

TECHONOMY



Man, Machines and the Network
A World Where People and Computing Converge

When technology unlocks potential, brilliant ideas come to life.

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Strategy | Consulting | Digital | Technology | Operations

The logo for Accenture Technology, featuring a green chevron pointing right above the word "accenture" in white and "technology" in green.

Techonomy's Community: Central to Our Mission

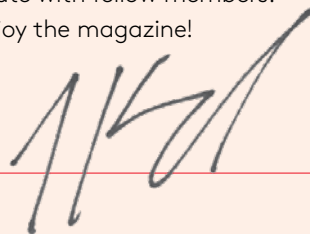
A lot has changed in the seven years since we started Techonomy. Global access to the internet has nearly doubled, and companies like Airbnb and Uber have matured from unknown start-ups into universal examples of how any industry can be transformed. We started saying "every company is a technology company" all the way back in 2011. Now that idea has become familiar, though acting accordingly is not easy. So our mission is more relevant than ever: helping leaders gain a better grasp of how technology impacts business and society.

Even as the underlying building blocks of modern tech – cloud, social, mobile, and big data – continue to evolve, they have given birth to key new tools including artificial intelligence, the blockchain, the Internet of Things, and augmented and virtual reality. The impact, separately and together, will be vast and unsettling. Business executives and government officials not only need to understand these trends. They also have to vigorously explore the potential effects on economic and social progress. Leaders no longer have the luxury of relegating this responsibility to designated geeks. To be effective you must be fluent in this new global language.

Through events and content, Techonomy strives to be the foremost resource for presenting and exchanging ideas that help us all along this journey. Our community is an integral part of everything we do. We rely on you for new ideas, as partners in exploration, and to help us evangelize this critical mission. Even the magazine in your hands (or on your screen) would not be possible if not for our community's passion and commitment. You don't just consume the content. You contribute to the conference sessions we excerpt, participate in our polls (see page 50), and write many of the articles in these pages.

We have learned a lot in these seven years, specifically about how we can further embrace and integrate this community, to deliver even more value and help us all learn and adapt faster. In 2017 we will offer members more opportunities to come together, both in the physical and virtual domains. We will host more facilitated dialogues around the world, produce more exclusive content, and provide new opportunities to collaborate with fellow members.

I hope you will join us on the journey. Enjoy the magazine!



JOSH KAMPEL
President, Techonomy

Entrepreneur and philanthropist Sean Parker expounded for over an hour after dinner at Techonomy 2015, about medicine, politics, and Facebook, where he played a central role in the early days.



Techonomy Magazine 2017



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The Fin-ternet of Things

Connecting everything will require a new approach to money.

by Jennifer Schenker

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HTC's high-end Vive virtual reality headset ▶





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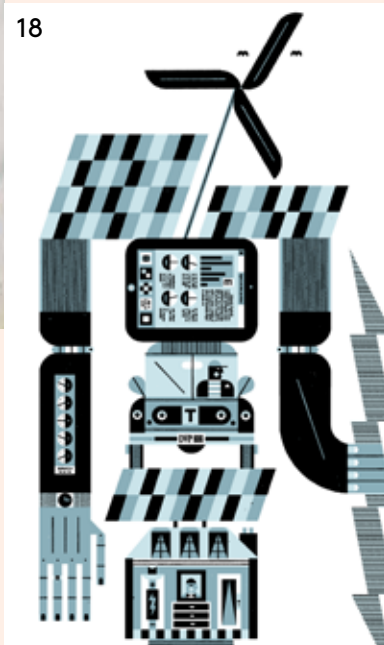
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Artificial Intelligence Will Change the Face of Business

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By Paul Daugherty

▼
Publication Design
by Rob Hewitt

Cover Illustration
by Jeffrey Decoster

From the Chief Techonomist

Techonomy is all about ideas, especially ideas about how technology offers new tools to transform and improve the world. We see a planet in dire need of progress, but also innumerable ways that tech can be better leveraged by leaders in all fields, and by anyone, to help humankind move forward.

The magazine you have in your hands is something akin to a printed version of the live program at one of our events. Its topics range widely, from how companies can better hire and retain star programmers to how we can all fulfill the idealistic vision that animated the early years of the Web. You'll learn about the blockchain, about how virtual reality is evolving, and hear of a cool Brooklyn incubator called Eyebeam where both tech companies and art are born. Our star genomics writer Meredith Salisbury explains the vexing complexity of public attitudes towards genetic modification.

Several stories explore the importance of the Internet of Things (IoT). Veteran tech journalist Jennifer Schenker explains its many ramifications in finance and banking. You'll read that IoT has a growing role in wine production. And I contribute a piece, co-written with Diane Regas, executive director of the Environmental Defense Fund, about how critical IoT will be in fighting climate change.

We delve deep into the opportunities and challenges of galloping progress in artificial intelligence (AI). Here we see our Techonomy community in full swing, contributing insights just as at our events. Paul Daugherty, chief technology officer at Accenture, explains why his company is so energized by the possibilities



The four full-time techonomists in Madison Square Park, around the corner from our New York offices. From left: President Josh Kampel, Co-founder and Program chief Simone Ross, Operations Coordinator Atticus Mulkey, and Chief Techonomist David Kirkpatrick

of this evolving set of technologies. Then Vivienne Ming, a neuroscientist and herself an AI entrepreneur, writes a short work of fiction that illustrates the potential problems as AI takes over work formerly done by humans. (Both Daugherty and Ming are speakers at Techonomy 2016.) Finally, Jennifer Schenker explains how all this puts us in extremely complex ethical territory. Even as she underscores AI's potential, she quotes an expert as saying "We should not let Silicon Valley be the mission control for humanity." Is that really the risk? Read her piece (page

30) and see what you think.

Techonomy Media is a small but devoted crew who care deeply about technology and its potential. Putting out this magazine at the same time we were planning our flagship annual conference, with Mark Zuckerberg as a speaker no less, was all-consuming. But we are delighted with the final product, and thrilled to share it with you.

A handwritten signature in black ink, appearing to read "David Kirkpatrick".

DAVID KIRKPATRICK

“We are a human-machine civilization...A kid in Africa with a smartphone has access to more intelligently searchable information than the President of the United States did 15 years ago.”

RAY KURZWEIL, *INVENTOR* TECHONOMY 2012

“Finally, the things that we have spent the last three or four decades of our life working on are impacting the world in a positive way and creating the change we’ve all wanted since the ‘60s.”

MARC BENIOFF, *SALESFORCE*
TECHONOMY 2011

“We’re running an absolutely gigantic experiment on life on this planet. We are increasingly in charge of the evolution of bacteria, of plants, of animals, and of ourselves.”

JUAN ENRIQUEZ,
AUTHOR AND ENTREPRENEUR
TECHONOMY BIO 2015



“In many ways, Detroit was Silicon Valley 50 years ago. This was the epicenter of innovation.”

STEVE CASE, *REVOLUTION VENTURES*
TECHONOMY DETROIT 2012

A complete list of all the digital industrial companies in the world today:

1. GE
2. See 1

As a digital industrial company, we’re in a category of one. No one else has ever merged machines and analytics on such a scale. Over the past year, we’ve reshaped our portfolio around core strengths like sharing software and technology across our products and services, while expanding margins and making our businesses more efficient. We’d say we were the industry standard, but really we’re the entire industry.



From the Techonomy Archives



Jack Dorsey at
Techonomy Detroit 2014

"Someone anywhere around the world can have an idea and it can spread instantly... It's not the technologies or the companies that are influential; it's the people using the technologies to gain influence."

JACK DORSEY, TWITTER
AND SQUARE
TECHONOMY 2014

"Now we're worried that everyone is going to be narcissistic, egotistical, self-involved assholes, spending all their time agonizing over every single photo of themselves... Generally I'm going to discourage [my own children] from using those products."

SEAN PARKER, INVESTOR
AND FOUNDING
PRESIDENT, FACEBOOK
TECHONOMY 2015

"Anybody who doesn't think digitization is the heart of this country's future and innovation just doesn't understand where this market's going."

JOHN CHAMBERS, CISCO
TECHONOMY 2015

"We're focused on a free and open internet and free data flows... I get very animated about this because I recognize what's at stake here and I feel an enormous sense of urgency."

PENNY PRITZKER U.S. SECRETARY OF
COMMERCE TECHONOMY 2015



"Our regulatory framework right now isn't allowing for innovation to thrive in this country."

CORY BOOKER SENATOR,
(D-NJ)
TECHONOMY POLICY 2015

"We're talking about amazing, magnificent cures for diseases we've never been able to touch before – advances in hepatitis, in cancer, in rheumatic diseases."

SUSAN DESMOND-HELLMANN,
THE GATES FOUNDATION
TECHONOMY BIO 2015



At Techonomy Policy 2015
in Washington, D.C.:
(from left) Sean Parker,
Senator Cory Booker
(D-NJ), and Senator
Deb Fischer (R-NE)

In the thousands of years since people in China first began fermenting a mixture of grapes and rice, the art and especially the science of making wine has grown ever more sophisticated. Today vineyards are meticulously planned, with rows of vines carefully maintained and cultivated to generate the highest yield and refined taste characteristics. The result is highly-dependent on weather conditions, as well as variables like alkalinity and nutrients in the soil, humidity, and the presence or absence of pests or other animals in the surrounding ecosystem.

Variations in a crop can have huge economic impact, so vintners are turning to technology to monitor and grow grapes, seeking the best possible wine. “Making wine is a series of vineyard and winery choices involving information that surrounds us, as well as intuition. Technology is providing us tools that improve the amount and quality of the information and make us more efficient,” says Paul Clifton, general manager at Hahn Family Wines (HFW) in Soledad, California.

HFW is on the cutting edge of leveraging information about environmental conditions in its vineyards. In the past, such data was only collected periodically and for large plots of land that may not have been representative of the conditions in specific parcels. Now Hahn has deployed sensors throughout the vineyard to take information like what comes out of real clouds and route it to computer “clouds” where the data is stored and analyzed. Verizon, extending its services in new areas, has partnered with HFW



to explore this new application of the Internet of Things, in which connected intelligent devices enable systems to operate more efficiently.

Andy Mitchell, HFW’s director of viticulture (the cultivation of grapevines), says the new methods provide more precise data about how the vines use water, which enables him to know exactly when best to give them more. As these relatively new systems improve, he anticipates monitoring vineyard mildew and “rot pressure,” so vintners can know more exactly where and when to apply special vine treatments.

The goal, of course, is to improve output, but even more importantly taste.

“It all leads to an end product, a bottle of wine,” says general manager Clifton, who clearly loves his job. “Most winemakers strive for better than just tasting good. We want the wine to be so great that it sparks the same emotional high for the consumer that the winemaker experienced while making it.” In his opinion the process still requires a substantial element of art. “I don’t think technology can replace our senses...yet.”

JOSH KAMPEL is Technomy's president.

Wired Wineries

How the Internet of Things Helps Vineyards Fine-Tune Ancient Processes

▼
by Josh Kampel

Tradition meets technology.

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Let us help you use data to grow your business. Merge our intelligent technology and your intuition to adapt to market and climate changes. Better utilize your resources to increase productivity.

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verizon^v

How Real is Virtual Reality?

Why it will succeed, and what could slow it down

▼
by Tim Weber

The numbers are stunning for a new technology. By 2020, annual revenue from Virtual Reality devices will reach \$21 billion, predict Gartner and Bloomberg Intelligence. By then, more than 30 million VR devices will ship every year, asserts Forrester, with demand coming both from consumers and companies. No wonder Mark Papermaster, Chief Technology Officer of chip maker AMD, calls Virtual Reality the “next one billion people opportunity”.

Few technologies have raced through the proverbial technology hype cycle in such a short time as Virtual, Augmented and Mixed Reality. These three technologies are closely related but distinct. Virtual Reality goggles take the user into a completely artificial world. Augmented Reality glasses allow you still to see where you are and overlay information and apparent objects onto the real world. Mixed Reality combines both, weaving a thorough virtual experience into the real world; it aims to truly blur boundaries between the real and the virtual. ▶



Oculus Rift headset,
for use with a PC
\$599

All three make digital information, entertainment and productivity tools not just interactive, but immersive.

The sector's hyper-speed evolution may explain why the novelty hasn't yet worn off. Wherever there's a VR experience, you can expect a crowd - whether it's in Las Vegas at CES, in Barcelona at Mobile World Congress, or at IFA Berlin, the world's largest consumer electronics show.

Two years ago, there were just a few early conceptual videos and prototypes. The first high-end VR devices, Oculus Rift and HTC Vive, reached the market only a few months ago. But already there is an end-to-end VR/AR ecosystem. At this year's IFA, more than 35 companies showcased devices and applications.

Companies have rushed in and are ready to hit the market with products that often are genuinely entertaining or meet business needs. Russian VR start-up Fibrum's virtual rollercoaster ride has been downloaded more than 10 million times. Epson's new AR glasses not only make it easy to

control a far-away drone, they also allow you to race bicycles with a friend - while you both work out in a gym. Then there are AR applications that help you to guide far-away colleagues through complex repair and maintenance work; you can remotely demonstrate every single step.

Most customer-facing industries will see useful applications. In retail, AR and VR allow you to experience

products before you buy. Concert promoters demonstrate 360 degree views from each seat, while travel firms take you - virtually - poolside and into your holiday villa. Architects can construct a virtual life-size model of a still-nonexistent home, and take clients "inside." Whether you have donned a VR headset already or have yet to join the 20 million plus people who - in the U.S. alone - at its peak were playing the AR game Pokémon Go (catch a Charizard?), it's obvious something big is happening.

But here is the multi-billion dollar question: Has VR/AR truly reached the final stage of the hype cycle - the 'plateau of productivity' - or could it falter and become the industry's next "3D"? To predict the success of immersive media, let's look at the industry's three distinct approaches for delivering such experiences.

BASIC: To augment your reality, you only need a smartphone camera (for example, to play Pokémon Go). For a basic but slightly more immersive VR experience, a cardboard box



Google Daydream View
(for use with Android phone)
\$79





1



2



3

holding a couple of lenses and enveloping your smartphone will suffice. The New York Times distributed Google Cardboard viewers to all its U.S. print subscribers last year.

WORKHORSES: The mid-range approach also uses your smartphone, but with software and goggles to dramatically improve the VR experience. Examples are the Zeiss VR One Plus and the Samsung Galaxy Gear VR, both well under \$150. It's "virtual reality for everyone," and the most popular gateway. But VR demands massive bandwidth and storage capacity; four minutes of content may require a 500 MB download.

HIGH PERFORMANCE: This is the cutting (or maybe bleeding) edge of Virtual and Augmented Reality. Headsets like Oculus Rift and HTC Vive deliver truly immersive graphics, because they connect by cable to a high-spec desktop computer (or for Sony's version, a game console). Staying tethered to a computer is limiting, and the quality of their displays is about the same as smartphone-based VR. Such systems are also expensive—\$600-800, though prices are falling fast.

Smartphones already are the perfect "gateway drug" to VR and AR; the step from a 360 degree video to a fully immersive experience is small. While cameras to shoot VR content were virtually nonexistent only a year ago, there are now many.

And this is just the first generation of devices, in an age when mobiles and wearables are changing at huge speed. Compare the smartphone on which you may be reading this article to the bricks that were mobile phones not that long ago. Now look at today's bulky VR headsets and grainy images and re-imagine them

five or 10 years from now. Already there are patents for VR and AR devices the size of contact lenses.

If you doubt the power of the experience, try out Microsoft's still-unreleased HoloLens. Using this Mixed Reality device, which I've tried, feels like stepping into a Star Trek-style science fiction movie. Still, three hurdles hold these technologies back for the time being.

IT MUST BE SOCIAL. Right now, these technologies are solitary pursuits. But it will probably be shared experiences that result in a real take-off. Facebook is most committed to making this happen; after all, it bought Oculus Rift.

AR AND MR RISK DISTORTING THE WORLD. Many of us already worry about the echo chambers and filter bubbles created by social network algorithms. What if this augmented information is merely propaganda – not what's there but what someone we shouldn't trust would like us to see? Virtual Reality, by contrast, might be a counterpoint, with an

ability to foster empathy. What's more compelling: reading about suffering or experiencing it – virtually – from close-up?

VR, AR AND MR ARE SECURITY RISKS. As we build immersive media experiences – whether for business or entertainment – the need to secure them grows exponentially, for the very reason that they are so immersive and thus persuasive. Imagine a hacker or unfriendly nation-state gaining control of our in-goggle experiences.

Mobile devices changed our relationship with information, entertainment and technology. VR, AR and MR will trigger an equally-fundamental paradigm shift. This time though, the pace of the next digital revolution will be measured in years, not decades.

TIM WEBER works at communications marketing firm Edelman. With his colleagues, he assists VR/AR clients including AMD, IFA, Microsoft, and Samsung.

1
Zeiss VR ONE Plus,
for use with Android or
iPhone \$129

2
Samsung Gear VR
(powered by Oculus)
\$100

3
HTC Vive,
for use with a PC
\$799

HOW TECH CHANGES MARKETING

“We now all have information at our fingertips, and for marketers that completely rewrites the rules. The expectation is that if you show up on my mobile phone, you must show up in a relevant, useful, delightful way.”

CAROLYN EVERSON, VP, GLOBAL MARKETING SOLUTIONS, FACEBOOK

“We’re now going to see marketing become much more central in business...CEOs will model themselves much more on a Mark Zuckerberg who listens, than on a Steve Ballmer, the Proctor & Gamble-trained brand manager who was all about managing the channel.”

DAVE MORGAN, CEO, SIMULMEDIA



THE STATE OF CAPITALISM

“Only 15% of all the capital flows coming out of financial institutions today actually end up in business investment. So where is the rest of it going? It’s going into trading. It’s going into the bidding up of various assets—stocks, bonds, houses...The system is broken.”

RANA FOROZHAR, TIME MAGAZINE AND AUTHOR, MAKERS AND TAKERS: THE RISE OF FINANCE AND THE FALL OF AMERICAN BUSINESS

“Everyone who goes to college today wants to be involved in a young company. There is a spirit in this country, in spite of all the things you’re talking about, that cannot be stopped...So maybe instead of industrial or corporate capitalism, we’re seeing peoples’ capitalism.”

ALAN PATRICOFF, GREYCROFT PARTNERS

May 26, 2016

New York University Kimmel Center

Our First New York Conference

In May 2016 at NYU we celebrated Cities and the Internet of Things...and worried about data



1. David Kirkpatrick of Technomy (l) in a lively session on advertising's future with Facebook ad boss Carolyn Everson and Dave Morgan of Simulmedia

2. Rana Foroohar of Time (l) and Alan Patricof of Greycroft Partners discussed the state of banking and tech's advances

3. Facing us (from left) Josh Kempel of Technomy and SAP Chief Strategy Officer Deepak Krishnamurthy

4. Simone Ross of Technomy on stage

ON DATA

"If you don't have data you have nothing." Bill Ruh, GE Digital

PAUL DAUGHERTY, ACCENTURE CHIEF TECHNOLOGY OFFICER: "Is Artificial Intelligence real this time? Yes, in a much more profound way than it has been, because to power AI you need good techniques and algorithms but more importantly lots of data. And we now have data available, and cheap data storage costs, and we have sensors and IoT delivering data to us."

DANAH BOYD, DATA & SOCIETY AND MICROSOFT RESEARCH: "Big data' is actually wrapped up with an ideology, as though we could magically solve all of the world's problems if we just have more data."

BILL RUH, CEO, GE DIGITAL: "Data is water rights to the valley."



THE ALGORITHMS ARE COMING

Q: TOM GLOCER, ANGELIC VENTURES (AND FORMER CEO, THOMSON REUTERS): "Why should someone trust an algorithm with their money more than their three-martini broker?"

A: JON STEIN, CEO, BETTERMENT: "In financial services, there are lots of conflicts of interest. Your broker might have a bad day, might have an interest in some stock that they're promoting, might have a financial interest in selling you one thing over another. When you trust software to make these decisions for you, it's a lot harder to have conflicts because you have to hard code them into the software. And that's auditable."

IT'S ALL ABOUT THE CONNECTIONS

"We're talking trillions of dollars by 2025 and beyond for the Internet of Things. The big question is what does it take to unlock that? How do you align all of the elements in order to drive adoption?"

MARK PATEL,
PRINCIPAL, MCKINSEY & CO.

"We never use the word IoT with an industrial customer. The conversations don't go well. We talk about driving productivity through data and analytics."

BILL RUH, CEO, GE DIGITAL

"Everyone talks about IoT platforms and software as a service and cloud computing, but many of these still end up being walled gardens. We need to get to the phase where the platforms are interconnected and the technology is just in the background."

MARK BARTOLOMEO, VERIZON VICE
PRESIDENT FOR CONNECTED SOLUTIONS AND IOT

"Digital and the IoT is not a technology topic. It's a people topic. It's all about the connections and breaking down silos, bringing information together and speaking the same language."

JESSICA FEDERER BAYER CHIEF
DIGITAL OFFICER

THE FUTURE OF MEDICINE

"Artificial Intelligence will not treat patients. It will never happen. I guarantee you that. There will always be an art to medicine."

"Big data can be transformative. The problem now is that most of the data is collected without context, in a non-standardized way, and using non-standardized data elements. That's what's challenging. Context matters, and we don't know how to describe context in health."

"Don't just focus on the technology...Go to the clinicians, the physicians out there and ask, 'What are the problems?' Go to the patients and ask, 'What are the problems?' And make a hierarchy of the problems and focus on them."

DAVID AGUS, UNIVERSITY OF
SOUTHERN CALIFORNIA AND
AUTHOR, THE END OF ILLNESS
AND THE LUCKY YEARS





3.



THE INTERNET AND SOCIETY

What is the Moral Responsibility of Facebook?

“What is the moral responsibility of organizations like Twitter or Google or Facebook? Their business imperative is very, very clear: give people what they want. They will spend more time. They will click. They will pay attention. It’s really good.

But that may not actually be the thing that creates a healthy society.”

DANAH BOYD DATA & SOCIETY AND MICROSOFT RESEARCH

“Technology has the ability for us to rewrite all kinds of cultural patterns, but only if we employ our brains. Otherwise it just intensifies the existing cultural patterns in ways that are fantastically dangerous.”

GILLIAN TETT U.S. EDITOR, THE FINANCIAL TIMES



4.



2.

1. Jessica Federer, Bayer’s chief digital officer, on a panel about the Internet of Things

2. Dr. David Agus (l) interviewed by Krishna Kumar, CEO of emerging businesses at Philips

3. Kirkpatrick with danah boyd of Data & Society (l) and Gillian Tett of The Financial Times

4. U.S. Secretary of Transportation Anthony Foxx with Megan Murphy, Washington bureau chief for Bloomberg



A FAR-THINKING GOVERNMENT LEADER

“Autonomous vehicle technology is going to be ready in a period of years. And I would say single digits...We have 33,000 or so deaths every year on our highways...The possibility that we could reduce those accidents and fatalities by 80% is pretty amazing. About 94% of the accidents and fatalities we have are attributable to human error. So if we eliminate human error from the equation that doesn’t mean we eliminate accidents. It means we reduce them. If the public has the expectation that these vehicles are going to perform perfectly, that’s probably unreasonable.”

ANTHONY FOXX, U.S. SECRETARY OF TRANSPORTATION

Technology is completely changing how we live our lives, and every company must make technology innovation a strategic priority for its business. This isn't a huge surprise; most leaders these days mouth words along these lines. But a surprising number of executives don't understand something that is obvious to most of us technologists: companies that don't establish the latest internal software development processes will fail to get and retain the best programmers. And then, those companies will decline.

Great engineers want to have an impact. But the talents of fantastic people are wasted by poor infrastructure and processes that squander their time. And they know it. By infrastructure, I mean things

like internal software frameworks, development tools, cloud infrastructure, and the existing base of software code that new applications get written on top of. Getting these systems right is critical to business success. Companies that maintain state-of-the-art tools stand a much better chance of attracting talented engineers and programmers.

It's not that much different from what happens in a factory in the physical world. If the workers are burdened by outdated equipment, they follow old processes and work in ways that haven't changed for a generation. Contrast that factory's output against a modern agile environment, with a well-trained workforce that uses automation and streamlined manufacturing processes. Everyone knows which

team will be more productive. But it's not so obvious with today's digital product "factories." Internal software processes and infrastructure are not very visible. So executives disregard them. Typically, this seemingly-boring internal infrastructure is underfunded and unevolved.

Too many leaders chase innovation, but don't think about the tools and processes that enable it to occur. Increasingly, senior executive teams are aware of the need to undergo digital transformation. One mistake many leaders make, though, is to assign blame for failures, rather than take ownership of the problem. It's easy to blame company culture, or point a finger at poor quality from product teams. I often hear non-tech leaders say, "If only we hired engineers from



The Technology Secret Most Leaders Miss

By James Barrese
Illustration by Jon Han

The technology environment you provide for your programmers could be the key to your company's success.



XYZ organization,” or, “We just don’t have that kind of talent.”

It’s true that the best programmers often want to go to the biggest and richest internet companies. But it’s not just because of the money. They’re also attracted to the tantalizing challenges and technical opportunities. They like working with modern tools in an environment that encourages them to ship products quickly. They also know that in many traditional companies a lot of time is spent pushing back against friction and an internal resistance to change.

Sometimes companies will hire a few top engineers, thinking that’s the solution to their software problems. But because this new talent has to work against poor internal processes and frustrating, outdated infrastructure, the expected results don’t materialize and the engineers eventually leave.

Many companies are still lucky enough to have talented technologists. But rather than blaming them when they don’t innovate fast enough, you need to help them. The great thing about quality infrastructure is that a rising tide lifts all boats. An average engineer with fantastic tools can outperform a genius working with outdated ones. If you compare a modern software engineer to one working in the 1960’s, their quality, pace, and productivity today is orders of magnitude greater than it was back then. But biologically and intellectually, engineers aren’t much different (and their wardrobes haven’t changed much either!).

What has evolved are the tools for productivity. The systems, infrastructure and processes have improved to make possible radically new innovations and ever-increasing productivity. So ask yourself what would be more valuable: spending money hiring away rock star engineers from Google? Or spending it instead on modernizing internal technologies to unlock the potential of your entire product development team?

Companies that focus on this can see radical benefits. For example, Amazon Web Services (AWS) originated from internal work to build simple services, tools, infrastructure, and platforms. That not only helped all of Amazon’s software teams move faster, but made it possible to create an entirely new product that has helped turn the chronically money-losing company profitable. During the five years I was chief technology officer at PayPal, we prioritized improving the work environment, infrastructure, and tools. The resulting dramatic progress cut the time needed to take a software product from conception to market by 70% and unlocked a flood of innovation.

Every company needs to embrace the fact that, in crucial ways, it is a technology company. GE is a great

example to emulate. Its CEO Jeff Immelt has a clear vision that GE needs to be more capable in software. He is investing heavily to make the 124-year-old company operate like an innovative startup. Part of that has meant building world-class software infrastructure.

Creating this kind of environment and improving your company’s product-development and engineering capabilities doesn’t just happen. It takes significant investment, focus, and discipline. It may take years to move a company’s culture, technology, and its talent forward. But any company can do it.

JAMES BARRESE is an independent director, advisor, and the former CTO and senior vice president of payment services at PayPal.

HOW TO SPEED UP SOFTWARE INNOVATION

A company’s digital transformation must be supported from the top down. The CEO and executive management team should give it significant attention, and make that known.

APPOINT AN EMPOWERED SENIOR TECHNICAL LEADER to drive product development process improvement on a full-time basis, and support them at the executive level with aggressive, shared goals.

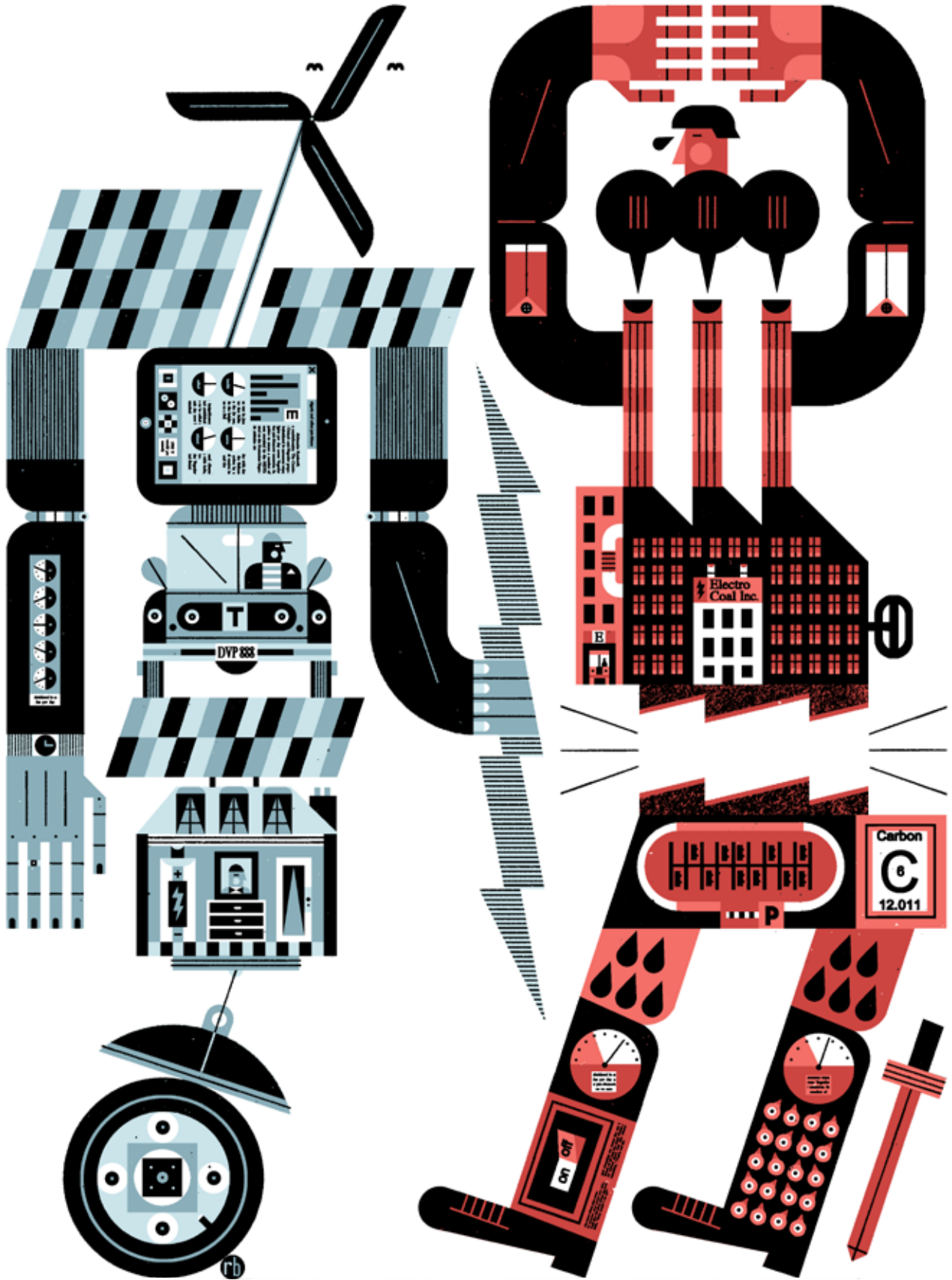
BUILD THE ACTUAL CAPABILITY TO DEVELOP. Your software engineers need the right tools and environments.

PROCESSES SHOULD BE STREAMLINED TO SUPPORT PRODUCT TEAMS.

Adopt so-called “agile” approaches, which are iterative and collaborative. Reinvent the processes that facilitate shipping software code. Empower the internal upstarts, the innovators, and the people who know what needs to happen. We’ve all seen or worked in large corporations where corporate antibodies hold back progress and teams need support to reinvent and accelerate processes.

MEASURE, BASELINE AND IMPROVE. You can’t improve unless you know where you are on the metrics of product development and time to market. This means things like software build times, process wait times, the time to receive approvals, how long it takes to process a purchase order, and lots of other details. Unaddressed, any of these can really slow down a team. CEOs need to include relevant metrics on their company score card.

STOP OUTSOURCING AND INSTEAD HIRE GREAT PEOPLE. Abandon low-cost labor arbitrage for this most critical of functions and instead develop a high quality, diverse base of development employees.



WHEN ELON MUSK ANNOUNCED HIS LOWER-PRICED TESLA 3 electric car in the spring of 2016, he opened the press conference with rhetorical questions. “Why does Tesla exist? Why are we making electric cars?” The audience of car fanatics and techies didn’t expect the answer he gave, though a clue came from the fact that Musk was already working to fold his other company, SolarCity, into Tesla. He continued: “Because it’s very important to accelerate the transition to sustainable transport...for the future of the world.” Then Musk started talking about the world’s “record CO2 levels,” noting, “The chart looks like a vertical line, and it’s still climbing!” He sees Tesla as targeting climate change — the cars will connect to the solar systems and home storage batteries, so “every individual is their own utility,” and less carbon is emitted. Not what you’d expect from a car company. • Musk seldom uses the phrase, but what he was talking about was the Internet of Things — putting computing intelligence into the objects and systems that surround us, connecting them to the network, and stitching it all into a digital ecosystem. Tesla’s cars, solar collectors and batteries all are connected, communicating via the internet. While the concept of IoT has been batted around the tech industry for a decade, with companies including Cisco and Intel placing hefty bets on its success, only now — suddenly — is it starting to make sense. ▶

HOW THE INTERNET OF THINGS WILL FIGHT CLIMATE CHANGE

We must become more energy-efficient, produce less carbon dioxide, and power more things with electricity from wind and solar. IoT can make it possible.

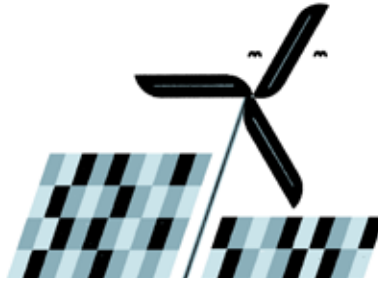
▼
by David Kirkpatrick
and Diane Regas

▼
Illustration by
Raymond Biesinger

IoT's "killer app" — what's going to make it indispensable to society — will be combatting climate change. As much as the steam engine reconfigured Western economies at the start of the industrial revolution, IoT may shift how our energy system works as the world focuses on its climate crisis.

What is primarily causing the climate to warm, and weather to go wild, is the way humankind is flooding the atmosphere with carbon dioxide. We generate CO₂ when we burn fuels like coal, petroleum, or natural gas. We thus need both to become radically more energy-efficient and to drive carbon out of the electricity generating system, even as we use electricity in more ways (like powering vehicles). But the electricity must be produced using sustainable sources like solar and wind that don't create CO₂.

Up until recently this equation really didn't add up — in part because wind and solar could only be relied upon some of the time. As Robert Gaudette, a top executive at giant utility NRG, puts it, "The wind



in which both production and usage can be quantified in real time, and correlated. Power will no longer need to be produced only when it is consumed, because we will have new ways of predicting demand, adjusting usage, and storing energy.

For one thing, periods of peak demand will begin to be accommodated as much by conservation of electricity as by additional production. "Once your lightbulbs and your air conditioners become connected and part of the Internet of Things, you can aggregate your resources," says NRG's Gaudette. Once all those appliances are stitched into the network, they can be selectively turned down, or turned off.

Commercial power users like factories and offices, in addition to residential customers, can benefit from this ecosystem. Businesses as

a rebate on their electricity bill.

Conservation is not the only way users can help the energy grid adapt to periods of high demand. The giant batteries in electric vehicles can serve as a source of supply to the smart connected grid when they are parked and plugged in. If the grid needs to find an extra megawatt of power to satisfy demand, it doesn't matter to it whether that electricity comes from a power plant or from somewhere else, be it an idle battery or conservation elsewhere.

All these connected systems will make it possible to rely much more on variable sources of power like wind and solar. Many experts originally thought such sustainable sources couldn't comprise more than 10% of total energy production, at best, because of how intermittent they were. But as the potential of the IoT has become clearer, it now appears that as much as 80% of the world's total energy production could eventually come from renewables. NRG, the giant commercial utility where Gaudette works, is so confident of such a transition that it has a firm goal of reducing its overall carbon emissions 50% by 2030, even as the company expects to continue growing. And by 2050 it promises to cut CO₂ an impressive 90%, using 2014 emissions as a baseline.

The move toward connected electric vehicles is a major part of this transition. There are already more than two million plug-in vehicles in operation worldwide. A recent study by McKinsey & Co. and Bloomberg New Energy Finance estimated that plug-ins could account for as many as 60% of all vehicles in high-density developed cities by 2030. Affluent Norway has a national target that only electric cars are to be sold there after 2025. Germany is moving in the same direction. And California's Pacific Gas & Electric is already conducting an experiment with BMW using electric vehicles as sources of supply when they are plugged in and

As much as the steam engine reconfigured Western economies at the start of the industrial revolution, IoT may shift how our energy system works as the world focuses on its climate crisis.

doesn't always blow and the sun doesn't always shine, so you end up with these intermittent resources in your grid."

Historically, electricity always had to be consumed exactly when it was generated. The minute someone wanted more supply, a utility had to generate it into the grid. But there was no way to adjust demand.

IoT enables the creation of a smart electric system in which there can be flexibility in both supply and demand. It makes possible, for the first time, a responsive energy network

well as homes increasingly will have "smart meters" that enable a utility to gather information and, with the user's consent, modify usage. Utilities gain the ability to adjust a user's electric load, and reward customers for using less power at peak times. Such a system might automatically turn off appliances like water heaters, or temporarily adjust thermostats when energy demand is up. This allows customers to become suppliers rather than just consumers of power. What's more, at the end of the month, many customers will get

not in use.

The nations of the world committed in the Paris Agreement to work towards limiting the warming of the earth's atmosphere to no more than two degrees Celsius above pre-industrial levels, beyond which scientists consider extremely dangerous. To achieve that, the world must reduce carbon dioxide emissions by roughly 80% below 2005 levels by 2050. It's a daunting task, but estimates by communications equipment giant Ericsson and environmental group Carbon War Room both say advances in machine-to-machine communications, or IoT, can get us a good part of the way there, contributing to as much as an 18% reduction by 2030. Ericsson is a major developer of the next phase in wireless communications, 5G, which will be critical for the widespread IoT systems necessary.

Connected devices will offer plenty of additional ways to make society

and its energy use more efficient, and reduce carbon production. For example, a relatively simple recent project in Los Angeles synchronized traffic lights to enable traffic to flow more smoothly, not only conserving drivers' time but saving more than 35 million gallons of gasoline annually. Drivers sitting in traffic just in the United States burn an estimated three billion extra gallons of gas each year, contributing over 25 million tons of unnecessary CO2 emissions. Even something as basic as smart trash cans can play a role. Since they announce when they are full, garbage trucks don't drive to empty them as often. Some regions have reduced pickups by 80%.

One of the biggest challenges for a lower-carbon future is that regulation and business models are lagging behind technology. We need to reward entrepreneurs who use IoT to drive down pollution. We need business models that incorporate and

respond to the reality that electricity is more valuable at some times than at others. As the grid becomes more complex, it's essential to add more information—about when renewables are available, where electricity can be stored or drawn from, and when demand can be delayed.

It's clear that IoT will not change our lives by automatically reordering food for our refrigerators, as a long-standing technology cliché would have it. Summarizes Arun Majumdar, director of Stanford's Precourt Center for Energy: "The Internet of Things can help decarbonize our energy system, provide modern energy systems to every human being, manage our infrastructure, and allow us to adapt to and address climate change."

DIANE REGAS is executive director of the Environmental Defense Fund; DAVID KIRKPATRICK is Technonomy's CEO.

McKinsey & Company

Knowledge partner of Technonomy

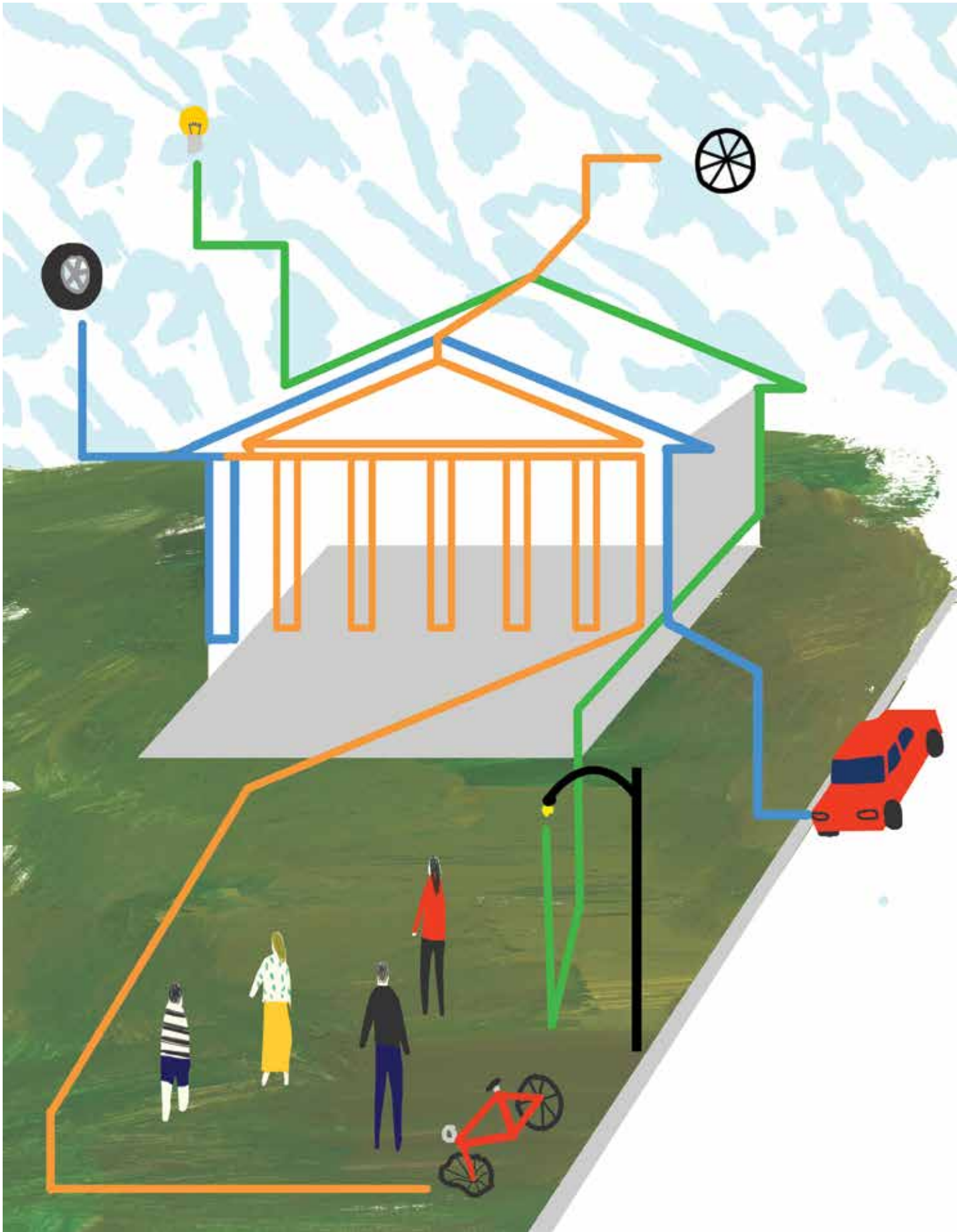
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Insights for You

Preparing IT systems and organizations for the Internet of Things
To accommodate the development and support of smart devices, companies will need to update existing IT architectures and operating models. Here's a ...

Making data analytics work for you – instead of the other way around
Your data should have a purpose. Here's how to discover one and then translate it into action.

Straight talk about big data
Transforming analytics from a "science-fair project" to the core of a business model starts with leadership from the top. Here are five questions CEOs should be asking ...



Driverless cars that make per-minute toll road payments.

Lightbulbs that decide the right energy vendor at a given time and price. Investment decisions made by robo-advisors. And products created in-situ by 3D printers, with royalties paid in real time on whatever intellectual property is needed.

This is the coming world of the Internet of Everything, as intelligence and connectivity becomes distributed more and more widely across our economy. Everything will talk to everything and end-points will make their own decisions, powered by sensor-driven data collection and computing that continually improves, known as machine learning. To make this a reality, we will need a well-functioning, secure micropayments system. We must reimagine the nature of financial assets, digital assets, rights management, intellectual property and royalties. "Sensor technologies and the collection and exchange of data by the Internet of Things (IoT) will require a fundamental rethink of financial services,"

says Udayan Goyal, a London-based private-equity and venture capital investor focused on financial services.

If they aren't careful, banks could be relegated in this new world to becoming mere clearing houses. Credit card and insurance companies could see business shrink. So traditional financial services companies are seeking a role for

themselves at the nexus of the digital economy. Getting a pole position in the evolving IoT would allow banks to gain new revenue from a range of innovative services.

"In the IoT, payments become a kind of backbeat to life. They are everywhere, but they retreat from view. Your car will be connected to your debit card and will settle your gas charges for you. And your house will settle your utility bills," says ▶

The Fin-ternet of Things

Why connecting everything will require a new approach to money

By **Jennifer L. Schenker**
Illustrations by **Jon Han**

former Deutsche Bank executive Dan Marovitz, COO of Earthport, a London-based company building an alternative to correspondent banking. “The reality is that most payments are still made through banks and most people still keep their money in banks, so the banks will necessarily be part of these future flows.” But the way forward is rife with challenges.

WILL BANKS BE THE BROKERS OF DIGITAL DATA?

Digital identity, data management and data privacy are key components of the IoT. The people, devices, and software that make up systems, applications, and services will all have to be defined and given a digital identity. So who will develop, safeguard and store digital IDs?

In the past, powerful Silicon Valley players tried and failed to play a key role in securing and disseminating data. Microsoft attempted a centralized digital identity service 14 years ago with its Passport and Hailstorm initiatives. Intel, Sun, Oracle and AOL tried to develop their own such service around the same time through a group called the Liberty Alliance. Today, Facebook has vast stores of personal data, though for the most part it has shied away from financial services.

Now data is a valuable digital asset on a par with capital. Many believe that banks, not Silicon Valley companies, may be best placed to create and safeguard our digital identities and be brokers for data exchange. They could potentially offer services for identity, privacy, and security to accompany the global trading of any digital asset.

If smart developers can build apps on top of data that its owners give permission to use, taking into account an individual or organization’s preferences, it could usher in many types of new financial services. For example, access to commercial and transaction data, via the IoT and

point-of-sale systems, could help banks assess the creditworthiness of people and businesses. They could anticipate the need for capital, pre-empting requests for financing from small businesses and providing real-time credit, according to a Fintech 2.0 white paper prepared by Santander Innoventures, Oliver Wyman and Anthemis (the venture and advisory firm founded by London’s Udayan Goyal).

New consumer services could crunch data about individuals’ purchases, payment and habits. That may make people smarter financially, much as weaving together health records with dietary and exercise tracking is likely to make us healthier. Consumers could marshal their data to signal an intent to purchase directly to retailers, potentially attracting better offers.

With such future services in mind, a dozen banks – including Citi, BNP Paribas, Deutsche Bank, HSBC, and JPMorgan Chase – began in 2011 to work with The Society for Worldwide Interbank Financial Telecommunications (SWIFT), a cooperative that handles transactions like wire transfers for thousands of banks. They envisioned an underlying global financial infrastructure called the Digital Asset Grid (or DAG) to bring bank-grade identity, privacy and security to the global exchange of any digital asset. But the project was later abandoned.

The obstacles were bigger than just getting many large institutions to cooperate. Something like the DAG would require banks to think and operate like a company such as Apple, offering a platform on top of which others could create new innovative services. Banks may not be able to shed the outdated and arrogant thinking that comes from keeping a physical valuation in the basement. Also, many big banks still lack the digital infrastructure necessary to operate in the emerging IoT. Francisco Gonzalez, CEO of Spanish

banking giant BBVA and a former computer programmer, says “In order to compete in the digital world you need to have platforms that perform in real time, and not run batch processes overnight. But behind the scenes most banks still have what we call a ‘spaghetti platform.’” (His own company has aggressively invested in digital banking.)

Still, the World Economic Forum argues in an August 2016 report that financial institutions are well positioned to drive digital identity systems, since they already have well-developed ways to verify user information for commercial and regulatory purposes. Doing so would allow banks to offer extended financial advisory services and things like behavior-based insurance. Banks could also offer “identity-as-a-service” to businesses that can’t or don’t wish to store their clients’ personal data. And, they could potentially offer identity management as a separate, fee-based service.

One thing is sure: digital identity will be a key part of financial services going forward. The topic took center stage this year at Sibos, a major annual financial industry conference organized by SWIFT that convenes more than 7,000 financial services executives. Says Carlos Menendez, Mastercard’s president of enterprise partnerships: “Money is now more than an exchange of value and payment. Further information can be embedded with each transaction in the form of a digital ID.”

And digital IDs will have far more utility than merely improving security. “Identity and authentication schemes coupled with payment platforms can enable financial inclusion and poverty alleviation for billions of people,” says Kosta Peric, Deputy Director, Financial Services for the Poor, at the Bill & Melinda Gates Foundation, who worked on the WEF report on digital identity. “Ultimately, digital services such as data lockers will become the fundamental

fabric of the digital society, and also a new, immense, opportunity to provide existing and new government and financial services," he says.

THE DARK SIDE OF DATA

Once digital IDs are ubiquitous and most of the things we own are connected to the Net, more and more information will be traded about us. The challenge will be keeping it all under control. "The question for the not-so-far future is 'What will a data market look like? Who will shape the rules? And how will rules be enforced?'," asks Aurelie Pols, a data governance and privacy advocate at Krux Digital, a venture-backed San Francisco company that aims to unify data about people into a single view to help businesses. Pols is also an advisor on ethics to the Data Protection Supervisor established 15 years ago by the European Union.

The IoT is a major step towards the long heralded—and feared—path to truly personalized marketing. It is rich with promise at the same time that it is fraught with complexity and the risk of intrusion. Cars, watches, refrigerators, and garage door openers will become nodes on the network, controllable with a smart phone and trailing what Earthport's Marovitz calls a "digital slipstream." The endless resulting flow of purchases, preferences and decisions will define a very specific demographic—you.

Companies of many types may thus acquire an invaluable resource. "The way the financial services industry thinks about risk will fundamentally change as a result of the availability of the very granular data that can be collected through IoT devices," says investor Goyal, who in addition to being a VC is managing partner of private equity firm Apis Partners.

The way insurance works could change dramatically. Continues Goyal: "The data collected from smart devices and wearable tech-

nology will be useful in redefining risk models for life insurers." That sounds good for them, but maybe not so good for you. Similarly, connected vehicles will enable new risk models for auto insurance. Several insurers already offer policies in which a driver's behavior is monitored while he or she drives, with the information transmitted directly to the insurer. The company assesses the chances that driver will have an accident and charges premiums accordingly. On the one hand, those who drive well should get lower rates. But the use of highly personalized data will



potentially aid the creation of what Goyal calls "tail exclusion risks." If you are perceived as risky as your personal data becomes exposed, you may become completely uninsurable, he explains.

And when lots of information about your health and other personal details is shared freely by companies and government, that could also have a dark side. Principles and data ethics need to be established and new technical innovations will be required, so that permissions can flow with the data to make clear who can access what and when, says Krux Digital's Pols. Many startups are pursuing ways to give control of personal information back to the individual, but it's a dauntingly difficult task.

ETHICAL AND SECURITY ISSUES

When artificial intelligence gets added to the IoT, as it inevitably will, the challenges will become even greater. The question of who will shape and enforce the rules is no clearer for AI than it is for data governance. But the combination of the IoT and AI is expected to usher in new personalized financial services like smart wallets that monitor and learn your habits and needs and alert and coach you to adjust your spending and saving behavior. Or automated agents may assist you, over the network, to determine your insurance needs, or to provide financial advice and portfolio management. As these systems become more autonomous and reliance on them increases, we will need safeguards.

Once a system becomes automated, feedback loops may develop and create problems like asset bubbles or market crashes. Autonomous AI can also lead to other unintended consequences, raising ethical and legal issues (see story page 30).

In addition to the introduction of new services, the IoT will also lead to more transparency and efficiency, especially in trade, both locally and globally. The blockchain, a distributed ledger technology (explained in detail on page 28), could add unprecedented levels of security and authentication when it comes to things like tracking the whereabouts, ownership and condition of assets of all sorts. Says the 2015 Fintech 2.0 white paper: "We expect the IoT, combined with the distributed ledger and smart contracts, to dramatically reduce the costs of trade finance." International trade is expected to grow by 8% per year by 2020, with associated finance revenues growing to \$70 billion, according to the Fintech 2.0 report. "This represents a massive opportunity for both banks and fintech start-ups to...streamline trade finance processes," it continues.

Big financial organizations are ▶

trying to adapt by reaching out to small, more agile companies. Everledger, a London-based startup that uses blockchain technology to monitor the supply chain for diamonds and other precious stones sold at retail, has partnered with Mastercard. And BlockVerify, another London start-up that uses blockchain technology to improve anti-counterfeit measures in supply chains, is part of Startupbootcamp Fintech, supported by Rabobank and Lloyds banking group.

As the IoT connects things like light bulbs in a home and integrates them into the network, the bulbs themselves may be able to negotiate the most favorable price for electricity from competitive power grids. (For more about the IoT and energy see page 18.) Visa envisions a lightbulb paying for electricity only when it consumes it. And rather than a single payment, the bulb pays continually and incrementally. This will require a new type of currency for ultra-tiny transactions. The digital currencies Bitcoin or Ethereum's Ether may work for this, as well as paying for tiny chunks of bandwidth, storage, or CPU time in a computer, or energy and sensor data. Visa Europe is running a trial of such micropayment systems with Berlin-based SatoshiPay.

But investor Goyal wonders "What happens if these micropayments get hacked?" The security and efficiency of such systems must be reassuringly reliable, but they aren't yet.

Financial services companies will need to do more. The companies that win in the networked economy will not just process transactions but must leverage the rich information in the electronic trail clients leave behind – the so-called digital slipstream, explains Earthport's Marovitz. If banks become trusted brokers of our data and figure out how to leverage our digital breadcrumbs, the Web could be transformed from a place where people go to visit sites

and be tracked without their knowledge, to one where we give permission to know what we are doing and that helps automate our lives.

For example, say a consumer wants a car. Today she uses a bank network to send the payment. In the future, with banks as digital brokers, she could let it be known digitally that she is shopping for a car, a process known as "intent casting." Others on the grid, like dealers or insurance companies, could pitch her in real-time, and she could filter those pitches based on their digital reputations. When she makes the purchase, the information for the paperwork to buy, insure and register the car could be released from her account, securely and with her permission,

so it could go to relevant parties. She could also, if she chooses, authorize her data for third-party warranty services. In this scenario - originally envisioned by the SWIFT industry project - banks would take a cut for brokering these kind of exchanges.

When the IoT network is in full swing we may even be able to text our car and tell it to go sell or rent itself. When we do, a data broker – which may or may not be a bank – will make money managing millions of such transactions.

JENNIFER SCHENKER is Editor-in-Chief for The Innovator. She has covered technology and innovation for the Wall Street Journal Europe, Time Magazine, Red Herring, Businessweek and Informilo.

SIX FIN-TERNET OF THINGS STARTUPS

New companies like these are helping create a real-time connected financial ecosystem.

1. **EVERLEDGER**
www.everledger.io / London, England
Uses the blockchain to record a permanent ledger for diamond certification and transaction history.
2. **WALLET.AI**
www.wallet.ai / San Francisco, California
Applies artificial intelligence to analyze massive amounts of data to help people make better financial decisions.
3. **ZOVOLT**
www.zovolt.com / Hereford, England
Works with banks to implement secure Internet of Things software and payment solutions.
4. **SATOSHIPAY**
www.satoshipay.io / Berlin, Germany
Bitcoin micropayments. Visa Europe is working with it on machine-to-machine payments for the Internet of Things.
5. **BLOCKVERIFY**
www.blockverify.io / London, England
Blockchain-based anti-counterfeit technology to track and verify pharmaceuticals, luxury goods, electronics and diamonds.
6. **TILEPAY**
www.tilepay.org / Montreal, Canada
A platform that enables users to control access to Internet of Things device data.

THERE'S NEVER BEEN A BETTER TIME

A woman wearing an orange saree and glasses is sitting on a black rectangular ledge. She is holding a black bag. In the background, a blue train is moving rapidly, creating a blurred effect. The text 'THERE'S NEVER BEEN A BETTER TIME' is overlaid on the image in large, white, sans-serif capital letters.

to make cities smarter

Right now Cisco is coordinating trains, buses and traffic lights for the 8 million people of Bangalore. See why there's never been a better time to change the way we live at cisco.com/neverbetter



Why Blockchains are For Every Company

Blockchains will replace databases, and form a new trust layer on the internet

The advent of Bitcoin/Blockchain innovations is very much like the arrival of the internet/World Wide Web. The blockchain will fundamentally disrupt technology, society and business, just as the Web did. It was the first significant overlay on top of the internet when it emerged in 1992, and the blockchain is the second one. This new technology is mostly about trust, so we could call it the trust layer.

In many cases the blockchain will replace how databases interact with each other. Databases are generally controlled by individual companies or organizations, whereas the blockchain is a commonly-shared ledger with access equally distributed among its users. That equality of access is a key part of its appeal.

The blockchain puts the record of who owns an asset with the owner of the asset, and does not rely on a third party that owns a database that points to a record that says who is the owner. Instead of each organization maintaining its own database of records, the blockchain's common record is shared by multiple parties who have a collective stake in it. They agree to update only one single version, known as the blockchain ledger. Each party adds their own information, and users of the ledger become peers with inherent rights and access permissions.

Once a change is made in the blockchain, its history is unalterable. That is a fundamental aspect of its computer architecture, and makes it highly secure as a means of keeping track of all sorts of data, financial and otherwise. The great virtue of blockchains will be to keep track of records in a way that is not con-

trolled by any one central entity, and yet cannot reasonably be disputed.

The Web could not exist without the internet. The Web made the internet more useful, because it was about using information, rather than merely figuring out how to hook up computers together. Blockchain applications need the internet, but they could in some instances bypass the Web and give us a new flavor of software applications that are more decentralized than traditional Web applications, and perhaps more equitable.

Just like access to the Web can be public or private, blockchains and their applications will come in both public and private versions. The key characteristic of public blockchains is that they are permissionless, which means any user can join, either anonymously or with a known identity. If you can get on the internet, you will generally be able to get on a public blockchain, via a specific application. But private blockchains are like fenced environments whose

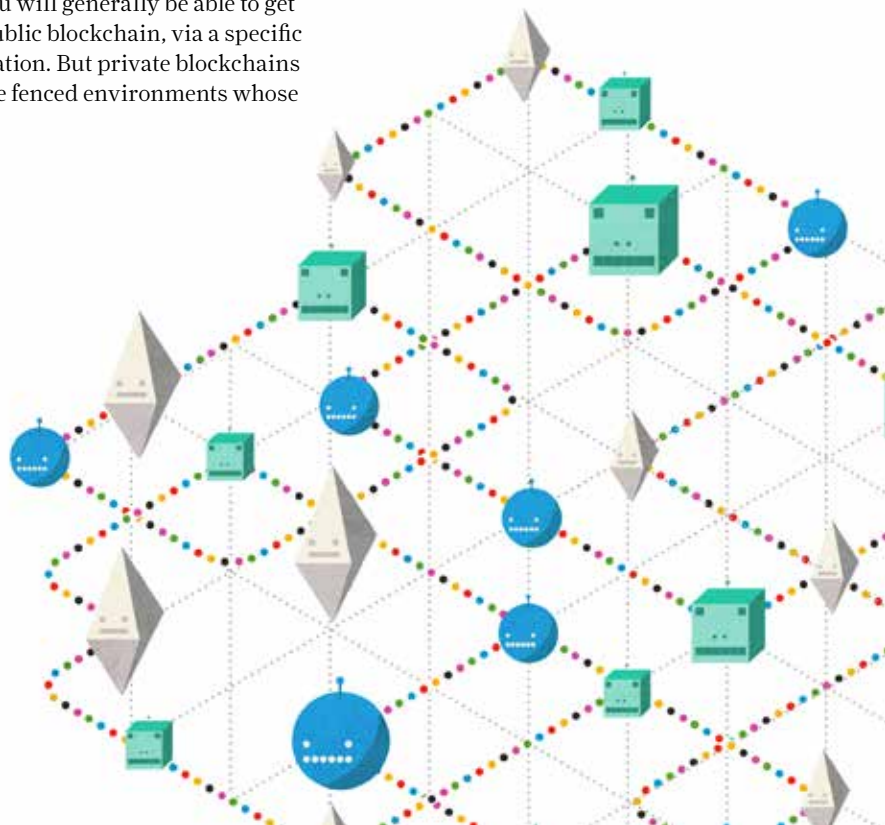
membership and access rights are only granted to parties already known to each other.

Any executive or leader must understand three strategic themes:

1. **The Blockchain as a Website**
2. **The Blockchain as a Development Environment**
3. **The Blockchain as Google-like**

It is unfathomable today not to have a Website. Almost every business, organization, entity or individual owns or runs one or several. The blockchain is destined for a similar future.

One role of the Web is to help define an identity for its users, via profiles that we either deliberately create on Websites or that are created



for us based on the Websites we visit. Websites or apps also serve as front doors to our companies, services, products or our personal brands (on LinkedIn, Facebook, a blog, or an artist's Website, for instance).

Fairly soon, every company will operate or be on one or several blockchains, just as organizations have many Websites today. Similarly, we will soon have blockchain-based identities. A plethora of blockchain applications will lead to new sorts of Website-like utility, and blockchains will allow us to interact within new trusted environments that didn't exist before.

For companies, blockchains could be operating in the background of a Website, as reference repositories for the authoritative version of the "truth." They will make available useful information about what has happened, when it happened, who was involved, and what transactions took place. This will be true for commerce, for contracts, for historical records of corporate and personal behavior, and for legal matters, among many others. Blockchains will confirm what actually exists and who owns or is responsible for it. (For more on what this means for finance, see article on page 22.)

Companies must begin to ask what uses would be appropriate for the blockchain, starting with their cur-

rent operations. Just as we all asked, when creating our first Websites, "What information can we publish?", there will be basic questions to answer about using blockchains: What types of (digital) assets can we transfer, manage or create there? What do we need to keep immutable records about? What data or processes can we notarize on the blockchain, so we can later enable peer-to-peer transactions to occur without requiring someone to check them?

The first phase for using the blockchain may involve recording and moving assets, identities, ownerships, contracts, balances, records or data. That will be the equivalent of the electronic brochures that were the first Websites in the mid-90s, and will be succeeded by far more complex uses.

Just as the Web brought us Web applications, the blockchain will usher in blockchain applications. There will be many ways to build them. You will be able to build them natively or mix them within existing Web applications. In theory, just about any software application could be rewritten with some decentralized blockchain element.

As we attempt to understand what will happen next with this peculiar and promising technology, perhaps we should think of 2017 for the blockchain as equivalent to 1995 for the Web. That's when the Java programming language became available, making it easier to create large-scale Web applications. Applications that were written with Java could run on any Java Virtual Machine software, regardless of which kind of computer architecture it resided on. Importantly, blockchains similarly allow programs to execute without requiring developers to be concerned with a specific computer architecture.

But to achieve all this promise, we will need millions of software developers to become proficient with blockchain technologies. (There are less than 20,000 today.) Meanwhile,

over 9 million developers worldwide now program in Java.

Today, we "Google" for nearly everything – information, services and products. Tomorrow, we will search blockchains to perform the equivalent of "Googling" – to verify records, identities, authenticity, rights, work done, titles, contracts, and other valuable asset-related processes. There will be digital ownership certificates for just about everything. We will expect the utmost transparency in all record-keeping.

I still remember the initial excitement around being able to track a shipped package on the Web when FedEx introduced this capability for the first time in 1994. Today we take it for granted, but the introduction of this feature was a watershed. It demonstrated what we could do on the Web. It helped illustrate to a broad public that a previously private service could become accessible to anyone with internet access. A whole host of such services followed: online banking, filing taxes, buying products, trading stocks, checking on orders, and myriad others.

Blockchains cannot be described as a revolution. They are a marching phenomenon, slowly advancing like a tsunami. They have many facets. Just as it took a long time for the internet to infiltrate our world, the blockchain will spread slowly at first, then pick up steam. Today, we're saying blockchain does this or that, but tomorrow blockchains will likely be unremarkable. We will talk more about what they enable.

What is today in a database will tomorrow be in a blockchain. Today, we wonder, "Is it on the Web?" Tomorrow, the question will be: "Is it on the blockchain?"

WILLIAM MOUGAYAR is a Toronto-based investor, blogger, and author of [The Business Blockchain](#) (Wiley, 2016). He is an advisor or board member for some of the world's leading blockchain organizations, including [Ethereum](#), [OpenBazaar](#), [Coin Center](#) and [Bloq](#). He blogs about blockchains at [Startup Management](#).



Can We Balance Human Ethics With Artificial Intelligence?

You are driving along and your car's brakes suddenly fail.

If it swerves to the left, three old men and two elderly women will die. If the car veers to the right, it kills a woman doctor, two babies and a boy and girl.

This question is part of MIT Media Lab's "moral machine," a platform for gathering peoples' opinions on moral decisions made by machine intelligence, such as self-driving cars.

In the coming age of automation and artificial intelligence (AI), such life and death decisions and many other complicated choices will increasingly be made by machines rather than people. ● A lot depends on who determines the value systems for artificial intelligence software. Those values could be carefully and methodically crowd-sourced from society at large or could just reflect the ethics of an overworked programmer racing to meet a product deadline. Since he or she is likely to work at a company that answers to investors, the outcome may not be what we could consider socially responsible. "We should not let Silicon Valley be the mission control for humanity," argues futurist Gerd Leonhard, author of a new book called *Tech versus Humanity: The Coming Clash Between Man and Machine*. ● If autonomous AI software, crunching data far more rapidly than humans, can help eradicate disease and poverty and introduce societal improvements and efficiencies, then we must embrace it, Leonhard says. But "at the same time we have to have governance. And right now there is no such thing." He and others are pushing for human values to be codified ▶

by **Jennifer L. Schenker**
Illustration by **Jeffrey Decoster**





into the design of AI systems.

“Programmers and systems need to implement ethical standards from the operating system level up,” says John C. Havens, author of *Heartificial Intelligence: Embracing Our Humanity to Maximize Machines*. Havens is executive director of the Global Initiative for Ethical Considerations in the Design of Autonomous Systems, formed in 2016 by the IEEE, a large association for engineers, to help incubate new AI standards.

Says Mary Ward Callan, who directs technical activities for the IEEE: “As the IEEE’s mission is to advance technology for the benefit of humanity, we need to determine how we can design in aspects of our human decision process. We have not yet constructed that model.”

In Havens’ book he warns that if ethics are not baked into AI systems, algorithms simply seeking to fulfill their goals may cause harm. In his own book *Superintelligence: Paths, Dangers, Strategies*, philosopher Nick Bostrom of Oxford University imagines an AI that has been programmed to make as many paper clips as possible. It ruthlessly transforms all of Earth and then even increasing portions of outer space into paper clip manufacturing facilities.

Bostrom’s book helped inspire Elon Musk, the CEO of Tesla and SpaceX, to say that AI “is potentially more dangerous than nukes.” Musk, physicist Stephen Hawking and others in the scientific and tech community signed an open letter last year calling for a ban on autonomous military weapons and for work to ensure that AI systems are beneficial to humanity.

Musk is one of the co-founders of OpenAI, a research institute that plans to spend more than \$1 billion to steer AI in a positive direction. Meanwhile, Google, Amazon, Facebook, IBM, and Microsoft have formed The Partnership on AI with

a similar goal. And Stanford University has launched the One Hundred Year Study on Artificial Intelligence, aiming to publish a report on the societal impact of AI every five years for the next century.

Discussion on ethics and AI is not limited to the tech community. A day was devoted to “man-machine convergence” at the giant 2016 Sibos financial services conference organized by SWIFT, a global bank cooperative. Banks already use robo-advisors and will implement



more autonomous AI systems. Says Peter Vander Auwera of SWIFT: “With the growing tension between technology and humanity we need to think through the digital ethics dimensions of an algorithmic economy for financial services.”

Science fiction writer Isaac Asimov formulated “Laws of Robotics,” which include: a robot may not injure a human being or, through inaction, allow a human being to come to harm; A robot must obey orders given it by human beings except where such orders would conflict with the first law. It sounds good, but we’ll need more sophisticated rules than that, many experts have concluded.

The Partnership on AI has proposed its own eight new tenets for people developing the technologies. They include “ensure that AI technologies benefit and empower as many people as possible,” “protect the privacy and security of individuals,” and “remain socially responsible, sensitive, and engaged directly with the potential influences of AI technologies on wider society.”

“Machines have to understand

complex change and consequences if they are going to be empowered with decisions,” says Dr. David Hanson, founder of Hanson Robotics. His company aims to make “friendly and empathic” robots. Its home page optimistically predicts: “In the not-too-distant future, Genius Machines will walk among us. They will be smart, kind, and wise. Together, man and machine will create a better future for the world.”

But Hanson himself warns that “to understand ethics, machines will have to understand not just the big picture and patterns but the human heart.” Yet that is challenging enough for mere people, and we often don’t behave in ways consistent with the values we profess. *Heartificial Intelligence* author Havens asks “How will machines know what we value if we don’t know ourselves?”

If we are going to codify human values into the intelligent systems that surround us, we must have a wider societal discussion about what our common values actually are. There won’t be unanimity, so we will have to develop ways to move forward, even with uncertainty. “I don’t have great faith in the consistency of the human value system,” says AI expert Dr. Ben Goertzl. “By experimenting with AI and ethics in simple situations we will learn more about this topic and what to do. Pontificating in the abstract is not going to be useful.”

The prospect of a national and even global dialogue about what machines should and shouldn’t do—what, in effect, are the bedrock behavioral values of mankind—could ironically subvert the oft-articulated argument that machines are taking us away from ourselves. It’s one thing to spend time staring at a smartphone instead of talking to the family at dinner. But it’s quite another to be forced to say what we value most in order for technologists to proceed.

“How will machines know what we value if we don’t know ourselves?”

One more practical solution might be something called society-in-the-loop artificial intelligence, a concept developed by Iyad Rahwan, an MIT Media Lab associate professor. Rahwan is polling the public to find out what decisions people would want self-driving cars to make. The idea is that through such polls we can train machines to behave in ways people feel fairly reflect their values, much as we agree to allow elected government officials to represent us.

Joi Ito, director of the MIT Media Lab, argued in a recent essay that if this works, human judges could eventually be replaced by AI for legal decisions like bail and parole. But, he says, “this will most likely require making the tools of machine learning available to everyone, having a very open and inclusive dialogue and redistributing the power that will come from advances in ar-

tificial intelligence, not just figuring out ways to train it to appear ethical.” We remain very far from that now.

Meanwhile, further complicating the move towards regulating and restraining our most powerful technologies is the controlling role often played in their deployment by for-profit corporations, including behemoths like Google and Facebook. It’s nice they are professing concern about AI’s impact, but they face other related challenges in retaining our trust and how their work affects society. The algorithms underlying their search and newsfeed software could, for example, be programmed to swing the results of elections almost anywhere in the world. Nobody would know unless a rogue employee turned whistleblower.

Thinking very big, AI expert Goertzel argues that the issues of

trust around AI could lessen over the long term as people become cyborgs and the divisions between man and machines begin to blur. “The way we think about ourselves will change,” he says. “Once an iPhone is inside your head and becomes a part of you and you start networking with other people and robots, there will be less of an ‘us versus them mentality.’” Some may not be consoled by this conclusion.

Author Leonhard argues that the key for now is to better understand where tech ends and where humanity starts. “We need to define what makes us human and decide what should be automated and what should not be,” he says. “We must embrace technology, but we must not become it.”

JENNIFER SCHENKER is editor-in-chief of The Innovator.

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KEN WASHINGTON *Ford Vice President of Research and Advanced Engineering Dearborn, Michigan*

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M O D I F I C A T I O N

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by MEREDITH SALISBURY
Illustrations by JASON HOLLEY



The general public in the United States and around the world has a headscratchingly complex set of attitudes about the science of genetic modification. People are so opposed to foods that have been developed using targeted genetic approaches, better known as GMOs, that such food has been banned in some countries and is under dispute in many others.

Meanwhile, decades of studies have found zero evidence that GMO foods harm people. But paradoxically, when it comes to editing human genomes—particularly for the purpose of possibly curing disease—many in the general public are eager to press forward. Yet in this area scientists themselves call for caution, out of concern for how little is known about the long-term ramifications.

For the first time in history we are equipped with tools to genetically alter ourselves and the organisms around us. But what’s scientifically possible is rapidly outpacing society’s ability to make informed decisions. Given the social and scientific complexities, where should we push ahead—or hold back?

One obvious cause of the public’s unpredictable and sometimes irrational reaction to genetic modification is ignorance, a result of the poor state of basic scientific education. In a survey of more than 1,000 Americans conducted by Oklahoma State University, 82% of respondents supported mandatory labeling for foods produced with genetic engineering. But nearly the same amount, 80%, supported mandatory labeling for foods containing DNA. How can we look to the public for useful input about DNA modification when most people don’t even know that all foods contain DNA?

Opposing genetic modification is not ignorant or wrong per se, but it’s hard to have an informed debate when so many opinions are formed without an understanding of the science or with religious bias. At this point the possibilities in genetic modification are moving so quickly even experts have trouble keeping up.

Genetic modification takes many

forms. Some methods have been in use for hundreds of years, while others go so far as to design completely new organisms. Attempts to modify natural species began with plants and animals, primarily crops and livestock. Much of the history of agriculture has involved breeding different strains of a plant or animal to produce more desirable traits. Today, these same approaches are used in conjunction with cutting-edge biotech programs to make crops and livestock more productive and better able to withstand climate changes. Maize, rice, coffee, and other crops are being improved in ways that most people would consider natural.

But take this approach a step further—say, introducing a hardier gene from a related plant species using genetic targeting, rather than traditional breeding—and suddenly you’ve reached the territory of GMOs, or genetically modified organisms. GMOs are developed in labs where scientists turn a gene on or off, or splice in a gene from another organism. GMOs include tomatoes with longer shelf lives and pest-resistant corn that needs less toxic pesticides. Despite such advantages, fears of what the public perceives as “Frankenfoods” have fueled much outcry. But in countries where feeding rapidly growing populations is a

challenge, GMO crops and livestock have been more readily accepted.

Many health experts believed people would more likely accept GMOs when there was clear-cut medical benefit, but what happened during the 2016 Zika epidemic challenged that theory. As the mosquito-borne virus marched toward U.S. shores, leaving thousands of babies with microcephaly in its wake, scientists suggested releasing genetically modified mosquitoes. They believed that might stem the epidemic by preventing mosquitoes known to carry Zika from successfully reproducing. In the Florida communities where these releases were considered, people mobilized quickly to protest. Placards in yards announced: “No consent to release of genetically modified mosquitoes,” while town meetings echoed with objections. The fear of Zika, it turned out, paled in comparison to the fear of unintended consequences from GMO mosquitoes.

So far, editing genes in bacteria hasn’t provoked a similar public outrage. With the right genetic tweaks, bacteria can become tiny factories, churning out everything from human insulin to spider silk to compounds needed to make paint. Such work is already widespread. But eager to avoid having it tarred by the GMO brush, the industries involved generally try to associate these techniques with fermentation, a natural process in which bacteria convert something we don’t care about into something we do.

The gene editing technique that has gotten the most attention recently, known as CRISPR, is based on a naturally occurring mechanism that protects bacteria from invaders. In the lab, it allows scientists to edit virtually any genome with breathtaking specificity by targeting a certain genetic sequence and swapping in a new one. In a remarkably short time, CRISPR has gone from concept to widely utilized method for introducing targeted genetic changes in plants, animals, and bacteria.

In this arena, scientists are ex-

pressing more alarm than the public, especially regarding CRISPR's use to modify humans. In meetings and editorials, leading researchers have been calling for a moratorium on using CRISPR to edit human genes that could be passed on to subsequent generations, though some scientists in China and other countries are nonetheless moving ahead. While editing genes to cure someone of a disease is considered acceptable, inducing changes that become heritable is, quite frankly, freaking many scientists out. After all, these kinds of modifications could alter the course of human evolution or lead to any number of unforeseen consequences. "The overriding question is when, if ever, we will want to use gene editing to change human inheritance," said Nobel laureate David Baltimore in a 2015 meeting.

The biggest editing feat of all would be to create an entirely new genome—a man-made organism—and scientists are already making significant progress. In the past few years, researchers at the J. Craig Venter Institute assembled DNA into a novel bacterial genome and inserted it into a cell, essentially booting up a new organism that then successfully reproduced.

Other scientists have rallied the research community to launch a considerably more ambitious project to create an entire synthetic human genome. Such a man-made DNA sequence could theoretically boot up the world's first "designed" human. Led by futuristic thinkers including Harvard professor George Church and Autodesk research scientist Andrew Hessel, the idea is that now that we can read a genome (that is, sequence it), the next step is to write one. In a publication announcing the idea, the scientists argued that the project could address many health challenges even as they welcome the inevitable discussion about possible regulation. They said that if they were to succeed it could enable us to grow human organs for transplantation, engineer resistance to cancer



and viruses, and accelerate vaccine development.

The scientific push to figure out what's possible in editing genomes has yet to sufficiently wrestle with the moral questions around whether we should. Among the conundrums: will editing or designing human genomes contribute to inequality by creating a group of genetically improved people? And how much should public opinion matter if the public continues to be uninformed? At this point, it seems unwise to proceed with genome editing for many human health purposes when

even researchers themselves widely disagree. No doubt each case will need to be considered one by one.

While ethicists and lawmakers figure out what to debate, it's likely that scientists will continue to surprise the public with new revelations about what is and isn't possible. In the meantime, the only thing we can say for sure is that the future of both genome editing and public attitudes toward it is wildly uncertain.

MEREDITH SALISBURY is a longtime genomics journalist and a communications consultant in life sciences.

THE SCIENTIFIC PUSH TO FIGURE OUT WHAT'S POSSIBLE IN EDITING GENOMES HAS YET TO SUFFICIENTLY WRESTLE WITH MORAL QUESTIONS ABOUT WHETHER WE SHOULD.

Artificial Intelligence (AI) may be the single most disruptive technology the world has seen since the Industrial Revolution. Granted, there is a lot of hype out there on AI, along with doomsday headlines and scary movies. But the reality is that it will positively and materially change how we engage with the world around us. It's going to improve not only how business is done, but the kind of work we do, while unleashing new levels of creativity and ingenuity.

In fact, research from Accenture estimates that AI could double annual economic growth rates of many developed countries by 2035, transforming work and fostering a new relationship between humans and machines. Accenture projects that AI technologies in business will boost labor productivity by up to 40 percent. Rather than undermining people, we believe AI will reinforce their role in driving business growth. As AI matures, it will potentially serve as a powerful antidote for the stagnant productivity and shortages in skilled labor of recent decades.

While it is early days, we are already seeing AI's impact. Combined with cloud, sophisticated analytics and other technologies, it is starting to change how work is done by both people and computers. It's also changing how organizations interact with consumers, sometimes

in startling ways.

AI is flourishing now because of the rise of ubiquitous computing, low-cost cloud services, near unlimited inexpensive storage, new algorithms, and other related technology innovations. Cloud computing along with advances in Graphical Processing Units (GPUs) has provided necessary computational power. AI algorithms and architectures have progressed rapidly, often enabled by open source software.

But equally important is a vast increase in the availability of data. AI does not think for itself. Its insights are possible because the software gets fed information, and the more information it gets, the more insight it can produce. Over the last decade, crowdsourced data in particular has proliferated on internet and social media. People in their daily lives upload massive quantities of images, videos, social media comments, and chat dialogues. That labelled data is available for machines to use in what's called machine learning.

While many believe that AI will supplant humans, we think it will instead mostly enable people to do more exceptional work. Certainly, AI will cause displacement of jobs, but it may also significantly boost the productivity of labor. Innovative AI technologies will enable people to make more efficient use of their time

and do what humans do best – create, imagine and innovate new things.

With technology overall and AI in particular, the key ingredient for success and creating value is taking a “people first” approach. But to make this transition means both companies and governments must acknowledge the challenges and change how they behave. They must be thoroughly prepared-intellectually, technologically, politically, ethically and socially.

Governments and businesses will need to take several steps, many of which are not easy:

PREPARE THE NEXT GENERATION:

Re-evaluate the type of knowledge and skills required for the future, and address the need for education and training. AI presents the opportunity to prepare entirely new sorts of skilled and trained workers that do not exist today. This training should be targeted to help those who are disproportionately affected by the coming changes in employment and incomes.

ADVOCATE FOR AND DEVELOP A CODE OF ETHICS FOR AI:

Ethical debates, challenging as they will be (see article on page 30) should be supplemented by tangible standards and best practices in the development and use of intelligent machines.

ENCOURAGE AI-POWERED REGULATION:

Update old laws and use AI

Artificial Intelligence Will Change the Face of Business

It could double economic growth rates in developed countries, writes Accenture's CTO.

by Paul Daugherty



itself to create adaptive, self-improving new ones to help close the gap between the pace of technological change and the pace of regulatory response. This will require government to think and act in new ways appropriate to the new landscape, and means more technologically-trained people must play an active role in government.

WORK TO INTEGRATE HUMAN INTELLIGENCE WITH MACHINE

INTELLIGENCE: Businesses must begin reimagining business processes, and reconstructing work to take advantage of the respective strengths of people and machines.

The market demand and opportunity for AI is expanding rapidly, with analyst firm IDC predicting that the worldwide content analytics, discovery and cognitive systems software market will grow from \$4.5 billion in 2014 to \$9.2 billion in 2019. In fact, Accenture's Technology Vision 2016—research that gathers input from more than 3,100 global business and IT executives—found that 70% are making more investments in AI-related technologies than two years ago, with 55% planning to use machine learning and embedded artificial intelligence. Equity financings for AI companies have risen from \$282 million in 2011 to \$2.4 billion in 2015, according to researchers at CB Insights. AI patents are being granted at a rate five times greater than 10 years ago. AI start-ups in the U.S. alone have increased 20-fold in just four years.

A major Italian government agency offers a good example of how AI can dovetail with the work people do and enable them to be more effective. Employees there were spending the majority of their time attending to routine customer queries. The agency worked with Accenture to automate the process with AI. An intelligent Virtual Agent application now handles real-time voice calls and webchat interactions, using a

combination of cognitive-semantic analysis and machine-learning algorithms. After just three months, the Virtual Agent application has already successfully served more than 70,000 users. Employees can now take on more demanding and rewarding tasks, which can positively impact their engagement.

AI is also positively impacting how governments operate. Singapore's Safe City program uses the latest in video analytics and image recognition to assist in public safety. It increases security, delivers services more effectively and makes more efficient use of city resources.

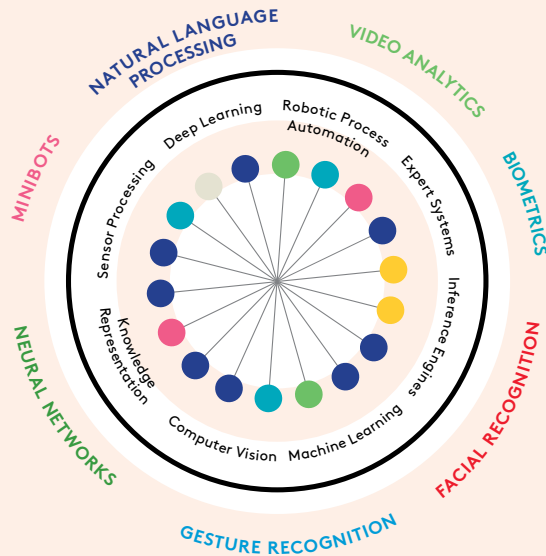
The Accenture Institute for High Performance and Accenture Technology, in collaboration with Frontier Economics, modeled the impact of artificial intelligence on 12 developed economies that together generate more than 50 percent of the world's economic output. The research compared the size of each country's economy in 2035 under a baseline scenario, in which economic growth continues under current conditions, with an AI scenario, in which the impact of AI has been

absorbed into the economy.

AI was found to yield the highest economic benefits for the United States, increasing annual growth from 2.6 percent to 4.6 percent by 2035, translating to an additional \$8.3 trillion in gross value added (GVA). In the United Kingdom, AI could add an additional \$814 billion to the economy in the same period. Japan has the potential to more than triple its annual rate of GVA growth by 2035, and Finland, Sweden, the Netherlands, Germany and Austria could see their growth rates double.

AI can empower people to create, imagine and innovate at entirely new levels to drive growth and productivity. Far from simply eliminating repetitive tasks, AI should put people at the center, augmenting the workforce by applying the capabilities of machines so people can focus on higher-value analysis, decision-making and innovation.

PAUL DAUGHERTY is chief technology officer at Accenture, overseeing technology strategy and innovation for the global professional services firm. More on AI at Accenture.com.



Artificial Intelligence is not just one technology, but rather a variety of different sorts of software that can be applied in numerous ways for different applications.



Just over twenty years ago, activist and internet pundit John Perry Barlow wrote a Declaration of the Independence of Cyberspace, motivated partly out of idealism and partly because he was angered by the U.S. Congress' passage of the 1995 Telecommunications Act (one of the

first times Congress sought to extend its laws and regulations to cyberspace). At the time, Barlow extolled the virtues of a system that not just spanned, but transcended identity, space, sovereignty, and geography: "We are creating a world that all may enter without privilege or prejudice accorded

by race, economic power, military force, or station of birth...a world where anyone, anywhere may express his or her beliefs, no matter how singular, without fear of being coerced into silence or conformity... Your legal concepts of property, expression, identity, movement, and context do not apply to us. They are all based on

Whatever Happened to the Internet's Promise?

by Simone Ross
illustration by Jon Han

"You do not know us, nor do you know our world. Cyberspace does not lie within your borders." - John Perry Barlow, 1996

matter, and there is no matter here.”

Today, many still gravitate towards the kind of techno-utopianism expressed in Barlow's declaration. Such idealism feeds into – and helped build – a massive global social movement around free culture and cyberspace. And perhaps it does offer us a powerful outline of what *should* be the ultimate governance of cyberspace: An arena that is uniformly equitable and enlightened, a benign and ever-growing ecosystem that interweaves people and machines through networks, the cloud, analytics and artificial intelligence. The digital revolution and resulting “democratization” of everything promised to lead us to a wealthier, healthier, more equitable world, one that brought us closer together, erasing both physical and virtual boundaries.

But unfortunately that is not the world (or cyberspace) we live in today.

We're not even close. We've just witnessed a brutal, divisive, made-for-reality-TV embarrassment of a U.S. presidential election. Parochial and nationalistic leaders around the world are making gains. We watch the progress of hate-filled groups like ISIS and Boko Haram, the decimation of countries including Syria and South Sudan, and the displacement of more than 65 million people globally in recent years. That's one refugee for every 113 people on the planet, according to the UN Refugee Agency. Borders clearly still matter. The UK voted for Brexit, Donald Trump probably still wants to build a wall to keep out Mexicans, and the refugee crisis is reconfiguring the politics and borders of Europe.

Not only that, but borders are hardening in the virtual world, too. There's the Great Firewall of China and the widespread emergence of internet “walled gardens.” Countries demand “data sovereignty,” insisting that information about their citizens in what is misleadingly called “the

cloud” be stored on physical servers located within their borders. Then there's the growing plague of cyber warfare and cyber attacks, ranging from the North Korean hack of Sony to Russia's attack on American political institutions.

We can't ignore the fact that tech enables insularity and hostility as readily as openness. Numerous countries “turn off” the internet or services like Twitter to prevent open discourse – including Brazil, Gabon, India, Iraq, Iran, Saudi Arabia, Syria and Turkey. A world where networks and algorithms only show us what “we want to see” is no recipe for inclusion. And with half of humanity still disconnected, lack of access to the internet is a major barrier in itself.

Yet our lives, businesses, and institutions will continue to march towards the digital and virtual. So we need to figure out who should control or manage the sprawling network our 21st century world operates on. Should it be national governments? The UN? A yet-to-be-created multi-stakeholder global entity? Corporations? Citizens? Is it really possible to force a system that was designed not to respect borders to do so?

I remain optimistic that we can overcome our challenges. Humans are after all brilliant, inventive, creative survivors. Connectivity is bringing us together, both online and in real life. And tech has certainly led to a more transparent world, one in which visibility can build moments and movements.

The potential of technology to change our world remains endless, limited only by our imaginations and our dated institutions. Satellites the size of tissue boxes now shoot into orbit to help us measure, monitor, and optimize how systems work on earth. Drones are used not just for military airstrikes but also for delivering humanitarian aid. Preci-

sion and vertical farming may help feed the world. And we can 3D-print almost anything.

Even more promisingly, the line between tech and science is growing blurrier. Synthetic biology has cross-industry applications from agriculture to manufacturing. Genome editing tool CRISPR allows us to edit DNA with precision (see page 34). As our ability to manipulate both the biological and physical world increases, it seems a lot less like science

The potential of technology to change our world remains endless, limited only by our imaginations and our dated institutions.

fiction to talk about the potential of a future sentient ecosystem that adapts to and intuitively meets our needs.

So, as we move towards a world in which we can foresee the potential of a genuine symbiosis of humans, intelligent machines and the physical world, how do we ensure it is a better one? The contrast between Barlow's ideals for cyberspace and our current reality gives us something to strive for. The cyber world envisioned in the Declaration is one in which individual liberty is ensured and social, economic, and political divisions are erased.

Is such a thing possible? Can we take the best of that vision and apply it to the physical world? I refuse to rule it out. But we cannot reduce our world to bits and bytes, ones and zeroes. People are more than just data generators and consumers. Our technology, the industries that create it, and the systems that govern it must respect human complexity if they are to give us tools that help us create a better future. I'm confident they can.

SIMONE ROSS is co-founder & chief program officer of Technomy.

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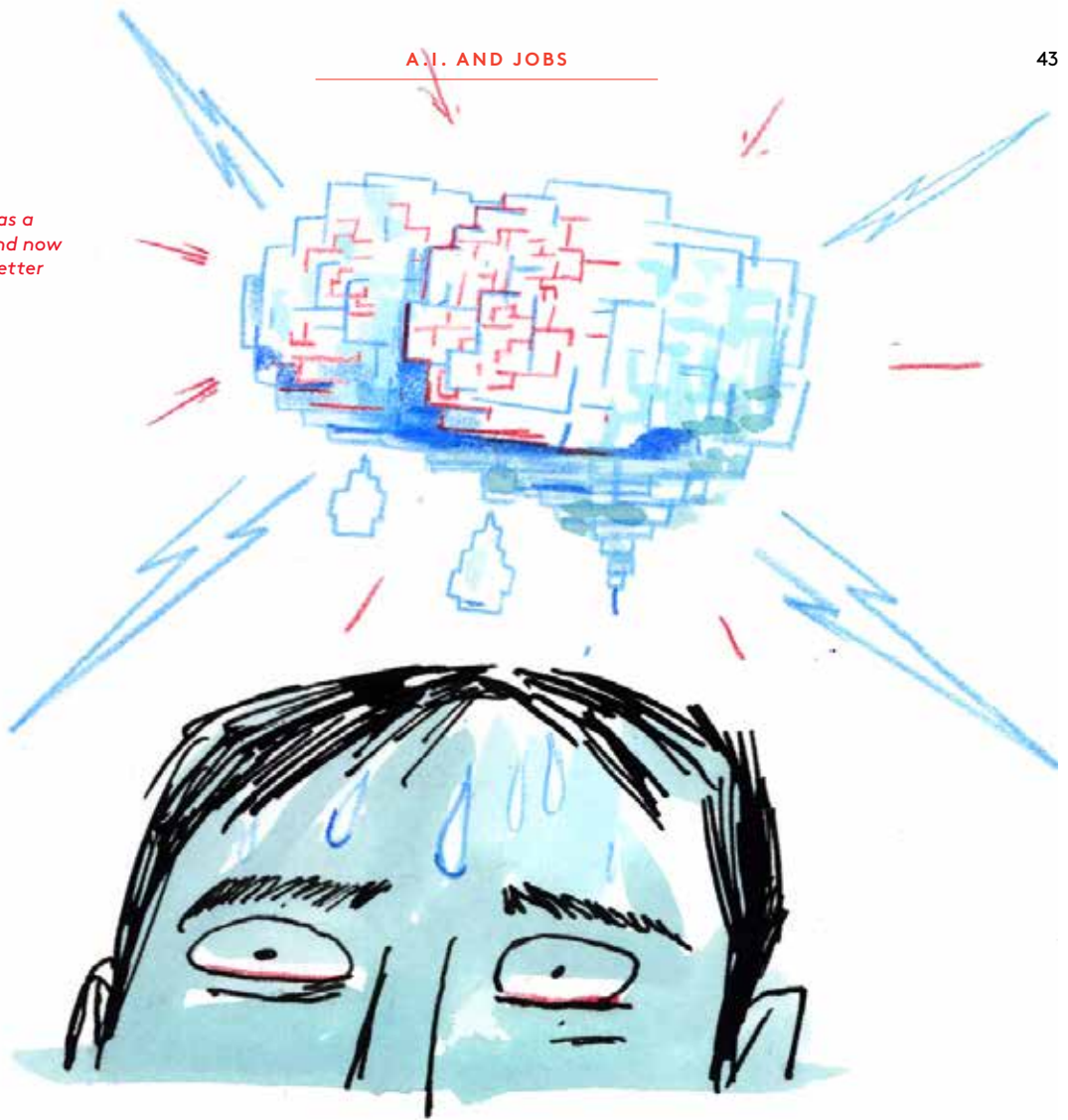
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"Thirteen years as a financial analyst and now some AI does it better than me?"



"I...don't have a job." The thought was colorless in Dinesh's head. The news earlier that afternoon had struck him like a concussion. "Thirteen years as a financial analyst and now some AI does it better than me."

The office was nearly empty. The announcement had cleared the entire floor. "Dozens of analysts replaced

in Midtown," said a voice from a big screen beaming CNBC from the wall. Some geeky blonde talking head was rambling wild-eyed about "the hyperinflation of work," as they made his personal disaster into chatty entertainment for the viewers.

"If you're doing the same job next week as you are today," the blonde

said, "someone like me is going to start thinking, 'I bet I can build an AI to do that cheaper, faster, and better.' The skills that bought you a job yesterday won't be enough to keep it tomorrow."

"I'm convinced we can retrain displaced workers," opined another talking head who seemed to be all mustache. ▶

Scene From an Office, 2017: The A.I. Arrives

Dinesh hadn't really seen this coming. ▼

Story by **Vivienne Ming**
Illustrations by **Graham Roumieu**

“The rate at which the technology is developing means there’s no time for retraining,” the blonde replied. “By the time you’ve gone through a degree program, or even just a job retraining, your new skill set will already be getting obsolete.”

Dinesh wasn’t really listening. The words just washed over him as he tried to get a grip on his feelings.

The blonde went on: “This isn’t just about ‘upskilling’ low-skill workers. Cognitive automation makes nearly everyone vulnerable. Radiologists or field workers, truck drivers or financial advisors — we don’t need those traditional jobs anymore. AI’s do them better. Today, we only need problem-solvers.”

“They don’t need me...but I did everything right,” Dinesh thought, back at the bank. He was smart and educated. He worked hard, had earned the right degrees, and



The blonde went on: “Cognitive automation makes nearly everyone vulnerable. Today, we only need problem-solvers.”

learned the arcane tools that were supposed to assure his indispensability. Dinesh may not have loved being an analyst, but he could read a Bloomberg terminal like a radiologist reads an x-ray. Now it turns out an AI can do both of those things better than he can.

“The damn thing has actually

been secretly watching you for the last six months,” his manager had told him as he broke the news earlier that day. “It’s some SaaS company that sells a reinforcement-learning deep neural network. You know, like that AlphaGo thing that beat that guy at Chinese checkers a few years ago. Turns out you’ve actually been training it to do your job this whole time. The CEO decided to flip the switch when he saw how much more the firm would earn. Quite frankly, if he didn’t, we’d probably have been driven out of the market within a year, even if no one seems to understand the AI’s decisions half the time.”

Dinesh had heard that a couple people were staying on, even getting promoted. He wasn’t surprised to hear that Angelica was one of them. Sometimes he’d felt sorry for her; she always seemed so awkward, on those rare occasions when she socialized outside work. She must have spent more nights at her desk than in her bed. Financial models and data science was who she was. Now she’d be part of some elite bleeding-edge team, inventing new solutions for clients.

“I guess I’m happy for her,” Dinesh mumbled to himself, “but I never wanted a life as some quant savant.” He’d had passions growing up — he’d wanted to help people with traumatic brain injuries like his brother. Still, part of growing up for him had been setting those dreams aside. He’d been taught by his parents and at school to earn good grades, go to the right school, and get the right job. He worked hard in this crappy office so that he could enjoy his life away from it. (And, he had to admit, to impress his family and friends.) “I can’t just start over again. I can’t build a whole new career from scratch.”

The blonde on the news kept talking through Dinesh’s numbness. “Our data show that jobs are becoming strongly bimodal as AIs improve. Employees are either moving up



Dinesh knew there were still elite engineers in the building, doing things with algorithms and databases, but he wasn’t going to join their ranks at this point.

into cutting-edge creative fields or down into mid-skill or even low-skill service positions.”

Dinesh sat up with pained recognition. “That’s me!” The company had offered to pay for retraining, but at only half his salary. He’d basically be customer support at some call center. Dinesh had heard complaints by lower-skilled workers — drivers, mechanics, warehouse labor — about losing their jobs to automation. But he’d always heard they were getting retrained into...well, some other job.

The mustache interjected: “But the new economy is hungry for talent. Competition for the right employee is brutal. I’ve said it before, this is just like the agricultural and industrial revolutions. As jobs are destroyed we’ll see vastly more new jobs, and whole new economies being created, just like the retrained weavers and iron smiths of 100 years ago.”

Dinesh had heard protesters on the news saying that as soon as they learned a new skill it was already obsolete. He thought they were just being lazy; now he was like them. The company had even offered to send him to coding bootcamp so he could become a developer.

“Programming?” he’d thought. No, he’d pass on that. Just last year the company had gone through a wave of layoffs after buying a DaaS

(development-as-a-service) platform. You describe to a chatbot what you want the software to do, and five minutes later you have a new feature, new analysis, or even a whole new product. Not only did you not need programmers to make new apps, you didn't even need to type.

Dinesh knew that there were still a few teams of elite research engineers somewhere in the building, doing cutting-edge things with algorithms and databases, but he was never going to join their ranks at this point.

"No. It isn't like the industrial revolution," the blonde on TV pounced. "Most of those new jobs are also being filled by AIs. We don't need lever-pullers; we need creative, adaptive problem-solvers. Whatever your industry, that will be the only job description. The rest is details."

"That's exactly my point! AIs are taking up these dull, repetitive jobs," the mustache responded, "freeing people to pursue their passions, to become scientists and artists. Like Burning Man...or something," his techno-utopian vista seemed to be running out of steam.

"You're right AI is amazing,

"By the time you've gone through a degree program or job retraining, your new skill set will already be getting obsolete."

and its development shouldn't be hobbled because of fear," the blonde agreed. "We sure as hell shouldn't be sending people down mines if we don't have to. But we need social institutions to keep pace. People aren't magically creative or gritty or any of the other qualities that make us 'robot-proof'. It takes 20 years to a 'build' a problem-solver. It takes liberal arts, and exposure to culture, and even learning to deal with repeated failures. Instead, we train people with static skillsets to fill specific jobs. All that misinvestment has turned human capital into a toxic asset. We have no idea what it will be worth in five years, but almost certainly much less than we invested. Even an insightful World Economic Forum report wrongly thought 'cognitive' jobs would be protected. If we start now, though, we do know how to grow problem-solvers..."

Dinesh tuned them out again.



Dinesh had always felt those people were just the lunatic fringe. But today it finally gave him a reason to keep going.

What did it matter? No one was "magically" changing him now. He'd taught some damned machine to do his job better than he could, without even realizing it. The only job he had any hope of getting now was as a caring voice on a phone.

The mustache wasn't giving up the fight. "With the huge increase in connectivity and access to information over the last year, a kid anywhere in the world can become a data scientist, conducting analyses using cloud resources such as Amazon Web Services and R, an open source language for statistics. Overnight we've turned them into problem solvers, and innovators."

"Wait," Dinesh thought, "weren't those lines right out of that book, *The Second Machine Age*? It's like this guy thinks everyone else is just like him—rich, educated and motivated, and all anybody needs is a mobile phone to unleash their pent-up creative potential."

"WHAT THE FUCK AM I GOING TO DO?!" he shouted at the empty office. "Am I just useless now?" He suddenly felt a divide that had always split the world and the wrenching alienation of unexpectedly getting onto the wrong side. "Next up," the host was saying on the screen..."The primaries are over. Can a campaign with the slogan 'Burn It Down' win the White House?"

Dinesh watched the clip and shots of an angry rally. He'd always felt like those people were just the lunatic fringe. But today it made him finally feel something—a purpose, a reason to keep going. It was more than anyone else was offering him.

VIVIENNE MING is a neuroscientist and entrepreneur. She co-founded Socos, to apply machine learning in education.

Giving Shape to Technology in New York

Newly-formed Tech:NYC draws together tech companies large and small to work with government, build industry ties and cultivate critical tech talent.

As every company becomes a technology company, tech becomes ever more central in New York, the global economy's heart. When we look out our windows at Technomy on West 22nd Street, we look in the windows of AppNexus, an adtech company with over 1,000 employees. Local streets swarm with programmers and startup employees. Accelerators and co-working spaces are on nearly every block. So we applaud the emergence of a new organization to give more shape and influence to the tech industry here. Tech:NYC was founded in 2016. Its co-chairs are Tim Armstrong, CEO of AOL, and Fred Wilson, managing partner at Union Square Ventures. Technomy spoke with Wilson and Tech:NYC Executive Director Julie Samuels about the organization and tech in New York. (Our own second annual Technomy NYC conference is May 17, 2017.)

TECHONOMY: Why Tech:NYC?

JULIE SAMUELS: The tech industry is becoming a bigger part of New York's economic pie and many of the city's cornerstone tech companies are maturing. It's an effort to organize the industry's companies, leaders, investors, etc., to help benefit not only our industry, but the city we all love. To say it more simply: we're growing up and it's time to act like it.



Tech:NYC Executive Director Julie Samuels came to New York to run the organization co-chaired by AOL CEO Tim Armstrong, left, and venture capitalist Fred Wilson of Union Square Ventures.

FRED WILSON: The New York tech community has always been engaged with the city and the world but it has largely been a few leaders of the community who have done this work and we feel like we need much broader engagement and representation.

“New York is the global leader in broad-based innovation”

- Fred Wilson

What kind of programs do you expect? What is success?

FW: Success is getting every “tech company” large and small to be a member and to participate actively. Our programs range from “Meet the Senator” events, to networking for the community, to participation in policy-oriented groups working on a distinct issue (for example drone policy in New York).

JS: A big part of our job is to support and champion New York City as the best place to build and grow a tech company, which in turn will help attract the kind of talent we need to support our robust and growing ecosystem.

Is New York sufficiently appreciated as a center for tech?

FW: We’ve come a long way on this one in the past twenty years but we can still do more. There are still young talented people with the technology skills we need who feel like they have to go to the West Coast to pursue a career in tech. Until that ends, our job is not done.

JS: We’re getting there! But a lot of work to do still. Needless to say, New Yorkers aren’t really going to settle for being second best.

Is the comparison with SV useful or valid?

FW: The better approach is not to compete for tech leadership with Silicon Valley, but to focus on innovation more broadly and explain that New York is the global leader in broad-based innovation and that tech is a key driver of that.

JS: It’s not a zero-sum game. That said, I have no doubt that New York is primed to be the leader in the next generation of tech innovation, especially when you think about where that innovation is most likely to take place: integrated into other industries. For example, think about blockchain technology and the financial sector, or drones and the future of logistics and infrastructure. That’s all going to happen here.

How are we doing in attracting engineers and programmers?

FW: We have focused too much on attracting tech talent to move to New York (which we are doing a fantastic job on) and not enough on developing our homegrown talent. We have been focusing a lot more on it in the last five years. Efforts like CS4All in our K-12 system and Cornell Tech in higher ed are two well-known examples. But there are literally hundreds of efforts, large and small.

JS: The City recently partnered with City University of New York to create 85 new entrepreneur visas in a forward-thinking and exciting program, IN2NYC.

Tech:NYC emphasizes civic engagement. What could be different in our city and country if more tech people focused on government?

FW: We need more experienced and skilled people there. Maybe this is an on-ramp for that.

JS: We can also do a better job of cutting through bureaucracy to improve the way government serves its citizens. Technologists and entrepre-

neurs are the most optimistic group of people I’ve ever met. They get to work to fix problems.

What policies does New York need to “assure its pre-eminence in the global innovation economy,” as your Website puts it?

FW: We need the people in the City and State governments to understand the issues that impact our sector better than they do now. And we need to work with them to enact laws and regulations that are well thought through. We need them to understand how important the tech sector is and will be, and then work with us to attract more companies, talent, and business here.

What makes New York different for tech-oriented companies?

FW: New York is the proverbial melting pot. It is where people of all mindsets come to work and live together. These “collisions” result in the sparks that light up innovation. But the innovation that happens in New York is not limited to tech. It is in theater, energy, health, transportation, and even government. Tech is a big piece but not the dominant piece. That makes New York tech different and special.

JS: This is also the best place to figure out the tough policy questions - we all live, commute, work, and play on top of each other. So we need to co-exist across industry, class, ethnic divide—you name it. It’s what I love most about New York and it’s why I’m so excited to do this work here.

At Eyebeam, Tech Meets Poetry and Aesthetics

by David Kirkpatrick

This Brooklyn incubator doesn't care if you call yourself an artist or an engineer, so long as you're making things that matter.

"We think artists are at the tip of the spear when it comes to cultural change, so they should be involved in the discussion about culture and technology," says Roddy Schrock, sitting in a cavernous space in Industry City, Brooklyn. Schrock is executive director of Eyebeam, an incubator where art meets tech. People come here to find the poetry, beauty, and even the soul of technology. At a time when every day zooms by in a blur of screen-inflected interaction, blitzkrieg news, and hyperventilated entertainment, distorted further by the sheer public nature of our digital selves, the work this institution does is urgent. How do we find a center amidst all the digital tumult?

Each year Eyebeam welcomes fellows – in fall 2016, five out of 450 applicants – for a \$32,000 stipend and year-long residency. Others stay for shorter periods. "They can be an engineer, a coder, or make new sculptural work using technology," explains Schrock. "The goal is to create a protected space for the creation of the new." Who wouldn't want to be part of that?

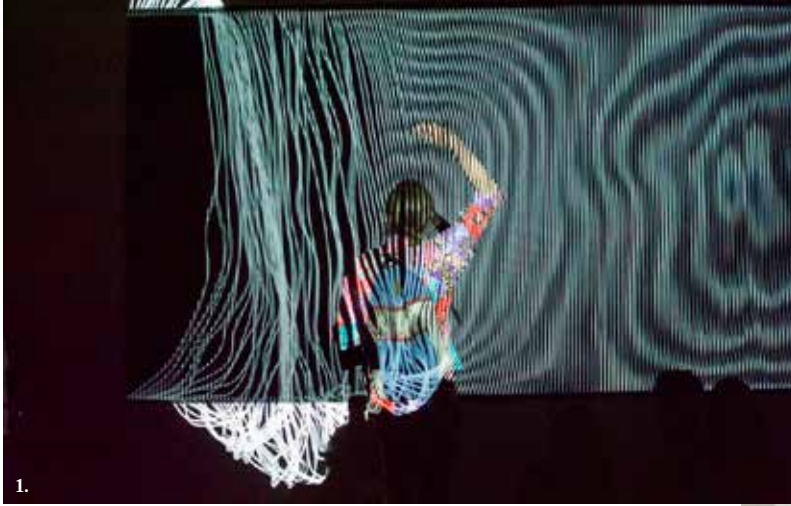
Eyebeam's eminent heritage goes all the way back to 1997, when philanthropist and filmmaker John S. Johnson III got together with friends and envisioned a sort of atelier for digital creativity. The first "share" button for digital content emerged there. BuzzFeed, one of today's most important digital media companies, was incubated at Eyebeam by Johnson and Jonah Peretti. In addition to numerous artworks with digital elements, its colloquies have generated institutions including one called the Center for Poetic

Computation.

On a recent visit, we found Sarah Grant and Amelia Marzec working on an upcoming conference called Radical Networks for artists and activists whose work involves networks. "What are the aesthetics of a network?" Grant asks. "I don't know anyone who can answer that question." It's the kind of thing Eyebeam exists to explore. We also met Morehshin Allahyari, who

makes 3D-printed reconstructions of antiquities destroyed by ISIS in the Middle East, paired with digital records on each one's history. She focuses on the politics as much as the poetics of technology. Says Schrock: "Part of our job is to create a space where you can just say you're an artist. And if you don't want to be, you can be an engineer. We want to challenge peoples' notions of what an artist or an engineer is."





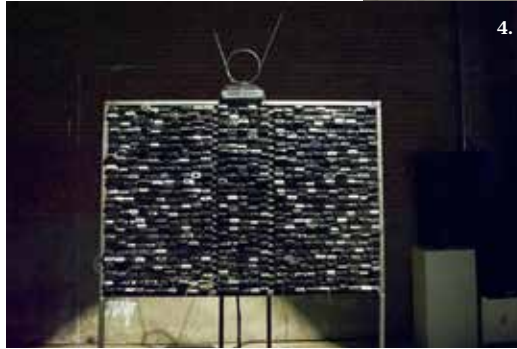
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1. Among artworks that have emerged from Eyebeam is *Nervous Structure (field)* by Annica Cuppetelli and Cristobal Mendoza.
2. Richard The installs *The Unresolved Image*, a fractal-like photograph with microscopic detail he made with Frederic Eyl. Collaborations are common at Eyebeam.
3. Architect and artist Annelie Koller, whose work seeks "a new language of design for a post-human era."
4. Chris Shen's work, *Infra*, is made of 625 TV remote controls. He rewired them to broadcast TV via their internal infrared LEDs. You use special goggles to see the image.
5. Eyebeam moved in 2014 from quarters in Manhattan to this capacious studio in Brooklyn's Bush Terminal/Industry City.

Techonomy asked our community to weigh in:

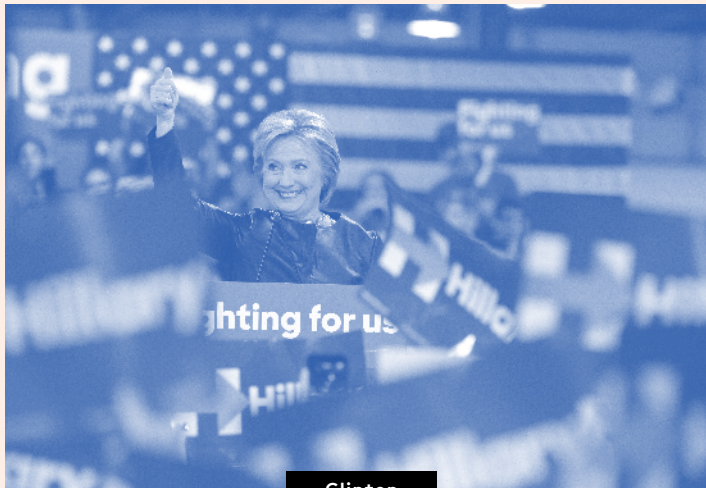
What is the most important tech-related issue for the incoming administration?

“Encryption”

“The visa process for talented individuals from other countries to stay and work at technology companies here. We’re doing the country a disservice by throwing out talented and extremely useful individuals.”

ANTHONY DIMARE,
Co-founder and CEO,
Nautilus Labs

DAN’L LEWIN, Corporate Vice President,
Technology and Civic Engagement, Microsoft



Clinton

Her detailed policy proposals generally align with priorities the Techonomy community identified.

“How to actually implement its programs! Peoples’ expectations for all ser-

vices, including those provided by government, are increasingly set by consumer mobile and web applications, with near-instantaneous response time and close attention to user experience. The utter failure of government services to meet those expectations undermines faith in government, increases the cost of delivering its services, and ultimately, contributes to

the failure of policy options that are often so fiercely debated.”

TIM O’REILLY, CEO, O’Reilly Media

“Cybersecurity”

DIANA FARRELL, CEO, JPMorgan Chase Institute

“Our antiquated immigration policies, especially for tech companies. We are losing some of the best talent in the world.”

BRETT A. HURT,
CEO and Co-founder,
Data.world

“How do we educate angry people who are being left behind because of skills made obsolete by the unstoppable forward motion of technology?”

JULIO OTTINO, Dean, Robert R.
McCormick School of Engineering
and Applied Sciences,
Northwestern University

“We need rational decision-making at the pace demanded by world events. Yet marred with political stalemate and asphyxiating decision processes, the U.S. government’s ability to act on and adopt new technologies has slowed to a crawl.”

PETER PLATZER,
CEO Spire Global

“Cyber security will be the most important technology issue the next administration will have to deal with, along with the trade-offs between cyber-security requirements and maintaining an open Internet system.”

MERIT JANOW, Dean, School of
International and Public Affairs,
Columbia University

"Hacking can be carried out anywhere and everywhere, potentially involving multiple networks in obscure locations. It defies conventional retaliation and protection strategies. As then-U.S. Defense Secretary Leon Panetta warned in 2012, given its current systems the United States is vulnerable to a "cyber Pearl Harbor" that could derail trains, poison water supplies, and cripple power grids."

CARLO RATTI,

Founder, Carlo Ratti Associati (design consultancy) and Director, SENSEable City Lab, MIT

"The role technology must play in solving climate change."

GERNOT WAGNER,

Research Associate and Lecturer, Harvard School of Engineering and Applied Sciences

"How might technology disrupt unemployment?"

And where might technology create the next job market?"

JOHN SUH, *Executive Director, Hyundai Ventures, Hyundai Motor Group*

"The U.S. economy is built on innovation and inventiveness and we must make it easier for highly educated and skilled workers to stay in the U.S. and apply those skills here."

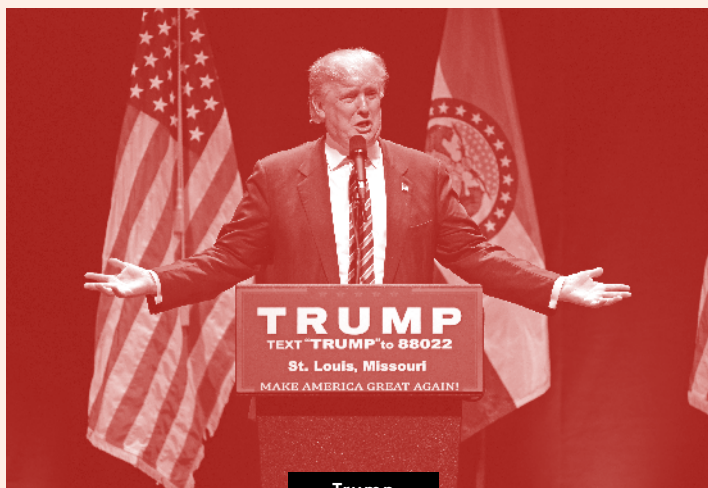
GARY E. RIESCHEL,

Founding Managing Partner, Qiming Venture Partners, China

"Reduce barriers to telehealth services.

It's important we ensure everyone has access to the life-saving benefits of technology-enabled care. We should also encourage the interoperability of healthcare information. And we must address cybersecurity threats in a balanced fashion. We need to protect privacy and security without being punitive and overly restrictive."

BERNARD J. TYSON, *Chairman and CEO, Kaiser Permanente*



Trump

Techonomists' hoped-for immigration reforms do not mesh with Trump's exclusionary approach.

"Ownership and regulation of data, particularly data exchanged digitally between industry participants. We need regulation that puts the ownership of that data squarely in the hands of the consumer who generates it, whether it is about their online behavior, their image, their financial history, or their health data."

LEX SOKOLIN, *Global Director - Fintech Strategy, Autonomous Research US LP*

"The education system must train for people-to-people interaction. Most technologies now will require high quality scientists, engineers, and technicians, especially in fields like biology, neurosciences, new materials, and information architecture. But they also will require many related workers with less education but who are good at interpersonal relationships. Students must go as far as possible in high-tech learning. Then we need to find new ways for "interaction jobs" to be decently compensated, not just with money but with social recognition."

DOMINIQUE TURCQ,

President, Boostzone Institute, France

Techonomy 2015

The Event that Asks: where is Tech Headed?

The Highlight of Our Year





Where: The conference takes place each year at the glorious and dramatic Ritz-Carlton, Half Moon Bay.

When: Annually for two dense days in early November.

What: We cover as many urgent business and tech issues as we can, with a strong future focus.

The aim at our annual flagship conference is to help all attendees gain a better understanding of where business and the economy are headed. Tech is our lens, because we think it is changing everything. In 2015 our speakers included Secretary of Commerce Penny Pritzker and tech luminaries like Sean Parker and Marc Benioff, not to mention numerous other innovators and entrepreneurs.



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1. Discussing the digital economy, (from left:) Techonomy's Kirkpatrick, Cisco's John Chambers, Jeroen Tas of Philips, Commerce Secretary Pritzker, and McKinsey's James Manyika

2. Kirkpatrick at dinner with, from left, the multi-talented Sean Parker and Adam Mosseri, who heads Facebook's news feed

3. Salesforce CEO Marc Benioff, right, was joined on stage by his colleague Adam Bosworth (now at Amazon) to discuss the Internet of Things

4. DARPA Director Arati Prabhakar with Pradeep Khosla, Chancellor of UC San Diego

5. From left: computer scientist & author Jaron Lanier, neuroscientist and philosopher Sir Colin Blakemore, and Steve Jurvetson of DFJ

6. Mary Lou Jepsen of Openwater (formerly of Facebook and One Laptop Per Child) asks a question

Continuing the Techonomy Conversation

While we are most known for wide-ranging and probing events, including our flagship Techonomy conference, Techonomy Media is more than that. We are a growing community that we want you to be part of.

In 2017 we will gather that community not just at our flagship Techonomy conference, November 5-7 in Half Moon Bay (at that stunning hotel on the cliffs you see to the right) but also at our annual Techonomy NYC conference, May 17, and at dinners, receptions, and short programs throughout the year.



Techonomy 2017 will take place at The Ritz-Carlton, Half Moon Bay, in California.



When techonomists gather they have great conversations, here at a Techonomy 2015 lunch.

The transformation of the world by technology is not slowing down, so neither can our efforts to stay abreast of it all. That's Techonomy's job—to help you think more methodically and effectively about the manifold changes underway, what they mean to you and your industry, and what they enable you to do that you couldn't do before. To accomplish that we produce content like this magazine, publish articles and videos on our Website and in our newsletter, and turn to you for input and content we can share. In today's

world, the most useful insight is almost always achieved in collective conversation, and that's what we work hardest to create.

We open our browsers or pick up our phones each morning a little worried about what we may find there, but always heartened to see the extraordinary advances in technology, communications, biotech, medicine, and all the ways they create new opportunities in industry after industry, country after country. Help us understand it, interpret it, and celebrate it.

TECHONOMY NYC
May 17, 2017
New York, New York

•
TECHONOMY 2017
November 5-7
The Ritz-Carlton,
Half Moon Bay, California

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*For details, see
Techonomy.com*



Connected solutions for better health

A new approach is required to prepare for an increasingly complex value-based healthcare landscape. We believe the answer is in the intersection between professional healthcare and solutions for healthy living and wellness. We're providing interoperable software and solutions across the entire health continuum. To enable access to data that truly matters in ways that are easily accessible, contextually relevant and actionable. We aim to seamlessly and securely connect devices, systems and people and enable new forms of collaboration. It's our mission and our commitment to help you prepare for the next generation of healthcare delivery.

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