TECHONOMY
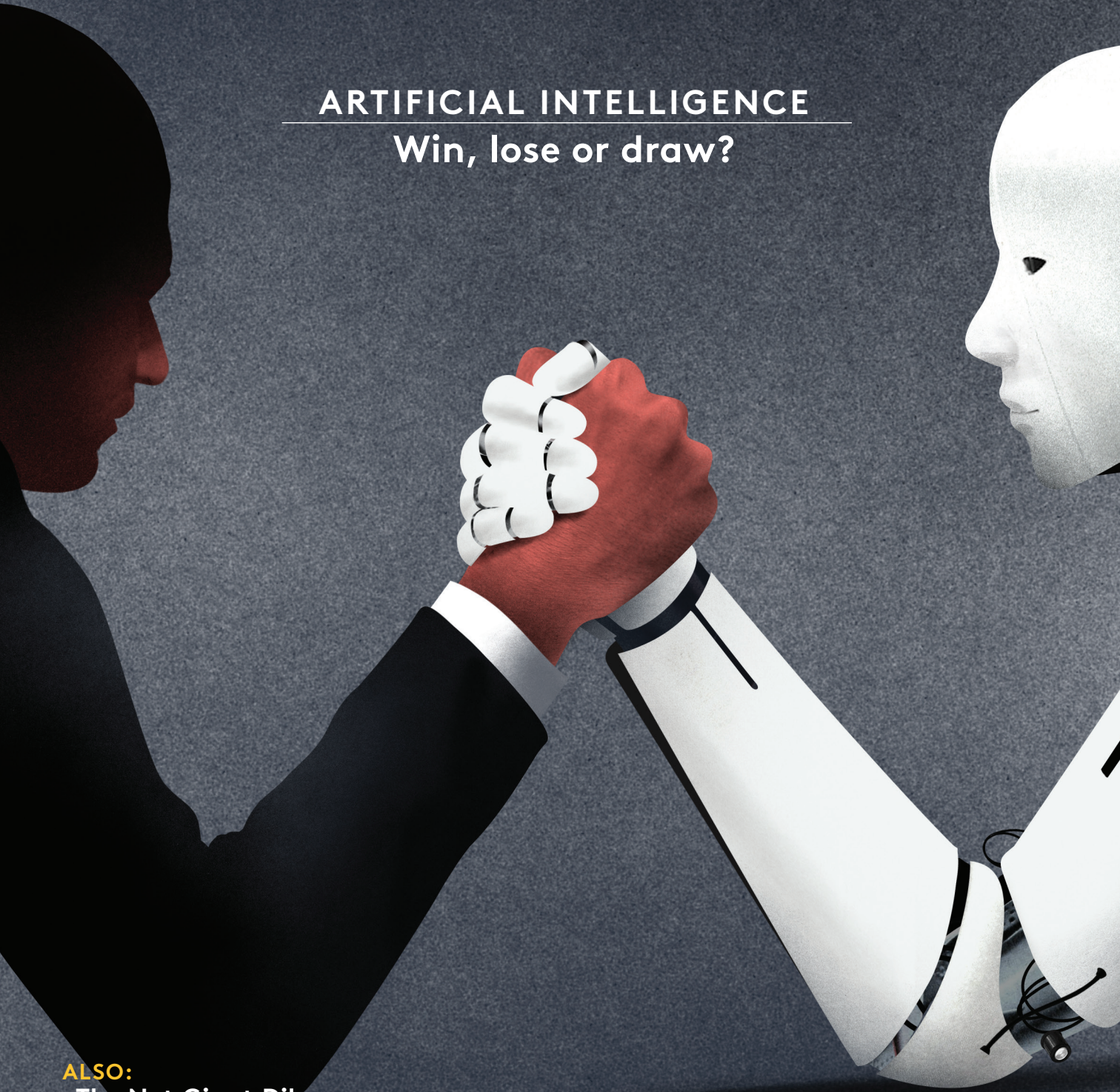
ARTIFICIAL INTELLIGENCE
Win, lose or draw?

ALSO:
- The Net Giant Dilemma
- Life on WeChat
- Europe Lights a Tech Fuse
- Conservation Genomics

Tech Must Help the World Forward

There's an old saying that something isn't worth doing unless lots of people think you're going to fail. Otherwise it's too easy. As it stands right now, pulling the rest of the world towards our own middle-class lifestyle is our greatest challenge, though many in the wealthier parts of the world would say it's impossible, or that it shouldn't even be tried. But business, interestingly, is getting onboard.

At Techonomy we've always focused on how tech can make the world healthier, wealthier and wiser. But we've also always been about business as the tool. We believe tech is the lever that can help humanity achieve the 17 Sustainable Development Goals (SDGs) that the United Nations has adopted to take the world forward by 2030. Ultimately, the real lever for that progress will be tech in the hands of business, working with governments and civil society.

In our unsettling political and social moment, with expectations so low for governments, it is encouraging to see how business leaders are stepping up with or without government's help. The business of business is becoming social progress, and smart companies are recognizing that.

Take, for example, mobile phones. One of the SDGs is improving the lot of women. Today, 200 million fewer women than men have phones. Rebalancing that would mean tens of billions in incremental revenue for mobile companies, as well as more gender parity and economic fairness.

Right now the tech industry faces innumerable challenges, and this issue of our magazine reflects it. Internet giants are under assault (page 12) and huge questions are emerging about the challenges posed by an AI-infused world (articles on pages 6, 7, 9, & 34). It's easy to fall into dystopian fantasies (page 20). But there are also tons of encouraging signs of tech's potential, including rapid entrepreneurial and innovation progress in Europe (page 38) and China (page 24). While we face environmental catastrophe, radical technologized remedies are possible (for example reviving extinct species–see page 46). And the blockchain engenders hope for fairer economic systems (page 10). To hear how we discussed all this recently in New York, see pages 18 and 44.

In 2018 we will devote our energies and activities to understanding and advocating for tech to help achieve the SDGs, because we too believe it is our moral and ethical obligation. In addition to our coverage here and at techonomy.com, we will host two major conferences to help leaders—in May in New York and November in California. We invite you to join our community.

DAVID KIRKPATRICK

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PHOTO: PAUL SAKUMA

After a long day of tech-infused debate, Techonomy 2016 participants relaxed before dinner.

ON THE COVER

Illustration by
Emmanuel Polanco

Publication Design
by Rob Hewitt
curiousoutsider.com

Who is Techonomy?

**Josh Kampel**

Simone Ross

Mary Kan

We are a small but passionate and tech-obsessed team. We live for ideas. We spend our days studying the world of business and tech and try to figure out the most surprising ways that tech is changing the world. What issues are most vexing business leaders? How can we help them think these challenges through?

We figure out how to get the most interesting thinkers about each issue on our stage. We ask them to write for our website or for this periodic magazine. We organize them into a cohesive community built around ideas. It's gratifying to live amidst such tumultuous change and at least sometimes think that we're making some sense of it all.

Scattered around this page you see the people who constitute our little company. **Josh Kampel,** the company president, spearheads strategy and our partner relationships (check out the back cover—he's good). Co-founder **Simone Ross** is one of the world's master programmers, and the quality of her work is evident on our stages. **Lawrence Dvorchik** joined Techonomy early in 2017, with a wealth of experience in events. He is having a big impact on our efforts to grow our audience and our impact. **Mary Kan** is the company's editorial and program assistant, which means she does a lot of different things we could not do without. And **Nora McNulty** is partnership coordinator, working closely with Josh, and recently becoming a
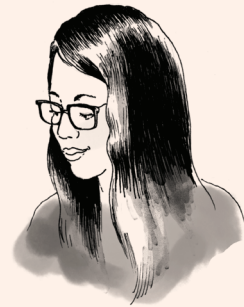
Photoshop wizard. **David Kirkpatrick** is chief techonomist.

The drawings were done by **Clara Kirkpatrick**, David's daughter, who is finishing her MFA in Illustration at New York's School of Visual Arts. She also illustrated Simone's dark humor on page 20 and Josh's piece on voice interfaces on page 30.
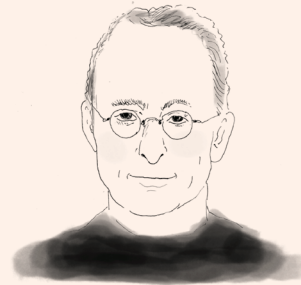
We believe in community, and it takes many forms.

Lawrence Dvorchik

Nora McNulty

David Kirkpatrick

Life-changing technology for a healthier world.

At Johnson & Johnson, we see how technology can transform people's lives by giving people everywhere better care for a better life. That's why we are a proud sponsor of Techonomy.

Johnson&Johnson

The Bots Aren't Taking Over

by Paul Roehrig

Business is combining software with people to make productivity and customer satisfaction rise

HUMANS HAVE BEEN STRUGGLING AGAINST machines since they were invented. American folk hero John Henry trying valiantly to dig faster than a steam drill really is not that different from the story of cabdrivers striking against Uber. What all of us need to realize, however, is that the winning play in a digital economy is not fighting against robots and artificial intelligence, but using our new tools to improve productivity. In our book, *What To Do When Machines Do Everything*, we call it "enhancement."

Quietly, but at a steady pace, white-collar knowledge work is being improved, accelerated, and enhanced by the new machines. In some cases, the examples are so familiar that we don't even recognize them. It can be as simple as starting to type "Where is a..." in a search in Google and having the bot instantly offer up alternatives including Aruba, Amsterdam, or Area 51. (Google can explain.) That may enable minor convenience—or perhaps not, if you are actually looking for "Where is an off switch for Slack messages?" But clear business value is starting to emerge when we apply AI to work that matters.

The financial industry is seeing it. Startups like Betterment, as well as venerable financial institutions like Charles Schwab and Vanguard, are linking humans with bots to provide better services to wealth management clients. Palantir and Credit Suisse formed a joint venture to monitor trading activity and identify patterns that might indicate unlawful trading. It connects data, software, and trained analysts to stop policy breaches and protect the bank's assets and brand.

In spite of the shrill warnings of the doomsday prophets, the bots will not be taking over anytime soon. But what we need to do is enhance knowledge work with systems of intelligence.

The good news is that such systems are appearing all over. And in many cases, they are not causing wholesale job disruption, but rather make us more effective and productive. In banking, education (with McGraw-Hill Education's ALEKS system), insurance (LexisNexis Risk Solutions), medicine (the da Vinci Surgical System), transportation (anything from Tesla), fashion (see story about Stitch Fix on facing page), and virtually every other industry, white-collar knowledge work is being enhanced by our new machines.

"Technology should augment the human intel-lect, not replace it," says John Giannandrea, who runs Google's AI efforts. "It should be a powerful tool to help us think better, and I think that is really the journey we are on," he says.

The best chess player is not Garry Kasparov or Deep Blue; it's Garry plus this year's model of AI. Augmented masters routinely beat machines alone. The best radiology results come from a trained radiologist plus AI. The practice of law is improved by smart lawyers plus robots that can do routine, often tedious, data analysis, and discovery.

Trying to win in the digital economy with industrial era tools is like churning your own butter. It may be fun—and get you hipster points—but it's bad business.

A carpenter, doctor, musician, executive, or claims adjuster is only as good as her tools. If you want to stay relevant for the next 10 years, recognize that the tools of your trade are changing faster than any time in your life. Open your mind to the reality that technology is significantly extending productivity and profitability in ways that even a few years ago would have seemed far-fetched and implausible. Ten times more? One-tenth the cost? Why not?

PAUL ROEHRIG *is co-founder and chief strategy officer of Cognizant Digital Business. He is also co-author—with Malcolm Frank and Ben Pring—of* What To Do When Machines Do Everything, *on which this essay is based.*
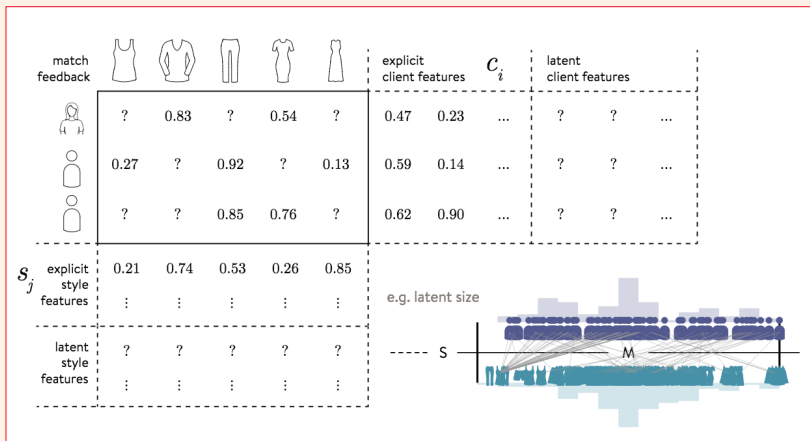
Software Plus Stylists Equal Sales for Stitch Fix

This fashion startup is winning by algorithmically enhancing humans

by **David Kirkpatrick**

Few American startups yield more insight about the future of business than Stitch Fix. To call this San Francisco-based company an online fashion retailer doesn't begin to give a sense of its uniqueness. It grew to $730 million in 2016 revenues from a start in 2011 when founder (now CEO) Katrina Lake was at Harvard Business School. It sells women, and more recently men, fashions they didn't know they wanted. But it achieved these enviable results by measuring and optimizing everything. It so suffuses itself in data analytics and artificial intelligence that to hear how it operates feels like receiving brain waves from the future.

But this message is particularly welcome, because of the way Stitch Fix succeeds—by blending machine intelligence with the real human intelligence of 3400 fashion stylists who work mostly part time from home, interacting with customers. The company's growing employee base suggests that a future world infused with AI may not decimate the workforce after all. (See facing page.)

"It really is the convergence of man and machine," says Chief Algorithms Officer Eric Colson, who was a six-year Netflix veteran before joining Stitch Fix in 2012. "We've stumbled onto being able to combine machine learning and AI with human judgement, to create a product much better than people could do on their own."

When a customer first starts "shopping" at Stitch Fix, all she does is fill out a lengthy questionnaire. If you say you wear medium-sized blouses, it asks whether they typically fit you loosely or tight. Does your office require business attire or is it casual? Do you take wardrobe risks? Which of this list of 15 colors would you wear? Please answer definitely, never, or maybe. Do you wear your jeans skinny, straight, or both? Many questions don't require a yes or no, recognizing that our choices can be mutable. Then the company feeds all this, along with social media profiles, Pinterest boards of styles you've "pinned," and plenty more, into its computers.

The customer agrees to receive clothing sight unseen. "There's no customer choosing," explains Colson. These shoppers-who-don't-shop pay a $20 "styling fee" to receive each periodic box of clothes, but can send anything back for free. The company pays shipping both ways if there is no sale. "We face severe penalties if we get it wrong," Colson continues.
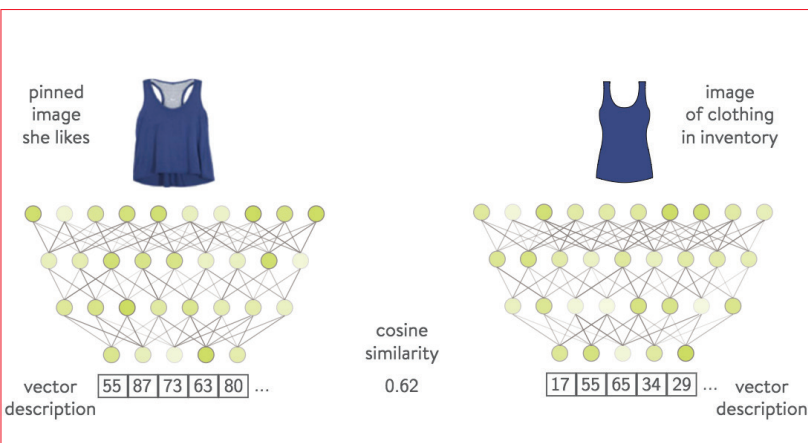
A box of clothes—called a "Fix shipment"—is assembled by a sort of teamwork between computers and the stylist. A custom data-crunching "styling algorithm" selects a group of items it thinks the customer would like. But crucially, that selection is shown not to the customer but to the stylist, who is generally matched to the customer, again, with an algorithm. The stylist streamlines the computer's choices to select the ultimate assortment for the customer.

"It turns out there are things humans can do much better, and are likely to remain better at for a long time," says Colson—"things like curation, the ability to see things as a cohesive set, and to improvise. Not to mention being able to relate to other human beings."

And the stylists seem to love their jobs. Stitch Fix surveys their job satisfaction twice a month. Whereas in most companies part-timers are the least satisfied employees, at this one they are the happiest.

So employment is growing in this smart, modern company because computers are augmenting what people do. That is a big, fat, positive data point for a world where software, as they say, is eating the world.

DAVID KIRKPATRICK *is chief techonomist.*

Stitch Fix's algorithms help its 3400 stylists send a desirable "Fix" of clothing to customers. It's a wonderful example of how AI helps create jobs. Here and at left are visualizations of how the software matches clothes to people.

pinned image she likes

image of clothing in inventory

cosine similarity

0.62

vector description   55 87 73 63 80 ...

17 55 65 34 29 ...   vector description

IMAGES COURTESY OF STITCH FIX

A New Goal for Health: Seamless Care

by Brent Shafer

HEALTHCARE IS BURSTING AT THE SEAMS WITH innovation. Brilliant clinicians, world-class research, cutting-edge technology, and sophisticated health systems are addressing the most challenging conditions and procedures. But despite those strengths, healthcare is still faced with deep complexity, resulting in barriers that make it hard for medical professionals to provide patients with personalized care in the right place, at the right time, in the right way.

At Philips, we're partnering with leading health systems to break down those barriers. We want to remove complexity and deliver a more seamless approach to healthcare when, where, and how people need it. And as the healthcare industry continues to shift away from "sick care" to prevention and healthy living, this kind of approach to seamless care becomes all the more critical.

It's clear we need to simplify data and insight gathering, drive improved treatment and outcomes, reduce costs, and give patients and staff a better experience. To seize these opportunities will require a new level of partnership and collaboration with health systems. That's why Philips is working side by side with customers and partners to create solutions centered around patients and care providers and tailored to each organization's specific needs and challenges.

Our 15-year partnership with Augusta Universi-

The Philips Azurion system, seen here, has helped doctors at Miami Cardiac & Vascular Institute treat and heal patients faster.

ty Health is a good example. It enabled an enterprise transformation. We achieved higher quality patient care at a lower cost. We increased capacity in magnetic resonance imaging by 63 percent while at the same time realizing $10 million in savings, in just 48 months. We reduced the complexity of working with numerous vendors, simplified the procurement process, and worked with both the hospital leadership and with patients to jointly cocreate innovative improvements in care.

At Banner Health in Phoenix, Arizona, our long-term strategic partnership in telehealth helped reduce costs of care by 34.5 percent and hospitalization rates by 49.5 percent as part of their Intensive Ambulatory Care (IAC) pilot program. The IAC treats patients with complex medical situations due to multiple chronic conditions. The cost savings were driven primarily by a reduction in hospitalization rates and days in the hospital, as well as a reduction in professional service and outpatient costs. Prior to the IAC program, there were 10.9 hospitalizations per 100 patients per month, but for those who enrolled in it, the acute and long-term hospitalization rate dropped to 5.5 for each 100 patients in a month.

Working with clinicians at Miami Cardiac & Vascular Institute, we implemented solutions including Philips Azurion, a new image-guided therapy platform, as well as 3-D abdominal imaging and a state-of-the-art endovascular suite for minimally invasive procedures affecting blood vessels, enabling improved workflow and better patient outcomes.

Using Philips eICU (Intensive Care Unit) technology to expand access to care, Emory Healthcare reduced variations and responded more quickly to changes in vital signs—resulting in $4.6 million in savings in just 15 months. The eICU allows healthcare organizations to manage shortages of highly skilled nurses and intensivists by employing telehealth solutions to provide around-the-clock remote patient monitoring at multiple locations.

To move toward seamless care, together we must continue to break down the barriers between departments and specialists. We have to create breakthrough innovations, eliminate the obstacles separating patients and caregivers, and cross the boundaries that exist between hospital walls and people's homes. Because today, health knows no bounds and neither do we.

BRENT SHAFER *is CEO of Philips North America.*

Striking Gold by Mining Data

by **Josh Kampel**

Digital Tools Helped Turn a Modest Single Into a Hit and MAX Into a Pop Star

MAX is a pop star, not least because his management company is a master at deciphering the data bubbling up in a digital entertainment economy. He joined us onstage at Techonomy 2017. To see his performance, go to Techonomy.com/MAX2017.

Signing the next big artist or identify-ing a hit song once relied on the gut of label executives and radio station program directors. Today, however, technology and data from a raft of new digital sources has become indispensable to the success of labels, artists, and radio stations.

I spent nearly five years managing musicians long before I joined Techonomy, and I know firsthand what you used to have to do to get an artist signed or break them on radio. It was neither pretty nor scientific.

But the labels themselves weren't much better off. "We used to call radio stations and record stores. That's how we found Hootie & the Blowfish," says Pete Ganbarg, head of Artists and Repertoire at Atlantic Records. "Now I have a team of researchers looking at SoundCloud, YouTube, and Spotify—anywhere an artist can put their music. It's easy for us to monitor and track."

Says Dan Kruchkow, chief marketing officer and head of digital strategy at music management and promotion firm, Crush Music: "There used to be three data points—how many copies you'd sold, how many radio plays you had, and ticket sales. Now there are so many data points, it's unthinkable. It's my job to find the relevant ones and show what's working, as well as what's not."

Working with young emerging recording artist MAX, Crush was able to leverage data, both to identify a song that would resonate with listeners, as well as demonstrate to radio stations and music streaming services that they had an international hit. It made all the difference.

MAX's debut album, *Hell's Kitchen Angel*, was released in March of 2016. A year later, it seemed to have nearly run its modest course. After promoting a few singles to radio stations nationwide with limited success, the label was beginning to think it was time for another album. Then Krushow, studying the vast amounts of data, spotted a blip on the radar. The company had not promoted a track that was generating interest on Spotify, in the Netherlands. By the time Dutch listeners had streamed "Lights Down Low" 5 million times, Crush executives were in London working to convince Spotify UK to pick up the track.

The song started performing well there. (In the Spotify domain, that means low skip rates.) Crush began lobbying Spotify in the United States, and the streaming music giant added the song to the biggest and most important playlist in streaming: "Today's Top Hits." Then, with a solid online story under its belt, Crush moved on to traditional radio, which still reaches an exponentially larger audience than streaming.

The single first got picked up by three pop stations in Hawaii. Then an exciting new data point emerged: it became the most Shazamed song in the state. That offered ammunition for a successful assault on the broader radio market, where the song took off. In September 2017, "Lights Down Low" went Gold.

"Success is ultimately fueled by a song that is real, that listeners react to," says Krushow. "But we parlayed each of the data points to build a story."

JOSH KAMPEL *is Techonomy's president.*

Could Blockchain-based Systems Replace Facebook?

Excerpts from our on-stage conversation with Union Square Ventures Managing Partner Fred Wilson at Techonomy NYC, May 2017

DAVID KIRKPATRICK: *How do you think about Facebook, Google, and Amazon in our lives and in our societies?*
WILSON: They are optimizing around an attention-driven business model. Somebody will create a new business model that is not attention-driven...and they won't be able to react to it quickly enough, and they will get disrupted.

I think probably the most disruptive business model is the token model that we're seeing emerge in the blockchain. It is really a native business model for the open source, creative commons. It's like Wikipedia or Linux–systems that are decentralized, open and community-powered.

We will use [blockchain-based] tokens to participate in those systems. People who create value in the systems will get rewarded with the tokens. People who participate in the systems spend the tokens and the tokens increase in value in the way that a stock price would increase in value as the impacts of the system grow. It's a native, elegant business model for community-powered systems. It's very disruptive to the attention-based business model, and there are going to be very, very large companies built from the ground up based on those business models.

KIRKPATRICK: *Why would that disrupt Facebook's ability to monetize attention with advertising?*
**WILSON:** People walked out on Facebook because they realized that they're basically giving Facebook all their data so Facebook can run advertising against them. A lot of people are already opting out of Facebook. We had a gathering last week of the CEOs of all of our portfolio companies. At the beginning of the day, we go around the room and people talk about the thing that has changed the most for them personally as they run their companies in the past year. The thing that came out, surprisingly, was that people are not using social media anymore, other than to promote themselves and their companies. They've unfollowed everybody, and they're just using it as a broadcast mechanism. They're not consuming anymore.

KIRKPATRICK: *So either blockchain itself or that kind of model will play a significant role in this next wave of innovation?*

WILSON: The architecture of the Internet is beautiful, but there are a bunch of things it doesn't do very well. Things are getting hacked right and left, and there is malware and spam and phishing. And the monetization models tend to be very attention-driven. And all of our data is stored in someone else's servers and not on our own servers. So our search history, Google has; our purchase history, Amazon has; our friend graph, Facebook has.

New technologies will emerge that will fix those things...we're going to have decentralized storage, decentralized compute, decentralized security. All these things are going to be monetized with a token or a coin-based business model, as opposed to a subscription or advertising-based business model.

Techonomy asked our community: How significant is the growing enthusiasm for blockchain?
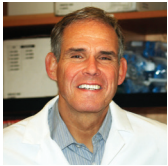
It should be considered a civil right for each individual to own his/her medical data—all of it, including office visit notes, labs, scans, hospitalizations, and add to that their genome sequence. Currently there is no home for this comprehensive data set and either blockchain or private personal clouds offer that opportunity. -DR. ERIC TOPOL, *DIRECTOR, SCRIPPS TRANSLATIONAL SCIENCE INSTITUTE*

Interest in blockchain-based record keeping will be much greater, and adoption will be much quicker, than for cryptocurrencies themselves. The distributed ledgers provide a disruptive way to accelerate, and potentially reduce costs on, many forms of collaborative record keeping. -CRAIG MUNDIE, *PRESIDENT, MUNDIE & ASSOCIATES*

Blockchain technology has many applications across industries. Records on blockchains provide a trusted and secure way to share information from financial transactions to digital assets, from digital identities to ballots in elections. -ERIC PISCINI, *PRINCIPAL, DELOITTE CONSULTING*

Blockchain is profoundly important—possibly equivalent in value to a second internet. Decentralized trust is a concept that will change the role of traditional institutions whose main purpose, in essence, is as a trusted party. -DAVID KIDDER, *CEO, BIONIC*

Innovation is all about changes in structure. Blockchain is a fundamental technology that provides a backbone for changes that will inevitably realign record keeping. -DAN'L LEWIN, *FORMER CORP. VP, TECH & CIVIC ENGAGEMENT, MICROSOFT*
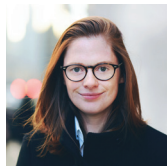
This innovation has enabled the future of how markets organize. Even in peer-to-peer models, markets today remain coordinated by central parties. Blockchain protocols take peer-to-peer models to their logical conclusions, allowing parties to interact directly and maintain immediate ownership of their property, data, and decisions. -KATHLEEN BREITMAN, *CEO, TEZOS*

Enthusiasm continues to grow for blockchain-backed record systems, because most financial assets today exist only as a digital record. Using a blockchain can have profound impact on efficiency and security, while making it easy to prove the integrity of transactions (whether financial or not). We're seeing development within top companies in nearly every possible sector. -MELANIE SHAPIRO, *CEO, TOKENIZE*

The potential of blockchain to dramatically reduce (and often eliminate) major transaction costs understandably generates profound enthusiasm. But because blockchain technology does not act as a substitute for, but rather needs to be embedded in contracts, transactions, and records, broad-based adoption and diffusion may be slower and harder than enthusiasts would hope. -DIANA FARRELL, *CEO, JPMORGAN CHASE INSTITUTE*

The transformative power of the blockchain lies in its ability to reduce transaction costs and provide a trustworthy audit trail. Numerous other "back office" and infrastructure applications also become possible when we remove the need for and cost of manual human intervention. For example, autonomous vehicles may own bitcoin wallets to pay tolls, parking, and other charges, and collect fees for micro-rentals. -TOM GLOCER, *MANAGING PARTNER, ANGELIC VENTURES*

The base of enthusiasm is both wide and deep. We are seeing proposals in healthcare and energy, far beyond traditional views of blockchain as a financial instrument. Carbon tax proposals will also likely use blockchain to capture and track how carbon flows through the economy. -GARY RIESCHEL, *MANAGING PARTNER, QIMING VENTURE PARTNERS*

THE AMAZON, FACEBOOK, AND GOOGLE DILEMMA

TOO BIG TO TOLERATE. TOO BIG TO STOP. WHAT COMES NEXT?

by **David Kirkpatrick**

Illustration by
Graham Roumieu

Here's why Mark Zuckerberg cannot run for president any time soon even if he wanted to. If he did, it would highlight a simple and disturbing fact. The company, if it chose, could engineer the results of any election in the world. Facebook controls the information flow to a huge percentage of the citizens in most of the democratic world, including the United States. Unless and until Zuckerberg takes concrete action to make the way his service works more transparent to the world, to run for office would invite scrutiny he has to avoid. The same holds true for his high-profile deputy Sheryl Sandberg, whose political ambitions have been the subject of speculation for considerably longer. ▸
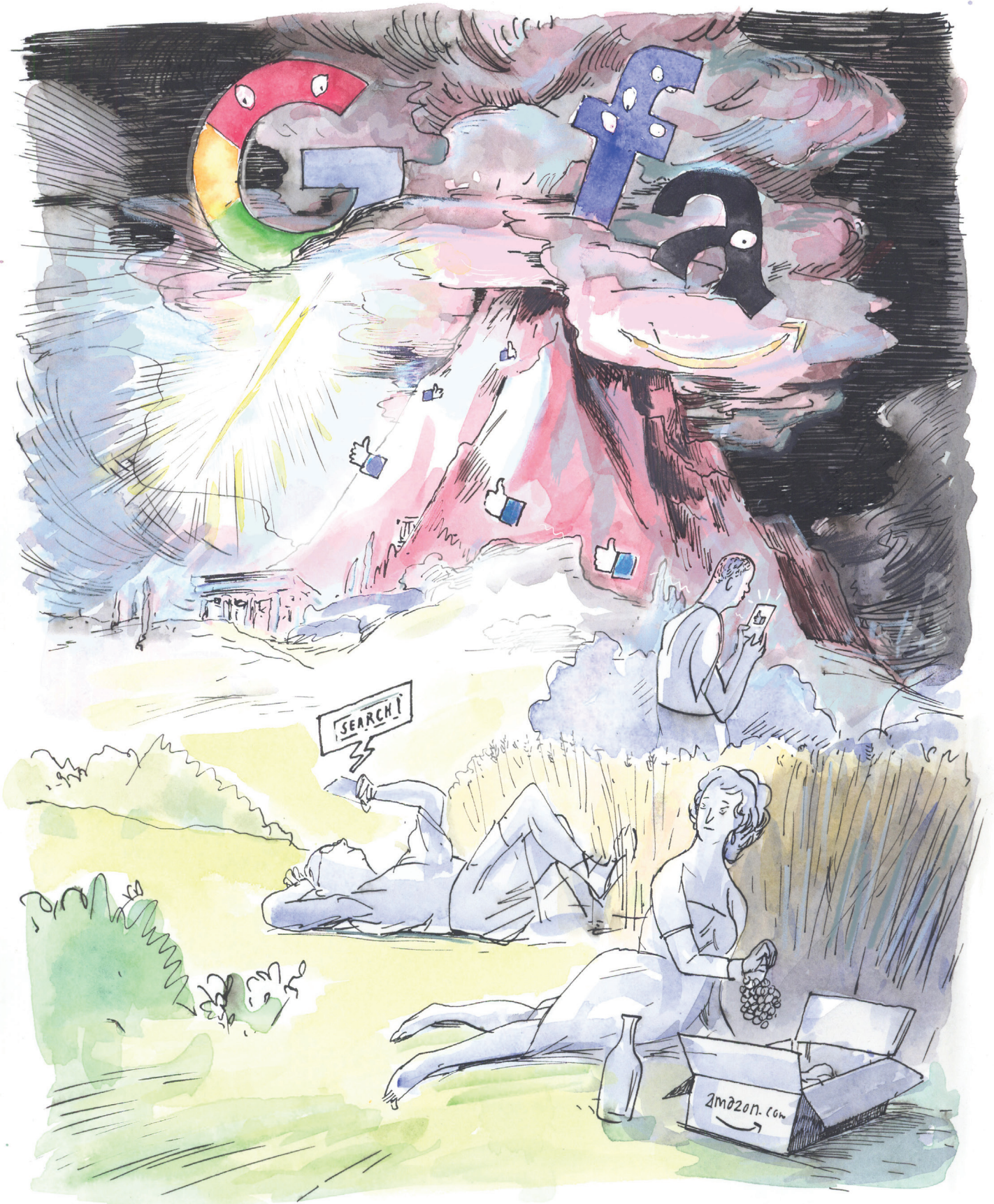
Facebook and Google present a dilemma to the world. Billions depend on them for communication, entertainment, and information. They have vast influence on society, including, it increasingly appears, some very unpalatable effects on social dialogue and politics. But they answer to nobody but themselves. And nobody inside or outside of the companies really has a good idea what we as a society should do about it.

Similar concerns surround Amazon, though for now they are less politically focused. It has an inordinate influence on commerce, commanding 40 percent of all online purchases in the United States. It is building vast databases about the preferences and purchases of hundreds of millions of citizens. That information enables it to extend its reach into a wide range of other industries. It's a major producer of TV shows and movies. Its Amazon Web Services (AWS) hosting and enterprise software business is often the default choice for companies that want to operate "in the cloud." A significant percentage of American companies store crucial data in Amazon's servers. Even its video rival Netflix uses AWS.

These three companies have all reached a scale and influence unprecedented in the history of capitalism. And they do bring very large benefits to society and to people. Yet their inner workings—the crucial algorithms that govern their news feed, search engine, and shopping systems—are theirs alone to operate and to know. These issues should concern not just citizens, but companies in every industry. "There is a complete lack of transparency into these networks," says venture capitalist Hemant Taneja of General Catalyst, among the most outspoken in Silicon Valley on these questions. "How do we run a society with the standards and egalitarian values that we care about in a world where these companies exist?"

Already, many in business eye the giants warily. Says Sir Martin Sorrell, CEO of global ad giant WPP: "Facebook, Google, and Amazon are increasingly becoming traditional utilities." The implication of being a utility is, of course, that it should be regulated.

The Russian fake news scandal has suddenly, finally, thrust some of these issues onto the agenda of the media and Congress. Facebook CEO Zuckerberg dismissed the notion that fake news on his platform could have affected Trump's election as a "crazy idea" when I interviewed him onstage at the Techonomy 2016 conference the day after the election. He has subsequently swung 180 degrees, and has contritely and forthrightly promised to increase the company's efforts to monitor and identify politically incendiary content. But the question of what kind of content society should tolerate on

websites during efforts to eliminate fake news from search results. But there is no recourse for such a concern. "Fakeness" is not always easy to determine. Google will not say why some things show up high in a search result and others not at all. And it doesn't have to.

Roger McNamee is one of the more surprising voices to have begun raising an alarm about the power of the net giants. The longtime tech investor put a lot of money into Facebook early, and he played a significant role in helping his then-friend Sheryl Sandberg get hired as Zuckerberg's number two. But he has had a cruel epiphany. He says the fundamental and pernicious challenge for Facebook and the other companies is the impact of an advertising-based business model. "It used to be a world of information scarcity," says McNamee. "People always wanted more, and a company

"If you want to win a battle for attention, it helps to addict your users, which social media companies have done more effectively than tobacco."

these services—including Google, Facebook, Instagram (owned by Facebook), Google's YouTube, and the much-smaller company Twitter—has now suddenly risen close to the top of worries about where society is headed.

There are endless calls for the companies to muzzle hate speech and ensure bad actors don't do nasty things like mess with elections. But do we really want commercial entities to be the ones charged with keeping alive the First Amendment? It should not be up to the leader of a for-profit company to decide what sort of speech is allowed in the public square, even if, as it appears, they own the public square.

In late 2017, Google faced a credible accusation that it had been suppressing traffic to left-leaning

could change the world by giving it to them. Smartphones changed the game by making the web accessible every moment a person is awake. That transformed media into a battle for attention, where players that could target individuals had a prohibitive advantage. Just as in traditional media, sensation has more economic value than substance, which leads to a race down the brainstem, aiming at emotions like fear and anger. If you want to win a battle for attention, it helps to addict your users, which social media companies have done more effectively than tobacco. Addiction, fear, and anger are the fuel for their social business models. My point isn't that we should ban these services, but we need to have a debate on what society should allow."

Facebook CEO Zuckerberg was interviewed by David Kirkpatrick at Techonomy 2016, and said it's a "crazy idea" that fake news affected the election–a statement he now has apologized for.

The net giants affect the behavior and even the thoughts of a vast swath of humanity—their users are the wealthiest, most wired, most influential group of people on the planet. It's their economic power that makes these companies so valuable to investors—they are showing advertising and selling things at a fast-growing rate that shows no sign of slowing. Longstanding once-powerful companies are left in their wake. When Amazon announced it would lower prices at Whole Foods on the completion of its acquisition, the stock of grocery giant Kroger dropped 8 percent immediately.

But the dilemma of power, and how to regulate or constrain it, is compounded by the very fact that the happy users of these services happen to be the voters. The Amazon Prime delivery service is used by roughly 60 percent of all American households. Facebook has about 213 million monthly users in the United States. And who doesn't use Google multiple times per day? Even if governments figured out how to properly regulate these companies, there is no assurance of political support to do so. The companies are in many ways more powerful than governments. Not only that, but they are truly global, operating across fragmented political jurisdictions.

Here's another challenging fact:
We are headed into a world controlled heavily by artificial intelligence (AI). That means algorithms will soon be giving us input and affecting our behavior and the world. And what makes AI work is data. The more you have, the better you can make your AI. The net giants, along with Apple and Microsoft in the United States, and Alibaba, Baidu, and Tencent in China, show every sign of having access to the largest pools of data anywhere. So an AI future will likely be one in which these companies have even more power.

The people who run Amazon, Facebook, and Google are generally good people, with honorable intentions. The problem is that once they became public companies, responsible to shareholders, their freedom of action was radically curtailed. How-ever much "non-evil" or "creating community" they want to do for the world has to happen under scrutiny from shareholders, who want the share price high and rising. To do the right thing morally and ethically can easily require cutting into profits.

For years, the companies have argued that they should bear no responsibility for the content users put there, saying they are mere "neutral platforms," and that it is near impossible to police such speech. Recently they made that argument around sexually-exploitive content, as Congress contemplated a law that requires platforms to insure such seamy material has no place, or face the risk of lawsuits if it slips past.

The "neutral platform" argument makes sense in the abstract, but when Facebook and Google became two of the most profitable companies in the world, the situation changed. They can now clearly afford to take much more stringent efforts to police speech, with the only downside being that profits might be somewhat less gigantic.

Mark Zuckerberg published an

impressive magnum opus on his Facebook page in February 2017. Entitled "Building Global Community," the 5700-word essay declared that the world faces a crisis of community—an inarguable truism—and that Facebook holds unique capabilities to remedy and address it–a more controversial point. In fact, Facebook has had powerful impact on bringing people together globally, in country after country, and Zuckerberg's desire to double down on that aspect of the company's work is admirable and understandable. No CEO of a major company has ever, so far as I know, written such a passionate, public-spirited, idealistic document promising to use his or her company for public good.

But here's the rub—policing hate speech and reducing anti-community behavior on Facebook inevitably will involve shutting down accounts, preventing posts, and in general pushing people and content off the site. That will reduce page views, the engine for ad sales. That, in turn, could cut into Facebook's astonishingly high earnings—projected to be $12 billion in 2017. Zuckerberg did not mention any commercial implications of his promised efforts to build global community. But the only true test of his commitment will

mood in Washington has shifted towards restraining these companies. Then-President Barack Obama pulled Mark Zuckerberg aside at a global meeting a few weeks after the election to implore him to address election-related fake news, no doubt influencing his turnabout. Hillary Clinton said in September that "we're going to make Facebook own up to everything." Senator Mark Warner, the top Democrat on the Senate Intelligence Committee, is now talking about a law that would address how net companies regulate content. Republicans, too, including President Trump, are talking critically about the net giants. On Fox News, conservative host Tucker Carlson said "Google is probably the most powerful company in the history of the world, more powerful than most countries." In a different segment, Carlson said "Google should be regulated like the public utility it is."

Google was fined $2.8 billion by the European Union in June 2017 for unfairly giving advantage in its search results to its own shopping service, over those operated by independent companies. But in a sign of how hard it is to make a dent in this fortress, Google's stock rose the following day, as investors shrugged. In late 2017 Google's stock market

billions parked overseas to avoid American taxes.

While fake news and abusive content is the main focus of governmental attention now, a host of other issues will follow in its wake. Issues of privacy, information access, and the ownership of vast stores of information about the thinking and behavior of citizens will be the next areas of concern. Meanwhile, challenges to our electoral system will likely continue.

Government may have finally begun to wake up to the challenge posed by the net giants. But when it comes to tech and the internet, government, and particularly the United States government, is generally inept and slow. Yet for any even marginally successful strategy to dampen the undue power of these companies, government will have to become a tech player, complicated and fraught though that might be.

Venture capitalist Taneja, who has given these matters a lot of thought, says, "these companies are effectively monopolies. Government has to step in." I asked him if one approach might be the one the U.S. Justice Department arrived at, to resolve its antitrust case against Microsoft in 2002. The company was required to make a number of technical and legal disclosures, and a judge was given extensive legal oversight of its actions for the next eight and a half years.

"The problem is, this time it's not going to get done by using humans," responded Taneja. "The government has to have its own AI department, so there can be a software watchdog." He says only algorithms will be able to effectively oversee other algorithms.

That is so far from being possible that it's another way of saying that today we don't have a way to restrain and oversee the net giants. But eventually, we have to find a way.

"The government has to have its own AI department, so there can be a software watchdog."

be how much money he is willing to spend, and profits he is willing to sacrifice, to achieve his lofty goals. Investor McNamee has a scathing way of expressing the current state of affairs: "Facebook has the largest margins of any company of similar size in the American economy. They're functioning like a drug company without doing clinical trials."

Largely because of the Russia elec-tion meddling scandal, the entire

value was about $660 billion, Facebook's just under $500 billion, and Amazon's $450 billion, even though, unlike the other two companies, it is barely profitable. Wall Street's willingness to bequeath such vast stock valuations to these behemoths makes them harder to restrain. If President Trump allows American companies holding profits overseas to repatriate them at a favorable tax rate, it will only further empower this group, all of whom have many

DAVID KIRKPATRICK *is chief techonomist, and author of* The Facebook Effect.

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"Most of the big challenges we face are cross-border in nature. Yet our institutions are primarily national."
-GILLIAN TETT,
U.S. Managing Editor,
The Financial Times

▶

Above: Gillian Tett, U.S. Managing Editor, *The Financial Times*, Fred Krupp, President, Environmental Defense Fund, Rodney Brooks, CTO, Rethink Robotics

2.

"It's not about having jobs or not having jobs. It's about how we structure the tasks that need to be completed, and the safety nets and systems around them."
-DIANA FARRELL,
CEO, JPMorgan Chase Institute

Tracy Young, CEO, PlanGrid

PHOTOGRAPHS BY REBECCA GREENFIELD

"We're overestimating AI and self-driving cars in the short run. Fifty years from now, it's going to be pervasive. But, we're underestimating them in the long run."
-RODNEY BROOKS, *CTO, Rethink Robotics*

◄

John Martin, CEO, Turner

"Privacy is gone. If you're going to debate whether or not we have privacy anymore, you're five years too late." -DAVID TREAT, *Managing Director, Accenture*

"Without user control, the future of identity is very scary."
-MELANIE SHAPIRO, *CEO, Tokenize*

"I was one of the lucky ones."

I woke up one morning to a loud, insistent voice. It was telling me to wake up. It took me a while to realize it was Siri. And nothing prepared me for what she was saying. "GET TO THE DONUT!" she screamed. "GET! TO! THE! DONUT!" My response was, of course, "Huh?" "Donut?" "WTF?" Then I checked my email, as you do when your dreams are rudely interrupted.

by **SIMONE ROSS**

Illustrations by
CLARA KIRKPATRICK

Very long story short, but the end of the world was nigh, and my only means of survival was to get to Cupertino. Cupertino? Of course. Where else, I wonder, would you go when you're trying to detour from dystopia? I made it, somehow. But this story isn't about that journey, it's about what I found when I got here.

We're now known as the House of Apple. Ours is the Appleland—a giant, donut-shaped, and seemingly perfect, panoptic utopia.
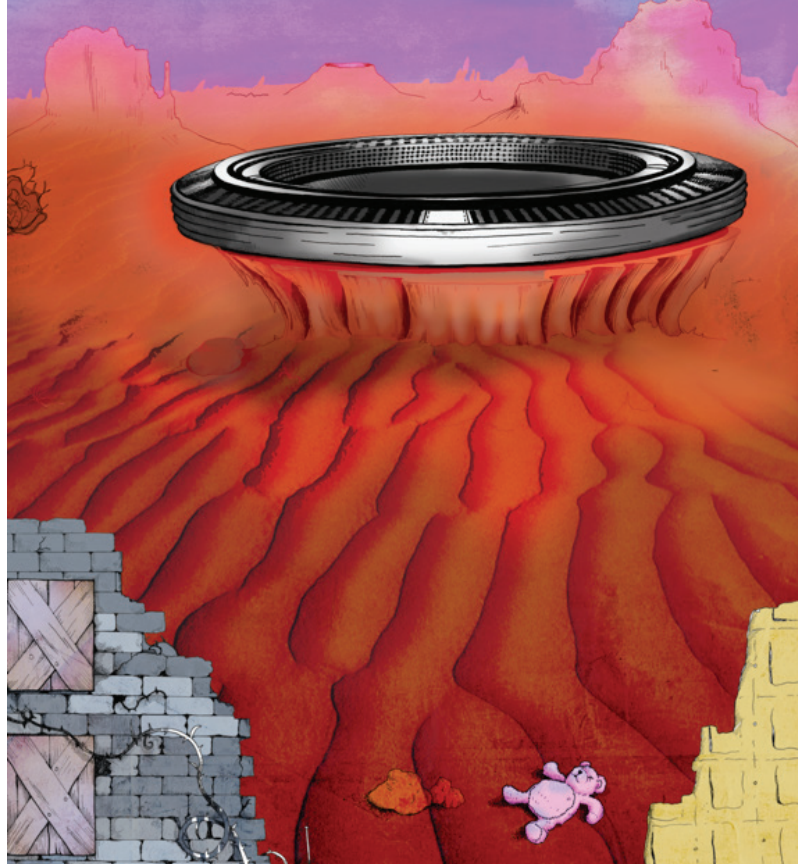
In the beginning, back before we all got here, all the Apple-ites and techies, the architects and designers, the media and intelligentsia, talked about the donut like it was a temple to a new kind of utopian company life. "It will revolutionize the way people work together," they said. "It will form the blueprint for a new paradigm in office buildings," they said (as if we needed yet another one of those). "The buildings will seamlessly integrate not only into the landscape and nature, but into the environment—100 percent sustainable and climate resilient," they said.

It was ambitious, and innovative, and absolutely beautiful...

But it wasn't about building an office. It was something quite different. It was in fact a modern, techno version of a medieval fortress. It was built, not to be open and harmonious with everything, but to enclose and protect, to keep certain people and

ambition coming from the richest company in Silicon Valley.

An iPhone was required for access. But of course not everyone with an iPhone could get in, or even get there.

But I was one of the chosen. I found myself on the inside. We're led to believe selection was random, kind of like how they pick lottery numbers. But if you listen to rumors (and let's face it, who doesn't? We are, after all, mostly human), then we were mindfully and deliberately chosen by an algorithm designed to identify those who could optimally contribute to the Age of Techno-Humanity.

minate amount of time. I'm not sure when I realized it, but I stopped aging almost as soon as I arrived. Everyone did. Time ceased to have meaning. Once we'd undergone the medical intake, which cross-referenced data from our microbiome, DNA, neurograph, social graph and FICO score, we were connected to the Internet of Things via a nanosensor. Then we were issued Burberry-esque jumpsuits (yes, Angela was in on it) and Yeezys, then shown to our micro apartments.

Things worked out well in techno-utopia for a while. Ethical super intelligences ensured order. There was no visible conflict. We had a universal basic income! We didn't need healthcare, because we hardly ever got sick. On the rare times we did, personalized medi-techno updates cured what ailed us almost instantly. Nutrition was plentiful because of the indigenous flora, the giant vertical greenhouses deep underground, and Soylent.

We didn't get bored in the old sense of the word, because our minds were in constant education and upload mode. Population growth wasn't an issue as we only reproduced as needed, on-demand (yes, we basically 3-D

The truth is, I've never figured out why I was picked. But it became clear that many were left out.

things out. The Apple Ring, despite its beauty, was a walled city, planned down to the last detail to be effortlessly and endlessly self-sustaining when the inevitable end came. The vision turned out to be not merely "the best office building in the world": it was the survival of humanity itself. In hindsight, maybe it was a predictable

The truth is, I've never figured out why I was picked. On entry, the human curation seemed designed to appear satisfyingly democratized. But it became clear that many were left out. How were we chosen? Why were we chosen? Who or what was doing the choosing?!

I've been in here for an indeter-

printed babies). And EVERYTHING was blockchain-based! Sleep was a thing of the past (sorry, Arianna). Kite surfing (virtual, of course) was the "sport" of choice. And nobody talked about the jobs or work of the future. It was great. Or so I thought.

Once you scratched the surface, and with time (which was endless), you realized that things weren't quite right. Our muscles atrophied from lack of physical activity. The default realities were virtual, augmented or mixed, but never real. Ultimately we are neither man nor machine, and it turns out there are constant glitches in the middle ground.

We're now grappling with the unintended consequences of our past decisions and actions. There's a reason evolution took time and institutions existed. And no matter how techo-enhanced we are, it has become clear that what has made us truly human—our emotions, our feelings—is not fully quantifiable or digitizable. Even our most independent, intelligent mechanical creations get tripped up by our own complex neurological and emotional responses. Despite our many advances, we don't seem to have cracked the code on the human brain, or the soul.

Data began to take on a life of its own: self-replicating and autonomous. It clogged up the internet of everything, and the information on which the AIs fed became increasingly meaningless. Some kind of techno-disease began to infect the system, clouding the judgment of the machines and creating friction between our fellow robot citizens and us enhanced humans. Yet we continue to muddle along.

For a while there was contact with other techno-settlements. There was Musk-on-Mars (designed by Zaha Hadid, who Elon had brilliantly thought to cryogenically freeze just for this purpose). And there were the cavernous, underground doomsday bunkers of Amazonia, with their endless supplies of reading material, packaged goods and Spam.

So what is it like out there? How are those techno-civilizations doing now? We don't actually know. The elegant metal fins on those giant curved glass windows haven't lifted since the day they closed.

SIMONE ROSS *is Techonomy's co-founder and chief program officer.*

Life on WeChat

The first thing David Yi does every morning when he wakes up is check WeChat. • He answers urgent messages, comments on people's "moments," and shares his own. Later, at the Shanghai office where he commands a staff of 50 for Kraft Heinz, he interacts with team members using WeChat group chats for various company functions—including strategic planning, marketing, and operations. • Yi is one of nearly 1 billion mostly-rabid WeChat users, half of them in China. Owned by Shenzhen-based net giant Tencent, in Chinese the service is called Weixin, or micro letter. While it started primarily as a tool to communicate, it is now defining what's possible anywhere with messaging and with mobile phones. WeChat has a powerful role in the Chinese economy. By the end of 2017, it is expected to be used by more than 79 percent of China's smartphone users, according to eMarketer. ▶
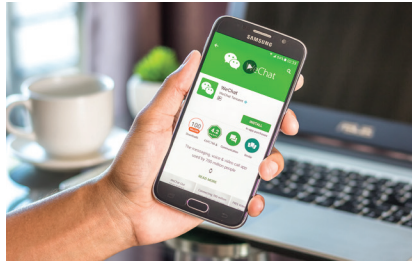
What China's Mobile Revolution Means

By Ann Babe

At lunchtime, Yi uses WeChat to order and pay for food deliveries.

After work, Kraft Heinz's general manager for e-commerce in China turns to the platform to buy movie tickets or make restaurant reservations. Before bed, he browses WeChat's "mini-programs," or apps that live inside the app. He hails taxis, handles utility bills, books flights, splits checks with friends, sends gifts, tracks fitness, and donates to charity—all with WeChat. "You can do almost anything you want on it," says Yi, 33, who was born in Beijing, grew up in the United States, and has lived in Shanghai since 2010. "WeChat has become the default portal. It's like combining Facebook and WhatsApp and Twitter and Snapchat and YouTube all together. It's a super app." (Of course, he told me all this via WeChat's voice call feature.)

The average user spends 66 minutes, or about a third of their daily mobile time, on WeChat, Tencent estimates. But it's not too much to say some users live there. By the end of 2016, more than 30 percent of users were spending at least four hours a day on WeChat, twice the proportion of a year earlier.

In China, "if you're not on WeChat, you're cut off," says Maria Repnikova, an expert on Chinese communications at Georgia State University.

This technology's entrenchment in Chinese society is so broad, so deep, and so complete that it's difficult for non-users to even imagine. The super app's all-in-one functionality means users seldom need—and perhaps seldom want—to exit the platform. It has become their most powerful resource and, for many, their greatest dependency.

Messaging is popular everywhere, but the big brands outside of China are all engaged in a furious game of imitation, trying to catch up to WeChat's capabilities. There are two other Asian heavyweights, Korea's KakaoTalk (in which Tencent is an investor) and Line, which dominates in Japan (though it is owned by Korea's Naver Corporation). Kakao and Line each command about 85 percent of smartphone users in their respective home countries, and Line also is dominant in Taiwan and Thailand. These two Asian chat apps incorporate many features similar to WeChat, but don't fully match it. Meanwhile, the two largest and most multinational messaging platforms in the world by far, Facebook Messenger and WhatsApp, have 1.3 billion global users apiece. Both of course are owned by Facebook. In a 2016 study by GlobalWebIndex, 37 and 33 percent of respondents worldwide, excluding China, reported using Messenger and WhatsApp, respectively, whereas 10 percent used Line, 6 percent used WeChat, and 3 percent used Kakao. For Americans with smartphones, a full 56 percent use Messenger, but it still offers less functionality than any of the Asian services. And WhatsApp remains relatively bare-bones.

WeChat itself started out as a copycat. Tencent aimed to develop a hybrid of WhatsApp and Facebook, but the shrewdly designed platform that resulted turned into a pioneer in its own right. Launched in 2011—about one year after WhatsApp and Kakao, and some months before Messenger—WeChat's innovative apps-within-an-app model provides an experience that acts for users more like an operating system than an app. Tencent could accomplish this in part because WeChat, unlike Facebook, was built for mobile, rather than adapted from a PC-based model. In China, PCs never captured mass adoption. Smartphones have.

For William Bao Bean, an American investor who runs the Shanghai-based accelerator MOX, which focuses on mobile startups, WeChat is the weather vane for the whole industry. "If you want to see the future of Facebook, just look to WeChat," he says. "The entire Facebook roadmap is a giant WeChat clone." Messenger has already outfitted itself with money transfer, games, and numerous other extensions. WhatsApp will soon launch mobile payment services in India, among other improvements.

There are good reasons why smart-phone functions have evolved differently in China. Users there prefer apps that combine as many features as possible into one platform, while Americans seem to like having plenty of options. Separate apps with singular functions ensure Americans have a lot to choose from, and they enjoy and expect that choice, says social media expert Karen North, a professor at the University of South-

From left, China's ubiquitous smartphone screen–always hosting WeChat; a smartphone break from shopping at a Beijing mall; and shooting selfies in Shanghai.

ern California's Annenberg School for Communication and Journalism. Individualistic and fickle Americans are uncomfortable with monopolies, she says. The Chinese, on the other hand, are a 1.3 billion-person "captive audience" in a closed, censored market. Here's how North explains it: "They look for innovations within their ecosystem, not challenges to their ecosystem." Chinese users want to be connected to their community, so only one option seems to matter. When one told us "WeChat is everything," she might just as well have been talking about the Communist party. "It's almost impossible to detach from this app," says Georgia State's Repnikova.

Asian culture itself may also be a useful lens for understanding such services. These communal societies focus on communicating in groups, achieving sense of self in relation to others, and preserving social harmony. So the one-app-fits-all approach may feel right. In Korea, Kakao plays a social role similar to WeChat in China. "If a person doesn't use KakaoTalk, it's difficult for him or her to communicate with other people," says Allen Kim, a 21-year-old student in Seoul. Many Japanese feel similarly about Line. "Line is the popular app," says Akina Egawa, 30, a project manager from Kagoshima. Shanghai investor Bean says WeChat itself functions, in a sense, communally. It may operate within a closed market. But it is itself quite open. Rather than shoulder the burden of developing its ever-expanding set of features, WeChat instead turns to third-party services in its community and integrates their work.

For Yehua Yang, a 33-year-old clothing designer who emigrated from Sichuan to New York City, WeChat is all about keeping in touch with family and friends back in China. "It's the reason I have to put my phone on night mode when I go to sleep. Or else the alerts would kill me," Yang jokes. Being a part of multiple group chats including 20 or more participants means she wakes up to hundreds of notifications every morning. But she likes it. "If I didn't have WeChat I would feel disconnected from a big portion of the people in my life. It's my only means of communication with them," she says, adding that she's pretty sure most of the Chinese diaspora would agree.

What might be more surprising is that Shanghai-based Yi feels the same way about keeping in touch with his staff at Kraft Heinz. "In China, nobody gives their phone numbers," he says, explaining that contacts are typically saved on WeChat by scanning individuals' QR codes. "There are people who work for me on a daily basis, and I don't actually have their phone numbers. I just communicate with them on WeChat."

Yi uses WeChat not only to talk work, but to do work. Much of his job involves building a corporate presence on the service to market the American company to a Chinese audience. He does this using official WeChat accounts. Consumers follow such accounts on WeChat, again, by scanning QR codes that are widely found on product packaging and websites. "WeChat is a basic requirement," says Yi. "It's where all the consumers are. A brand that wants to communicate with them has to use WeChat."

Once a follower subscribes to a company's account on WeChat, the possibilities for engagement are vast. Brands can provide customer

> "It's almost impossible to detach from this app," says one expert on Chinese communications services.

support. They can push promotions, and even use geotargeting to provide alerts when consumers pass a brick-and-mortar storefront. Companies also frequently operate their own virtual stores, not unlike how they do on Tmall, operated by Tencent's Chinese archrival Alibaba. WeChat estimates a third of all official accounts conduct some sort of e-commerce.

Nearly 80 percent of WeChat users follow official accounts, more than 30 percent shop on the platform, and about half of those who live in China have connected their bank accounts to it. (Tencent has put enormous effort into this to combat the even more gigantic market share of the Alipay service affiliated with Alibaba.) Consumers frequently use their "wallets" to pay offline too.

The battle between the two industry leaders is fueling a transactional landscape that in some parts of China has become almost totally digital. More than 94 percent of users in Beijing and Shanghai say mobile wallets are the primary way they pay for everything, according to Tencent.

McKinsey & Company calculates that in 2016 Chinese mobile pay transactions totaled $790 billion—11 times as much as in the U.S.

But all this convenient and efficient togetherness comes at a cost. Georgia State's Repnikova, who directs the Center for Global Information Studies, says WeChat is "heavily surveilled." She continues, "A lot of people talk about messages being deleted. There's an assumption that nothing's private." WeChat's own privacy policy basically admits as much. Repnikova points out that the service makes it easy for the government to keep tabs on all this behavioral data. But the worry does not seem to be shared by many Chinese. Says Yi: "This concern is almost nonexistent... In China, we know the Chinese government is already surveilling everyone."

But since WeChat has global ambitions, the issue of security and surveillance will probably be a sticking point in many markets. And its super-app style is unlikely to dislodge the global dominance of Messenger or WhatsApp. On the other hand, even if Facebook's brands were unbanned in China, they almost certainly wouldn't make serious inroads against such an entrenched incumbent.

WeChat may not be headed for worldwide domination. But it will carry on greasing the wheels of the Chinese economy, and setting the pace globally for what's possible on mobile.

ANN BABE *writes about community, identity, and tech-enabled social change around the world.*

That Old Chinese Can-Do

Have China and the U.S. switched roles for defining the future?

By David Ewing Duncan

Driving at night recently from Hong Kong International Airport to Shenzhen in mainland China, I felt like I was in a CGI depiction of an imagined near-future city. Huge, sleek bridges lit with colorful lights stretched across bays and inlets. Thirty-eight years ago, Shenzhen was a fishing village of 30,000 but its population now surpasses 12 million. It has the world's sixth-largest collection of skyscrapers.

I wondered if this sense of flitting through the future was what people once felt in New York or Los Angeles. Or what it was like when they drove on a new interstate highway system where state-of-the-art, American-made cars streaked across deserts and over mountains at unheard-of speeds.

Today, the United States talks cutbacks in government R&D while China prepares multibillion-dollar "moonshots." America still dazzles here and there, but less often as our infrastructure teeters and there are fewer bold projects. Silicon Valley and its ilk remain gung-ho as entrepreneurs churn out smart gizmos, driverless cars, drugs that use genetics to precisely target cancers, and tiny satellites that monitor ice flows and crop patterns.

Shenzhen at night

Little of this spirit, however, can be felt in large swaths of the U.S., aside from the coasts and a few scattered enclaves. Despite Elon Musk's hoped-for Hyperloop, America finds itself struggling to keep up with an aging infrastructure as our leaders spend most of their time saying "no."

Meanwhile, China continues to expand its infrastructure. Xi Jinping and his chums plan to spend as much as a trillion dollars to build a "new silk road" across Asia into Europe. It sounds like something Franklin Roosevelt might have cooked up to inspire America during the Depression. This so-called "One Belt, One Road" initiative could involve as many as 60 countries and knit much of Asia into one gigantic economy with one gigantic sponsor. And China's presence is felt, too, in projects elsewhere, from skyscrapers in New York, to oil refineries in Sudan and other projects across Africa.

China has maintained growth rates of greater than 7 percent for much of the last 30 years. Billion-dollar start-ups seem to launch every few days as digital wallets substitute for cash (see accompanying story), facial scanners replace boarding passes on airlines, and so forth. The world's fastest supercomputer is in China. Called the

Sunway TaihuLight, it is housed in the National Supercomputing Center in Wuxi. It can perform 93 quadrillion calculations per second, which is three times faster than supercomputer number two, which is also Chinese.

A recent study by Japan's National Institute of Science and Technology Policy found China to be a close second to the U.S. in terms of the number of AI studies presented at top academic conferences in 2015. And a U.S. government report calculates that the number of papers published by Chinese researchers that mention "deep learning" has exceeded the number published in the U.S.

Chinese pharmaceutical and biotechnology companies are rapidly developing new drugs and treatments, and BGI (formerly called Beijing Genomics Institute) is one of the top global powerhouses in genetic sequencing. BGI opened a five-hectare facility in Shenzhen known as the China National GeneBank that is already compiling a database of 1 million human genomes, which would be the world's largest.

It's not all Eastern sunshine, however. Today's China is experiencing serious growing pains as authoritarian impulses dating to ancient times grate against economic free-wheel-

ing. The pollution is legendary and disastrous. A debt bubble looms. And the bridges may look great, but some seem shoddy. Meanwhile, resistance to China's super-aggressive trade practices is rising globally.

History suggests, however, that China's outsized role in the world is no fluke. For much of the past 500 years, China was the number one economy in the world in terms of estimated GDP. Historians say that in 1500, it edged out India, with France placing a distant third. China stayed on top until falling into second place only in 1890, when the U.S. became number one, until China slipped ahead again in 2014, measured by its citizens' purchasing power.

Over the next decades, we'll see which system, authoritarian or democratic, becomes the template for this new century. Some countries will surely be swayed by China, but I suspect U.S. can-do is hardly finished. America will probably again demonstrate its legendary resilience. Yet it's clear that when it comes to glossy futurism and techno-inspiration, the U.S. has work to do.

DAVID EWING DUNCAN *is CEO and curator of Arc Fusion and an award-winning author.*

Me Tarzan, You Alexa

Voice interfaces may seem to be everywhere,
but they have a long way to go

by **JOSH KAMPEL**

Illustration by
CLARA KIRKPATRICK

Since the late 1960s when we first heard HAL in *2001: A Space Odyssey*, many have expected a day when we could converse with computers like we do with another person. And by now most of us have encountered a voice-powered virtual assistant, whether Apple's Siri, Amazon's Alexa, Google Assistant, Microsoft's Cortana, or Samsung's Bixby. Even Facebook is rumored to be getting into voice.

There was a lot of excitement following the release of Amazon's Echo in late 2014, which introduced the Alexa voice app. But after all of this time, the technology remains primitive and doesn't really do what we want it to. ▶

An industry legend agrees. "These systems will not be human anytime soon," says Adam Cheyer, who created both Siri and a new voice platform called Viv, which was recently acquired by Samsung.

Not that we don't need them. Screens will continue to get smaller, intelligent systems will surround us more and more, and the number of devices and applications we need to interact with will grow. Voice may turn out to be the only viable interface for such a world. Much as the graphical user interface (GUI) on the Macintosh and, later, Windows revolutionized how we interact with PCs,

on turning speech into text, crystallizing the first essential component for virtual assistants. Later, Cheyer began work on Siri's intelligent voice application inside SRI, layering it on top of Nuance's software foundation.

Siri became its own company, and the app launched on iOS in February 2010, generating instant buzz. Siri was snapped up by Apple itself months later. Then in the fall of 2011, Steve Jobs stood on stage and announced that Apple would build Siri into the iPhone.

The future for virtual assistants seemed bright. But in fact, explains Cheyer, Apple's built-in version of

and computing power, today's voice assistants exist in a fragmented landscape that prevents them from taking full advantage of what computers and cloud-based intelligence can do. Each system taps into its own data set. Amazon, Google, and others have each created their own artificial intelligence, and rely on developers to build specific applications or 'skills.' Each in effect lives on a little isolated island. Alexa skills aren't interoperable and do not share data. There are more than 10,000 of them.

But to achieve what users expect and to create contextually relevant responses, voice systems will need to access multiple skills at once, along with public, subscription, and personal data. A system will need to understand what it should do based on the request, the user's past behavior, and the context. Today, typically, you have to invoke an app and then tell it what to do: i.e. "Alexa, play *Complicated* by Avril Lavigne on Spotify."

Do you really want to have to use one app to find a restaurant, another to make a reservation, and a third one to send an invitation to your friend?

One company addressing this challenge is SoundHound, which has been around since 2005. Its voice recognition software is used to voice-enable third party applications and it also offers its own app to compete with those from Google, Amazon, and Microsoft. Unlike the other assistants, SoundHound works on any operating system or hardware and can access information from multiple partners at once. Data from Uber, Yelp, and OpenTable can be combined together to respond to a complex query. You can say things like "Hound—find me an Italian restaurant within three blocks that's open until midnight and has an outdoor patio and then make a reservation for four at 10 p.m." Says SoundHound Vice President Katie McMahon: "We realized early on that we would have to concentrate all of our energy in one interface that you

The way we talk to voice interfaces today is clumsy, stilted, and different for each application.

voice almost certainly will transform computing, eventually.

But today, the way we talk to voice interfaces today is clumsy, stilted, and different for each application. When we try to accomplish a specific task, we often end up frustrated. What we need is a universal voice interface that taps into a unified set of intelligent data that resides on the cloud in the background. While most voice systems today can accurately translate speech to recognizable text, we still await machines that can understand natural and conversational language, infer a speaker's intent, and factor in contextual information to deliver a useful response. (For a look at the ethical issues that will arise when we achieve all of this, see following article.)

It wasn't supposed to be this way. Cheyer, who began working on speech back in 1996 at SRI International in Menlo Park, says he "imagined a future when we could talk to computers even before I saw a web browser." Two key companies emerged out of SRI. Nuance focused

Siri had fewer features than the app that had launched in the App Store. That, in turn, had fewer features than the company's prototype, which itself had fewer than the product the company promised to build when it raised money in 2007.

"When we launched Siri, it did 20 to 25 things well—stocks, weather, time, even restaurant reservations," says Cheyer. But the service quickly found it had to aggressively manage expectations. "The biggest gap is that consumers don't know what assistants can do," Cheyer continues. "People will ask something that they think is reasonable, and it fails and then fails again. That results in users being afraid to explore and sticking to what they know. Users hate to feel stupid." Even though voice-powered devices have proliferated since those early Siri days, the problem remains. Research firm VoiceLabs finds that now only 3 percent of users who try a new voice application are still using it a week later.

While we are seeing rapid advancements in artificial intelligence

could speak to naturally, conversationally, and that was context aware."

The world is calling out for a universal language that allows us to interact with machines via voice, just as we already have in the more primitive domain of the phone or tablet. Today, for instance, the 'pinch' has become the universal gestures to zoom in or out of a picture. "There will need to be standardization across voice platforms," says Mark Webster, co-founder of Sayspring, a platform that helps companies design voice prototypes without coding. "Right now, it's common for different platforms, like Alexa or Google Assistant, to require different ways of speaking to indicate the same intent." Such a common language would need to extend beyond platforms into individual applications.

"It's likely there will be a different way to speaking to systems over people," Webster continues. "My wife started by saying 'Alexa, what's the weather today?' and now just says 'Alexa, weather' as she knows she'll get the same response. It's more efficient not to speak to Alexa like a person."

While the giants all seem dedicated to developing the all-encompassing assistant, others believe that voice-enabling applications within a specific domain may be more viable for now. Voysis, a Dublin-based startup, just raised $8 million to help retailers and e-commerce companies let consumers shop by voice. Says Voysis CEO Peter Cahill: "The narrower the application, the better the experience you can provide."

We still have a long way to go. We await a single ubiquitous assistant that we talk to in one way, and that can move with us from home to car to our mobile phone, regardless of what company made each of them or what operating system they have. That almost certainly will require decoupling the hardware from the software so users can put their virtual assistant on any device. The big software companies will probably resist that, until some adept startup forces their hand.

So for now, I'll just use the voice-enabled smart speaker in my living room for playing music, setting timers, and tormenting our Yorkie, Sadie. OK Google, bark like a dog.

JOSH KAMPEL *is Techonomy's president and chief dog whisperer.*

Will We Own AIs, or Will They Own Us?

The rise of artificial intelligence (AI) promises a technology revolution, but like most major innovations these days it is misunderstood. Some of its real risks to society and to the privacy and autonomy of our daily lives are practically undiscussed. Not that there isn't extensive fretting on other fronts. We hear endless talk about the threat AI could pose to jobs, and Elon Musk has warned that future AIs could develop their own autonomous mean streak. He tweeted they posed "vastly more risk than North Korea." ▸

By Tim Weber

Illustration
By Emmanuel Polanco
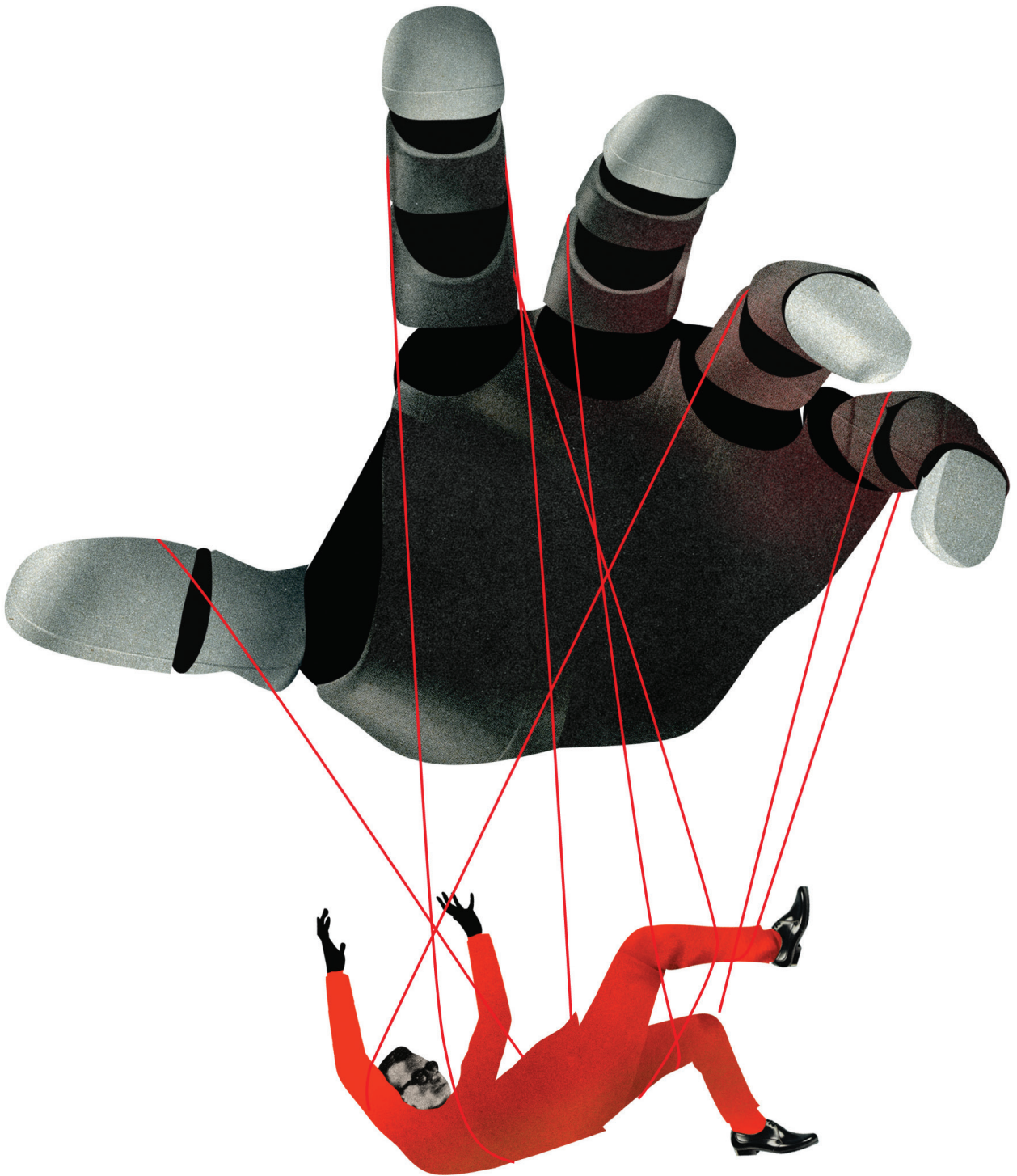
Meanwhile, AI is wildly over-hyped. Look: IBM's Watson is winning Jeopardy; industry executives blithely call AI "freakishly good" at voice recognition; Google's AlphaGo AI program has beaten a renowned Go Master!

What gets lost amidst all this, however, is a fundamental procedural, social, and policy challenge: Who will own—and control—artificial intelligence?

In his seminal science fiction *Neuromancer,* William Gibson not only popularized the term "cyberspace", but also sketched a future where the ownership of an AI is the ultimate hallmark of wealth; one big extended family owns not one, but two AIs, dubbed Neuromancer and Wintermute. But in reality few if any of us will own our own AIs. Instead, how we monitor those who do own them may determine whether we as humans have freedom of choice across our entire lives.

Technology rarely turns out quite the way we expect. Take online search: We were promised a tool for discovery—news, encyclopedias, libraries, and the phone book all rolled into one. But instead search more fundamentally transformed how we live. Our searches morphed into a decision-making mechanism that is not about finding things anymore. The results guide and shape our decisions. You may get scores of pages of results when you search for a product, service provider, or holiday destination. But in all likelihood, you will select one of the top five "choices" presented to you by Google's algorithm. Search does not deliver serendipity of discovery. Instead it has turned into a filter, fine-tuned by your web habits and fraught with highly targeted advertising.

Similarly with free web services–Flickr, Instagram, Netflix, LinkedIn or Facebook. As is widely said, when you don't pay for the product, instead you are the product, as the companies mine the rich data we all produce to show us ads.

The AI revolution, however, will be even more fundamental, but we may not even notice it. Already, we are happily using the rudimentary precursors of true artificial intelligence: the digital assistants in our smartphones or smart speakers, and the chatbots answering the basic queries we put to retailers, banks and other service providers. The more delicate the subject, the more happily we "talk" to the machines. Research suggests we would rather talk to a computer about a financial problem than to a human, who after all might be judgmental. (For more on the future of voice interfaces, see article on page 30.)

AND WHAT'S NOT TO LIKE: Do we really have to make every routine decision ourselves—"In which folder

pages of search results; instead, we will expect them to give us clear directions, or at most a choice between a couple of options. At this point, however, they will have stopped augmenting us; instead, they will have become our opaque gatekeepers. If today's search reduces our range of choices to five or maybe 10 options (since hardly any of us scroll beyond that), then voice-powered AIs will narrow that down to just one or two.

WHICH AIS WILL WE CHOOSE? The ones that promise to be good? The one that speaks with a celebrity voice? Or simply the one that comes preinstalled with our digital world's operating system?

How will we know whether our "personal" AI will do no evil? If we ask for the best restaurant nearby, will it give us the choice that we might have picked from a list of

"How we monitor those who own AIs may determine whether humans have freedom of choice."

should I file this email?" "When should I order more washing powder?" Many say that AI could give us the time and power to focus on truly creative work.

BUT HERE'S THE RUB: All this support comes at a cost.

At work, our employers may pay for the AI and try to ensure it has the company's best interests in mind. But what about the AIs that will augment our private lives? Many of them will be free, as are today's digital assistants like Alexa, Cortana, Google Assistant, and Siri. We will talk to computers all day long.

AIs will come into their own once they truly understand our natural-language queries and respond in kind. When that happens, they will not bore us by reading pages upon

search options, or the one that paid to be first? More significantly, if we ask our AI to give us the background on a political issue, will it skip the parts that interested parties have worked hard to suppress? Will today's relatively benign search engine optimization morph into a more pernicious gaming of AI results? Will someone be able to pay to "optimize" what the AI tells us so it is in their interest?

THE DYNAMICS OF VALUE EXCHANGE will have dramatically shifted again. We will have evolved from our small filter bubble and grown into a filter prison that could in practice offer us, at best, binary choices. The product at that point will not be the data trail of our behavior, but our behavior itself. To put it bluntly, it won't be the

AI that is the ownable service, but our own actions, as we closely follow the advice of "our" AI.

Today's smart phones and the voice-recognition services of our connected loudspeakers and other Internet of Things devices are already the harmless-seeming beachheads of AI in our homes and lives. As such devices and services proliferate and appear in more and more places, they may appear to be so harmless (and cheap) that we will barely notice until well after this revolution has triumphed.

Still, it's not too late for societies to make the right choices, so we as consumers can swerve before we enter this one-way street into dystopia. It doesn't help that today the technology industry remains the most trusted of all industries, according to the Edelman Trust Barometer, an annual survey of more than 33,000 people. But the 2017 survey also shows that the more cutting edge the technology, the more this trust is likely to evaporate. When it comes to the hot contemporary topic of autonomous cars, for instance, consumers are decidedly queasy whether they should get on board.

Car companies that want to entice us to buy an autonomous car are thus going to need to build trust first, based on clearly conveying to us the opportunities and limitations of the technology. All of us are going to have to demand similar levels of transparency before the AI revolution seeps into our lives. Companies will need to answer some key questions: What underpins AI decision-making? Who sets the parameters of their decision filters? Can third parties influence the options "our" AI offers? Both Microsoft and Google have already explicitly said they realize they have to make AI "people-friendly," and openly address issues of the transparency of the systems and proceed slowly in order to develop public trust.

Ultimately we will need clear laws and well-accepted procedures to regulate robots and AIs and deploy them effectively. Because as we go forward, whoever owns the AIs could, if we let them, own us.

TIM WEBER *is an SVP with communication marketing firm Edelman in the UK and the former business and technology editor of the BBC news website. Edelman supports several companies developing AI, but Weber does not work on their accounts.*

NO STARTUP MAY EMBODY THE PROM-ise and pain of Europe's striving startup scene more than Paris-based BlaBlaCar. Two of the guys who founded it in 2006 had logged time in Silicon Valley and absorbed that region's entrepreneurial culture. BlaBlaCar's intercity ride-sharing service has now raised more than $300 million in venture capital and will soon be operating in 22 countries. • Yet getting there was painstaking. The company didn't raise its seed round until 2009, and the first real venture capital came in 2011. Expanding across Europe involved baby steps to navigate each country's distinct labor laws, financial rules, and cultural mores. And partly because it had no intention of targeting the United States, the company had to interest European investors, few of whom had sufficient resources to provide the large amount of late-stage funding it needed. • And for all that, things are way better than they used to be. "If you go back 10 or 15 years ago, it was much harder to build a big European business than it is today," says BlaBlaCar co-founder Nicolas Brusson. "But it's still super complex. And that's a degree of complexity that's not going to go away." • Today, BlaBlaCar is hailed as a European success. But Europe wants more BlaBlaCars. A lot more. And fast. European politicians and business leaders want to rejuvenate stagnant economies, and they fear the growing high-tech hegemony of the United States. So they are pressing every lever they can to shift the region's innovation economy into high gear. • Perhaps most impressive, especially to jaded Americans, is the degree European government leaders are embracing tech. "One of the reasons this has become more and more urgent ▶

EUROPE LIGHTS THE TECH FUSE

ENVIOUS OF SILICON VALLEY, THE CONTINENT'S LEADERS EMBRACE AMBITIOUS PLANS TO ACCELERATE ENTREPRENEURSHIP

by CHRIS O'BRIEN

French President Emmanuel Macron at the opening of the $220 million Station F "start-up campus" in Paris. Governments across Europe are becoming advocates for and investors in tech.

is that we see the digitization of the entire economy," says Margrethe Vestager, the European Commissioner for Competition. "In the years to come, we have to support [digital innovation] to make sure European industry can survive." The European Union itself has now become one of the chief suppliers of investment capital to the continent's venture firms.

The initial return on these efforts has been positive. Startups and venture capital investments are on the rise. While absolute numbers still fall well short of the United States, there is a giddy feeling that a fundamental shift is happening, and that Europe is finally getting its startup mojo. "I'm seeing a radical change in the entrepreneurial mindset in Europe. People are thinking on a global level," says Lars Fjeldsoe-Nielsen, general partner at Balderton Capital, one of Europe's largest venture firms. "And I'm very surprised by how quickly that changed." Fjeldsoe-Nielsen spent several years as an executive at Dropbox and Uber in the U.S., and advised WhatsApp, before returning to London in 2015.

How did Europe light this fuse? Offering a sweeping picture of European innovation is difficult. The approach to building a tech economy varies across the European Union's 28 (give or take the United Kingdom) member nations. And yet European leaders have employed some distinct common strategies across borders to at least mitigate, if not overcome, some of the most galling advantages of Silicon Valley.

Europeans marvel at the venture capital plowed into U.S. companies. In 2016, U.S. startups raised $69.1 billion, according to the National Venture Capital Association. "You could fit the whole European venture capital industry into a parking lot on Sand Hill Road," said Nenad Marovac, chairman of Invest Europe, a VC trade association, and founder of London-based venture firm DN Capital.

Europe's government takes digital innovation seriously. Here, EU Commissioner for Budget and Human Resources Günther Oettinger speaks at Europe's top tech ideas forum— DLD in Munich, in January 2017.

In the face of this daunting gap, leaders of the European Union decided it needed a catalyst. The EU already had several programs to invest in small businesses, notably something called the European Investment Fund. The EIF had put €4.6 billion by 2010 into private equity funds across Europe. But starting in 2013, the EU began adopting a panoply of new programs like Horizon 2020, which aimed to pump €80 billion into research and innovation programs. There was also the Entrepreneurship Action Plan 2020

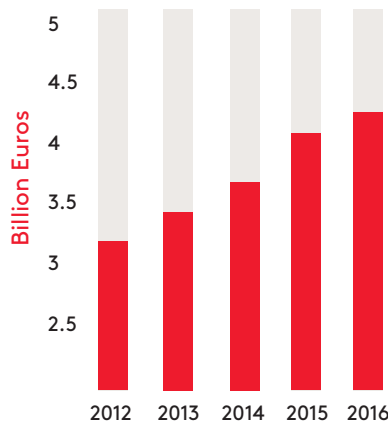**VENTURE CAPITAL INVESTED INTO EUROPEAN STARTUPS:**

and Startup Europe, wide-ranging support efforts for entrepreneurs that included education, financial reforms, and the encouragement of networking and information sharing around innovation.

In 2016, EIF's matching fund program invested €3.2 billion into 117 funds across Europe. The continent's government has also created a €320 million angel fund to boost early stage investments.

One recipient of that money: Scottish Equity Partners, which was a lead investor in Edinburgh-based travel search engine Skyscanner. Last year, a Chinese company paid $1.7 billion to buy Skyscanner. Stories like this have attracted additional money from American investors. Invest Europe says European VC funds now are attracting double the amount of money from the U.S. that they did five years ago.

The EU and American money is being supplemented at the national and local level. Perhaps the most notable example is "La French Tech," a program created in 2014 to stimulate the country's startup economy. It includes global marketing programs as well as matching funds for startups via a state-controlled bank, and €200 million for startup accelerators across the country.

As the result of all these programs, the amount of investment capital raised by European venture firms jumped from €3.7 billion in 2012 to €6.4 billion in 2016, according to Invest Europe. The amount going into European startups grew, too, if somewhat less dramatically, from €3.2 billion in 2012 to €4.3 billion in 2016. An enormous gap remains with Silicon Valley and the U.S., but mobilizing these programs has sent a critical and very welcome signal to entrepreneurs and investors continent-wide.

"When you see the government making tech a priority, it does have a huge impact," said Roxanne Varza, director of Station F, a massive startup campus that opened this year in Paris. "There are so many more resources for startups." (For more about Station F, see accompanying story.)

One of the great cultural barriers Europe has traditionally faced is that there haven't been enough entrepreneurs with a healthy appetite for risk. With Europe's cushy social benefits and the continuing hope among many for lifetime employment, few college graduates have embraced risky entrepreneurial careers. But in recent years stubbornly high unemployment among those under 25 has generated a "what-the-hell" attitude, so more are taking the leap.

Another important change in Europe has been a massive expansion in the number of accelerators and incubators, both publicly and privately funded. Some build all sorts of startups while others focus on a single technology or industry.

Gust, an online platform that manages fundraising for startups, reports that since 2015, Europe has had more operating accelerators and incubators than the U.S. and Canada. That year, 26 opened, bringing Europe's total to 113. There are also

Lights. Lovers. Artists. Entrepreneurs.

By CHRIS O'BRIEN

THE TEAM BEHIND PARIS-BASED Station F probably didn't need any more pressure after spending $220 million and three years building what they say is the world's largest startup campus. But on the day of its grand opening in late June, newly-elected French President Emmanuel Macron stood on a stage in the middle of the vast space of the renovated one-time train station and sent expectations into the stratosphere. "Transform our country, shake it up, change it," he said. "This responsibility is as much yours as it is mine."

That task now falls on the shoulders of director Roxanne Varza, a Silicon Valley ex-pat who moved to Paris in 2009. After working as a tech journalist and then director of startup relations for Microsoft, she was hired in 2015 to oversee the creation of Station F by its mastermind, Xavier Niel. The billionaire founder of telecom company Iliad, which operates Free—an upstart French wireless, internet, and cable provider—had purchased the decaying train station, Halle Freyssinet, to create something audacious as an emblem of France's startup ambitions.

"For our first year, it's a beta test on all levels," Varza said. "We're going to see what's working. There's still stuff we haven't had to do yet. This first year will be a lot about tweaking."

Station F is part of an emerging trend across Europe, as nascent tech hubs try to boost their startup economies. The city of Helsinki is adapting a massive abandoned hospital into a startup campus called Maria 01. Outside Venice, a rural incubator is building a startup campus called H-Farm. And in East London, the giant tech hub Here East opened this year in the buildings that once served as the press center for the 2012 Olympics. Each is designed to make a big statement. But in general, they're all attempts to bring the pieces of an innovation ecosystem under one roof.

At 34,000 square meters, Station F is big enough to house 26 different entire startup programs, including ones run by Facebook and Microsoft. There are also three venture firms with offices there, various corporate partnerships underway, and perks for residents offered by companies such as Airbnb and Amazon. Even former French president François Hollande will have an office there. Station F will also soon oversee two apartment buildings nearby for entrepreneurs, and a retail and restaurant section that will be open around-the-clock.

The launch of Station F comes at an interesting moment for France's tech scene. When it was first announced in 2014, the country was just starting to gain momentum under the government's French tech program. Three years later, France has seen big growth in the number of startups and the amount of venture capital raised, and an explosion in tech momentum capped in some ways by the election in 2017 of Macron. He had been an entrepreneurial champion in his previous job as economic minister.

And yet none of this has diminished the hype building around Station F, or the belief that it could indeed represent a signature moment in the country's startup history. "I think we're really looking at being an international player," Varza said. "When entrepreneurs come to Europe, we want them to think of France. And when they think of France, we want them to think of Station F."

now more startups based in accelerators in Europe than in the U.S. and Canada combined.

"We're trying to build community that puts in place the foundation that can help an entrepreneur," said Tom Wehmeier, a partner at London-based Atomico, one of Europe's largest VC firms. It plays an active role in mentoring companies at Stockholm's SUP46 startup hub. "People must embrace failure and take risks. To help them, you have to surround that person with the right people and role models and support."

That's not the only way to reduce the sense of entrepreneurial risk. In Germany, Rocket Internet has become famous (or infamous, depending on your view), for trying to create a startup factory. The idea is to take what the company calls "proven business models" and create companies for regions where those models haven't yet been introduced. Skeptics, especially at American companies that have pioneered businesses Rocket then duplicates, call it a copycat model that thrives on ripping off the ideas of others.

Jan Beckers helped invent a new twist on this approach when he co-founded a "company builder" called HitFox Group in Berlin. It operates in three verticals: digital advertising, fintech, and healthcare. HitFox starts companies in various geographies. Then, as other opportunities are spotted in those same markets, it gives seed funding to new companies and invites them to share back office functions such as human resources, finance, marketing, IT, and legal support. "As Germans, we like to control and mitigate risk," he said. "HitFox tries to systemize the creation of companies by eliminating as many variables as possible."

For a visitor from Silicon Valley, the second annual edition of the Viva Technology show in Paris this past June may have seemed odd.

The sprawling conference floor

was dominated not by tech names, but rather by sprawling booths anchored by giants of the analog economy, like LVMH, L'Oreal, Accor Hotels, and transportation giant SNCF. Within these hubs one could find an array of innovations, entrepreneurs, and startups supported by each big-name corporation. It documented a set of efforts few comparable American giants could duplicate, so far.

Viva Tech is a symbol of how Europe is counting on its big companies to help build a startup economy. For many years, it seemed that corporate leaders in Europe were content to go slow. Now government officials, academics, and policymakers from the EU level on down are scolding corporates for being laggards. At the same time governments are throwing incentives at them, like tax reforms and a governmental willingness to

Government officials and policymakers are scolding corporates for being laggards.

match their investments. Policymakers hope that by acting in their own self-interest, these companies will push even more venture capital into the system, as well as create another avenue for exits, as startups sell themselves to the giants.

The most recent State of European Tech report produced by Atomico noted the stunning fact that 65 of the 100 most valuable publicly-traded European companies are more than 100 years old. Only four are younger than 25 years, and they're all Russian oil companies. By comparison, the five most valuable U.S. companies recently were all tech: Apple, Alphabet, Microsoft, Facebook, and Amazon.

But the good news, found Atomico, is that the number of startup investments by those same corporate *éminences grises* rose from nine in 2011 to 80 in 2015. And their acquisitions of startups jumped from one

in 2011 to 23 in 2015. "We talk about a kind of corporate awakening," says Atomico's Wehmeier.

Accelerators help entice big companies to get their hands dirty. The Kickstart Accelerator in Zurich, created in 2015, bills itself as the "largest multi-corporate" accelerator in Europe. It brings startups from around the world to Zurich for an 11-week program where they rub shoulders with companies like insurance giant AXA or financial leader Credit Suisse.

Gavan Gravesen had been based in New York City, where he is co-founder and CEO of RAD, a 3-D imaging company. RAD has already raised money and is about to launch the first version of its product. But Gravesen swam against what has historically been a steady tide of growing European startups that moved to the U.S., and accepted an

invitation to join Kickstart. That's partly because one of Kickstart's corporate partners is Switzerland's ABB Robotics, a potential customer. "There is a view in the U.S. that innovation is not as energetic in Europe," Gravesen said. "And that's wrong. In machine learning and visualization, we see the same quantity and quality on both sides of the ocean."

For all this progress and buzz, Europe's startups face profound obstacles. There is still a big shortfall in late-stage funding, which eventually causes many startups still to drift toward the United States. And the emergence of numerous tech hubs has created a competition for talent and funding as well as a new spirit of local cooperation.

But the biggest hurdle remains that the traditional divisions of language and culture make scaling a company across Europe slow and

labor-intensive. European entrepreneurs look with envy upon the massive, English-speaking U.S. market, where startups often grow explosively before going international.

And the continent remains fragmented in other, less obvious ways. While the EU helped erase many physical divisions, ironically many continue to exist in the digital realm. On issues like taxation, privacy, security and labor law, Europe has 28 sets of policies a startup must navigate. The EU did launch a Digital Single Market initiative in 2015, aiming to unify some rules, but progress has been halting. "It's still a patchwork of different regimes," said Robin Wauters, editor of research and news site Tech.eu. "You can't speak of any policy without speaking of 28 policies."

Anna Alex, co-founder and CEO of Berlin-based Outfittery, felt this problem acutely in the first years after the company's founding in 2012. As the fashion firm initially grew, it kept all its stylists, employees and warehouses in Germany to avoid administrative challenges like opening a bank account in every new country and dealing with local taxation. Even so, the company had to be creative when shipping outside of Germany. Its drivers would go to the border, unload the shipment, and another courier would then have to reload it into a different truck to cross the frontier.

"It was a huge challenge to internationalize," Alex said. "We'd like to be in more countries. We just couldn't go as fast as we'd like."

Despite the halting start, Outfittery has raised €50 million of venture capital, employs 250 people, and ships to eight European countries. Outfittery's founders did what any entrepreneur anywhere must do: overcome every obstacle. More founders are finding the confidence to do just that, so the region's startup velocity continues to accelerate. And so does the belief that Europe is building an entrepreneurial culture that engenders economic hope.

CHRIS O'BRIEN *is the European correspondent for VentureBeat.*

"We are drowning in data and starved for wisdom…"
-Arianna Huffington

Dr. Dean Ornish, Founder, Preventive Medicine Research Institute

"We must collaborate with industry, provider, payer, and a disruptive innovator."
- DR. BRIAN DONLEY, *Chief of Staff, Cleveland Clinic*

▼

"We're finally at the point when we can start doing real genomics-driven preventative medicine."
- DR. JILL HAGENKORD, *Chief Medical Officer, Color Genomics*

David Kirkpatrick, Chief Techonomist; Yonatan Adiri, CEO, Healthy.io; Esther Dyson, Founder, Way to Wellville; Len Greer, President, Johnson & Johnson Health and Wellness Solutions; and Christian Madsbjerg, Co-founder, ReD Associates

"My wife got pregnant in 2012. I didn't understand the damn bills I was getting from the insurance company. I said there's got to be a better way..."
- MARIO SCHLOSSER, *Co-founder and CEO, Oscar*

"We are the first company to have successfully gone through clinical trials in transforming a smartphone camera...into a clinical-grade scanner."
- YONATAN ADIRI, *CEO, Healthy.io*

"AI can help us realize what works for what individual."
- JOHN MATTISON, *Chief Medical Information Officer, Kaiser Permanente*

Claudia Romo Edelman, Special Advisor, UNICEF and Dr. Agnes Binagwaho, Vice Chancellor, University of Global Health Equity
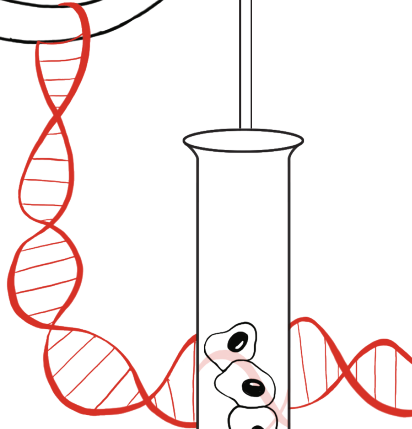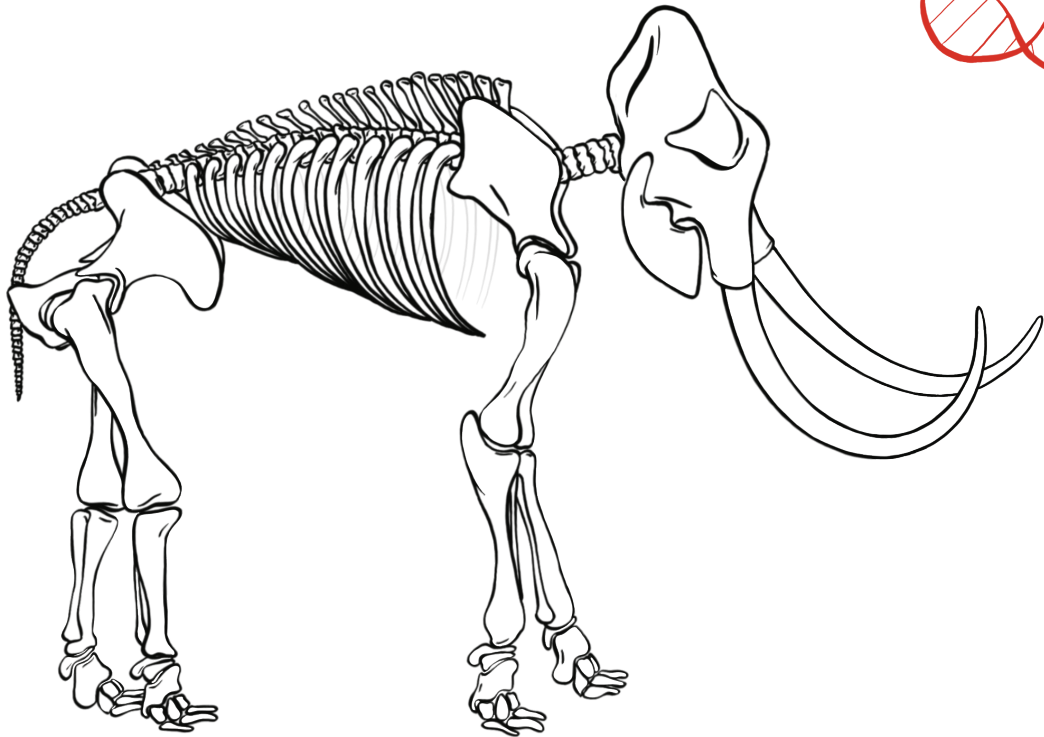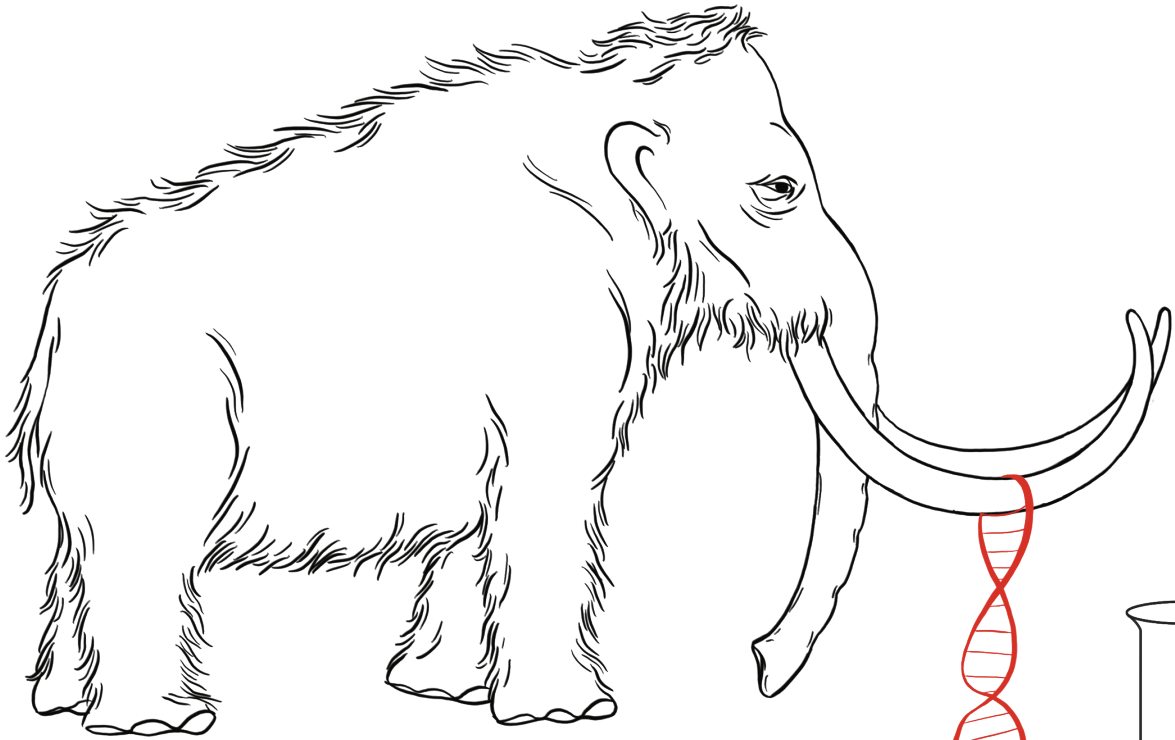

Arianna Huffington, Founder and CEO, Thrive Global

PHOTOGRAPHS BY REBECCA GREENFIELD

Mammuthus Primigenius

ExtiNct?

by Meredith Salisbury

As Mass Extinction Looms, Conservation Genomics Fights Back

When it comes to biodiversity, humans have been about as good for life on Earth as a giant asteroid slamming into it. Many leading scientists contend that we are in the midst of a mass extinction, not dissimilar to the one that wiped out dinosaurs and countless other species 66 million years ago—except that this time it's being caused by human activity. Species are now going extinct at rates 100 to 1,000 times faster than usual.

Illustration by Julia Kuhl

No wonder then that conservation biologists are grasping at any technology that might help rescue species before they go extinct. One toolkit they are turning to is genomics—to assess, preserve, and even manipulate species' genomes. The CRISPR genetic editing technology that has recently captured biology's imagination is one key tool, combined with high-quality DNA sequencing. Scientific interest has even extended beyond merely saving endangered species to the radical notion of reaching into the past to resurrect already-extinct ones, some from the distant past.

While these so-called de-extinction programs—best known for attempts to bring back the woolly mammoth—capture the imagination, less glamorous efforts to protect threatened species are already showing results. From American chestnut trees to Hawaiian crows, many types of flora and fauna are getting a second chance thanks to conservation genomics. But major issues, including regulatory hurdles and a dearth of funding, still stand in the way of significant progress.

Until the last decade or so, the most common use of genomics for conservation biology was for simple cataloging. Scientists collected thousands of samples to represent the existing genetic diversity of each species and stored them, often in seed banks or museum vaults. The idea was that having such vast collections of DNA would be useful in the future, a sort of "doomsday prepper's approach" to conservation.

But recent advances in genetic engineering, gene editing, and in-vitro fertilization have given scientists the opportunity to consider more active measures. Conservation biologist Douglas McCauley at the University of California, Santa Barbara has closely followed these new techniques, which in theory could allow researchers to alter an organism's genome and bring such manipulated embryos to term. "It's certainly an exciting time," he says. McCauley is not a geneticist, and these new

methods are still uncharted territory for most conservation scientists. But "things are so bad now with species loss and conservation," he says, "that I'm willing to hear out any plan for recovery that is sensible."

Today, typical goals include editing or naturally breeding genomes to add pieces of DNA that are associated with health, to remove genetic variants linked to disease or pathogen susceptibility, or to alter genes to give a species greater odds of surviving in different environments.

Ryan Phelan was one of the earliest champions of genome-based interventions in conservation. A successful entrepreneur in genomic medicine, she began thinking several years ago about how the same technical methods could make a difference in other fields. "No one was talking about conservation in genomics at all," recalls Phelan, who went on to launch Revive & Restore, a conservation genomics startup focused on the genetic rescue of endangered or extinct species. Seven years later, she is working closely with experts from genomics and traditional conservation to figure out how to utilize the best of both. By combining them, she says, "you could really figure out how to maintain [an endangered] species before it winks out. We can have a tremendous impact."

Revive & Restore's best-known effort is applying genomic tools to try to bring back the woolly mammoth. While this project has gotten plenty of attention, the science tends to get lost in translation. The effort calls to mind
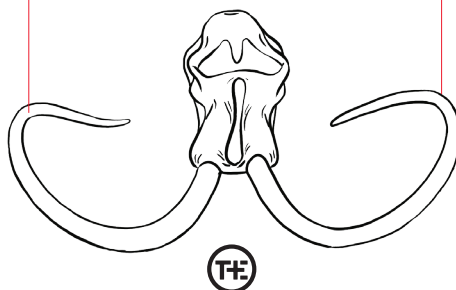
Jurassic Park-style images of ancient mammoths tromping around the modern Yukon, but resurrecting an extinct species remains a pretty far-fetched idea.

Scientists are today working with a living relative of the mammoth—the Asian elephant—and editing its genome to more closely resemble its extinct cousin. This would be akin to starting with our own closest relative, the chimpanzee, adding or altering some genes, and calling the result a human.

"We're not opening the door to the lab and out walks a woolly mammoth," says McCauley, who is not involved but has closely observed the project. The outcome, essentially a hairy Asian elephant, would be "a cross between something old, something new, and our imagination," he adds.

Regardless, there still seems to be a lot of value for conservation genomics in having a publicity-friendly project. For one thing, it is more likely to get funding. Philanthropist Peter Norton has given at least $100,000 to Revive & Restore, while entrepreneur and investor Peter Thiel donated $100,000 directly to the Harvard University lab undertaking the work. It also opens the doors to important discussions about the need for conservation, particularly in light of climate change. Some researchers even believe the woolly mammoth's grazing patterns were important for preventing the release of carbon captured in permafrost; bringing it back, they suggest, might help slow the effects of climate change.

While the hypothetical mammoth gets the attention, conservation biologists are thinking more about preserving whole ecosystems than about cherry-picking individual species for rescue. Ongoing efforts to save the American chestnut tree illustrate this approach.

Decades ago a blight swept through eastern American forests, wiping out the chestnut population. William Powell, a scientist who's been working on reversing that blight for more than 25 years, eventually implemented genomics approaches. He found a gene in another species that essentially detoxified the acid produced by the tree-killing fungus,

and spliced it into the chestnut's genome. His team has been planting the genetically modified trees in field trials overseen by the USDA since 2006 and has applied for approval to plant them in the wild.

For Powell, this is about more than saving a tree. Chestnuts once produced a reliable crop that supported diverse wildlife in the forests; several species of moles, a weevil, and others went extinct or became stressed without the nuts. "It's not just about bringing back the chestnut for the chestnut's sake, but for the environmental benefits it would bring," he says.

At the San Diego Zoo's Institute for Conservation Research, Oliver Ryder works on using genomics to rescue critically endangered birds. The California condor population declined dramatically due in part to a genetic disease; using genome data allowed scientists to structure a more effective breeding program to produce healthier

birds without the need for gene editing. Similarly, genetic information about Hawaiian crows is helping scientists improve the birds' health and figure out which ones to release into the wild. Both birds may be safely reintroduced to their native habitats in part because their ecological niche still exists.

Such ecosystem factors are essential for successful conservation efforts, says McCauley, who favors rescuing endangered or recently extinct species over long-extinct ones. "It's going to be a lot easier to slot a species that you bring back from the dead into the wild if there's still space for it," he says. "If we wait too long or reach too far back ... it's going to be like trying to take a piston for a Model T and shove it into a Tesla."

Efforts to save species with genomics are dogged by a continual lack of funding and a complex regulatory process. Powell, for example, has to submit his

genetically altered chestnut tree to the EPA, FDA, and USDA for separate and costly review protocols that can take as long as two years. There is no streamlined review process for releasing modified species into the wild. "We have been meeting with agencies for almost three years to find out how to do it" he says. "No university has ever taken a tree through the regulatory system."

Perhaps the biggest challenge for conservation, though, is the idea that extinction is a natural process that shouldn't be directly addressed by science. "It will be up to us how many species, and which ones, we let go," says San Diego Zoo's Ryder. "As a citizen of Earth, I believe that it's our responsibility to pass this [diversity] on to the future."

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

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In 2018, we host two multi-day events, one on the East Coast, one on the West Coast. On May 8-9, we enlarge our Techonomy NYC conference to two full days, in midtown Manhattan. We'll take the global view the city is known for, and embrace our local champion industries—finance, media and marketing, commerce and retail, healthcare, and tech. We've got some powerful speakers lined up.

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diverse formats, and kaleidoscopic range of speakers we're known for. One thing that characterizes all our events is that we make them room-wide conversations.

In the meantime, we will be appearing and creating content along with our community and partners at CES, the World Economic Forum in Davos, Mobile World Congress,
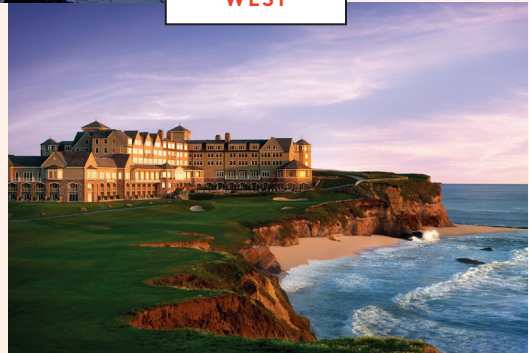
SXSW, London Tech Week, and VivaTechnology in Paris, among other events.

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