrong with AI ultimately being more intelligent than we are, but we are not becoming any wiser or more empathetic in the process, and these are the uniquely human characteristics that technology and AI don't have.

If we don't advance these characteristics at the same time

"We need to learn to set boundaries on our relationship with our technology."



ARIANNA HUFFINGTON

that AI is advancing in intelligence, then there is a real problem. We need to learn to set boundaries on our relationship with our technology. Algorithms can have a tremendous impact on our life, but we have a lot more control than we are exercising right now. At Thrive, we want to give you tools to use that power.

**Gosline:** When I think about algorithms and their predictive power, and how they look at individual cases—whether we should fund someone's desire to buy a home, or whether we should insure someone—I think about myself and others who were able to achieve things despite standard profiles.

**O'Neil:** As a data scientist, part of the reason that it was so disturbing to see this winners-from-losers separation was that it's arbitrary profiling. And it has a cumulative effect on society—whether we're applying to college, applying for jobs, applying for loans—they're not just *predicting*, but *creating* our future. That's really, really important. And the people who build that algorithm are choosing what success looks like.

**Stephanie Lampkin:** There are archetypes of success, and the engineers who are building these algorithmic solutions are building them so that those archetypes bubble to the top. They neglect people like you and me because oftentimes those engineers haven't met people like you and me, and we aren't in the room. Why do we know that a Stanford grad in computer science will be good for this role, on this team?

Have you tested that? Surprisingly, in an industry so driven by data and metrics, there isn't sufficient analytics.

At Blendoor, we are working to mitigate unconscious bias in hiring by tracking how far different demographics make it into your search. We also publish a corporate equality, diversity, and inclusion index every year measuring different ways in which you could be representing inclusion and equity. We have ways of showing companies their own bias in a credit-score format. We hope that accountability will drive better behavior before lawsuits do.



Cathy O'Neil suggests the creation of an FDA-like organization to monitor and test algorithms to prevent biased machine-based decision-making.

**Huffington:** We all have our stories. When I was a Greek immigrant living in London, I had a book rejected by 37 publishers, and I was ready to give up on being a writer because I had run out of money. Then, somebody made me walk in and see the bank manager, and he gave me the loan. There is no algorithm in the universe that would have given

me that loan; that loan changed my life. What we're talking about is how do we retain that humanity in our algorithmic interactions and in our human interactions?

**Gosline:** Can we take something that is often perceived as esoteric—namely, algorithms and all of these mathematical numbers—and talk about them in a way that inspires people to care and make changes happen?

**O'Neil:** Algorithms are powerful and they generate profits, but they need improvements. We should actually test our algorithms. We know that there is bias in the data; it's not intentional, but the algorithms are inherently backward-looking, and if our history has problematic practices, and we use the algorithms to create the future just like the past, we will be propagating those problems. It's not impossible to change things, but we also need something like an FDA to monitor algorithms.

**Lampkin:** I actually propose less of an FDA model and more of a lead-certification model. If you are a company purchasing software from a third-party vendor, it would be good to know that the software has been tested so it doesn't negatively affect certain groups disproportionately. That should be part of the brand of that company and that vendor.

**Huffington:** I'm optimistic that smart companies want to do well and satisfy customers, and smart people within these companies will optimize for long-term profit. Faced with government regulations of business tools, it's actually much better to make changes yourself.



# THE TRUTH ABOUT FALSE NEWS

**SINAN ARAL**  
 David Austin Professor of Management  
 Professor, Information Technology and Marketing  
 Research Co-lead, MIT IDE

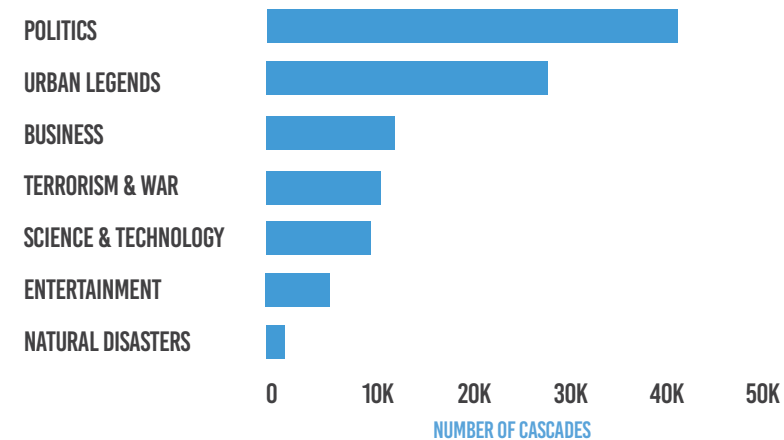
Social media is caught in a web of false news. Barely a day goes by without a new development questioning the veracity of social media, foreign meddling in U.S. elections, or dubious science. But what's really going on? Sinan Aral, co-lead of the MIT Initiative on the Digital Economy, offered some truths about false news based on his new research study.

The spread of false news and its impact is at the forefront of our collective unconscious, especially, in the last several months. We worry that it can drive the misallocation of resources during terror attacks and natural disasters, the misalignment of business investments, and it can misinform elections. If false information is seeping into the data that those algorithms are analyzing, it could create systematic biases in the decisions.

“False news spreads more quickly than the truth because humans, not robots, are more likely to spread it.”



## CATEGORIES OF FALSE NEWS



Our research, the largest-ever longitudinal study of the spread of false news online, published in *Science* on March 8, 2018, sheds new light on these trends, and affirms that false news spreads more pervasively online than the truth.

The data comprise approximately 126,000 stories tweeted by about

3 million people over 4.5 million times. We found that false news travels farther, faster, deeper, and more broadly than the truth online in all categories. The effects were more pronounced for false political news than for false news about terrorism, natural disasters, science, urban legends, or financial information.

## FALSE NEWS FIXES

How can we potentially solve the false news dilemma? There are several ideas worth considering, yet each has complex ramifications.

### LABELING

When you go to the grocery store, food is extensively labeled. But when you're consuming news, you don't know how often this news source produces true or false information; or how many independent sources this organization requires before journalists are allowed to publish.

### REGULATION

How do we think about regulation in a way that's not overbearing and that's not going to kill innovation, but could potentially help stem the spread of falsity?

### MACHINE INTELLIGENCE

Can we train algorithms to recognize falsity, and can we build that into the platforms on which falsity is spreading? Who do we trust to be the arbiter of truth and falsity in society?

And there is another new arms race unfolding, too: Bad actors are creating false audio and video, and it's not clear who's going to win. The falsity of tomorrow may be even scarier than today. Solutions will take time, and we need to remain very vigilant.

Contrary to conventional wisdom, we found that false news spreads more quickly than the truth because humans, not robots, are more likely to spread it. Moreover, falsehoods were 75% more likely to be retweeted than the truth, even when controlling for age, activity level, and number of followers of the original tweeter.





IDE Assistant Director Susan Young interviews Tala CEO Shivani Siroya about her focus on providing access to capital to the underserved in the developing world.

## MIT INCLUSIVE INNOVATION SPOTLIGHT

### SUSAN YOUNG

Assistant Director, MIT IDE  
Producer, MIT Inclusive  
Innovation Challenge

### SHIVANI SIROYA

CEO, Tala

No comprehensive discussion of the Future of Work can overlook the global implications of technology automation. As many speakers noted, economic inequalities are growing as workers are displaced and unprepared for the new skills required today. The Inclusive Innovation Challenge (IIC) seeks out solutions that close the gap.

For the past two years, the IIC has awarded a total of \$2 million to 40 organizations engaged in skills development, opportunity matching, technology access, job creation, income growth, and increasing financial inclusion. Susan Young of the IDE spoke with one of last year's winners, Shivani Siroya, CEO, at Tala, about its targeted approach to financial inclusion for underserved populations.

**Susan Young:** You see the lack of access to credit and financial services as a data problem, and your solution uses non-traditional mobile data signals to create financial identities. How did you get started?

**Shivani Siroya:** I started by understanding the stories of people—that's the basis behind everything we do. We wanted to understand the effect of the loan in terms of progressing out of poverty. I ended up traveling across nine countries and interviewing a little over 3,500 people.

Meeting them and seeing their lives first-hand allowed me to intuitively start underwriting loans without all the traditional data. I realized that a lot of data is behavioral information that you can gather through your interactions with a customer, through any medium, to validate a loan.

**Young:** How do you design for a customer that is new to financial services like credit, or is new to smartphones in general?

**Siroya:** The three basic categories of credit scoring are identity verification, understanding a customer's capacity, and understanding their likelihood to repay.

You have to make it incredibly simple. In a seamless way, we're showing them the permissions, category by category, and what it is that we're asking for and why. About 85% of our customers go through the loan application in under two minutes.

Rather than asking 50 questions at once, we want to understand "are you fraudulent? Can we verify your identity?" From there, can we assess your initial risk. Then we start to think about what products are best suited for you.

**Young:** How many loans have you provided?

**Siroya:** We have more than 1.3 million customers on the platform. In the last three years, we've disbursed over 6.5 million loans. Only about 31% of the adult population worldwide is actually in a credit bureau. There are billions of people without credit scores or access to formal financial services.

The challenge is that if you don't also educate the customer on their identity and what it can be used for, you're not really enabling them. Our mission is about financial choice and control. The IIC has really helped us get the message out.

## A DAY OF PARADOXES

### ANDREW MCAFEE

Co-Director, MIT IDE  
Senior Research Scientist,  
MIT Sloan School of Management



Andrew McAfee noted the mix of optimism and concern expressed by speakers.

Behemoth financial services companies like Nasdaq and Bank of America have more in common with Tala, a microfinance lender to underserved populations, than it may seem. Similarly, a group of young, highly trained data scientists owe their nascent AI methodologies to the long-honed intuitions of financial investors and social scientists.

Perhaps the thread tying together the very diverse organizations and perspectives at the 2018 MIT Future of Work event was a shared optimism, and also shared concern about financial markets and labor. Practitioners are excited about AI and the potential of ML, the Blockchain, voice and image recognition, and new consumer services. But they're also mindful of the unintended impacts of these technologies.

They are equally passionate and outspoken about the anxiety of today's workforce over jobs, wages, and automation. As economists, business leaders, and technologists, they are looking carefully at the bad actors emerging on the cryptocurrency frontier, the biases—both human and machine—that are rampant in our algorithms, and the dangerous rise of false news fed by social media. They want organizations and education to catch up to the rapid-fire tech advances taking place.

Their optimism lies in the conversations taking place, as Arianna Huffington noted. Creative minds at Tala, Blendoor, and Jobcase—among others—are working hard to achieve Inclusive Innovation and level playing fields. Determined efforts can correct the inequalities of the Second Machine Age, just as they are exploiting the opportunities.



### THE GOOD NEWS

- 1 AI and ML are fueling tremendous innovations
- 2 Humans still outperform machines at many tasks and occupations
- 3 Blockchain and cryptocurrencies have broad financial applications
- 4 Human empathy and wisdom can't yet be replicated by machines
- 5 Inclusive innovators are bridging the digital divide



### THE BAD NEWS

- 1 Large sections of the workforce are experiencing anxiety; wages and productivity are lagging
- 2 Crypto-frontiers are fertile ground for bad actors
- 3 Human and machine-learning biases are rampant
- 4 False news is spreading online farther and faster than the truth
- 5 Society is becoming isolated and addicted to mobile devices
- 6 Education, organizational adoption, and policy are lagging behind technology advances



**BE PART OF THE 2018 INCLUSIVE INNOVATION CHALLENGE GLOBAL GRAND PRIZE GALA AND FUTURE OF WORK CONGRESS AT MIT!**

The Inclusive Innovation Challenge (IIC) is the flagship initiative of the MIT Initiative on the Digital Economy (IDE). The IIC awards more than \$1.5 million in prizes each year to global entrepreneurs who are using technology to reinvent the future of work and create greater economic opportunity in the Second Machine Age.

In 2018, we launched our biggest Challenge yet: a global tournament with 20 winners in Africa, Asia, Europe, Latin America, and North America.

On November 8, the IIC will culminate with a Global Grand Prize Gala, a banquet dinner and awards show, where all 20 IIC Finalists will vie for four \$250,000 Global Grand Prizes. Featuring pitches from the Finalists, a Champion Committee of judges, and an audience of leading experts, the event celebrates the solutions that are reinventing the future of work today.

The Global Grand Prize Gala will conclude the 2018 Future of Work Congress, hosted by the IDE and MIT's Computer Science and Artificial Intelligence Lab. Featuring high-profile keynotes, panel discussions of experts, and outcome-focused workshops, this second annual event will explore the opportunities and challenges in the Future of Work.



**MIT IIC GLOBAL GRAND PRIZE GALA AND FUTURE OF WORK CONGRESS**

**MIT KRESGE AUDITORIUM & SAMBERG CONFERENCE CENTER, CAMBRIDGE, MA**

**NOVEMBER 8, 2018**

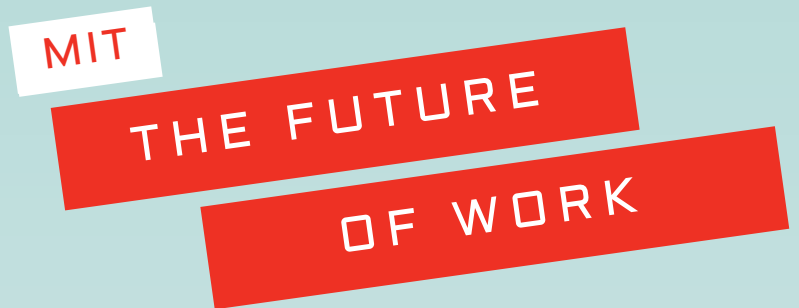
**CONGRESS: 8A-5P**

**GALA: 6:30P-8:30P**

**FOR MORE INFO:**

**IDE.MIT.EDU**

**MITINCLUSIVEINNOVATION.COM**



The MIT Initiative on the Digital Economy (IDE) thanks our sponsors and donors for enabling our research and supporting events like The Future of Work.

The IDE is also indebted to the MIT Sloan School of Management and the Sloan Alumni Association for co-hosting this event.

We are grateful to the speakers who gave their time to help us better understand the unique challenges faced by private and public organizations as they seek to adapt to their rapidly changing environments.



**CORPORATE MEMBERS**

- Accenture *Founding Member*
- 3M
- AI in Gov
- Amazon.com
- Boston Globe
- Capgemini Consulting
- Dell EMC
- Deloitte Digital
- Deutsche Bank
- EMD Serono
- Futurewei
- ING Group
- IRC4HR
- ISN
- MassMutual
- Merck & Co.
- Microsoft
- Northwestern Mutual
- Nomura Research Institute
- Philips Lighting
- Prudential Financial
- SAS
- Schindler Group
- Schneider Electric
- Suruga Bank
- TDF Ventures
- WeChat

**FOUNDATIONS**

- Ford Foundation
- Google.org
- Joyce Foundation
- NASDAQ Foundation
- Rockefeller Foundation
- Ralph C. Wilson, Jr. Foundation
- TDF Foundation

**GIFTS**

- Brad Feld and Amy Batchelor
- Steven A. Denning
- Joseph Eastin
- Ellen and Bruce Herzfelder
- Gustavo Marini
- David Morgenthaler
- Joel Andrew Ornstein
- Gustavo Pierini
- Eric and Wendy Schmidt
- Jeff and Leisl Wilke

And other individuals who prefer to remain anonymous.



MIT

THE FUTURE

OF WORK

CAPITAL MARKETS, DIGITAL ASSETS,  
AND THE DISRUPTION OF LABOR



MIT INITIATIVE ON THE DIGITAL ECONOMY



MIT Sloan School of Management  
245 First Street, Floor 15, Cambridge, MA 02142-1347

[ide.mit.edu](http://ide.mit.edu) @MIT\_IDE

**EDITORIAL + DESIGN**

Christie Ko  
Paula Klein  
Timothy Aepfel  
Shawneric Hachey  
Shannon Farrelly

**PHOTOGRAPHY**

Samuel Stuart Hollenshead

**MIT** MANAGEMENT  
SLOAN SCHOOL

