Information
and its discontents

BY STASH LUCZKIW

Big data has already changed much more than just the global economy. Now it is rapidly transforming how we experience reality. As the power of computers reaches a critical mass, technologists and those at the mercy of technology will be forced to reevaluate what it means to be human.

Artist's interpretation of the Panopticon.

There's something akin to a new religion percolating in Northern California's coffee-fueled brainstorming sessions and tech conferences. While not an "organized" religion per se – i.e., with stiff traditions, solemn rituals and scriptural myths rooted in the past – organization is the cornerstone of this, let's call it a movement: the organization of information. And while the past is no longer revered, it is consciously used as a benchmark against which the future will reveal itself in all its glory.

The technologists who champion this futuristic vision of human development call it the Singularity. A term borrowed from physics, the Singularity is an event horizon beyond which it is difficult to predict what happens. The prelude goes something like this: The power of technology, which is increasing exponentially, becomes so comprehensive that the networks of computers organizing human institutions and actions develop their own autonomous intelligence and literally begin to organize consciousness – human and non – on their own. From the Singularity onward, various scenarios ramify: On the sanguine side of the spectrum, we see a Silicon Valley nerd-Rapture occurring, in which mortal humans can upload their consciousness into a sort of Platonic Hyperuranius (the world of Ideas "beyond the heavens") and thereby achieve immortality. On the darker cyberpunk side, you get renegade artificial intelligences infinitely more clever than HAL in *2001: A Space Odyssey*, who decide to push aside the impediment of an inferior homo sapiens, much the way homo sapiens shunted Neanderthal man into extinction in the survival of the fittest game.
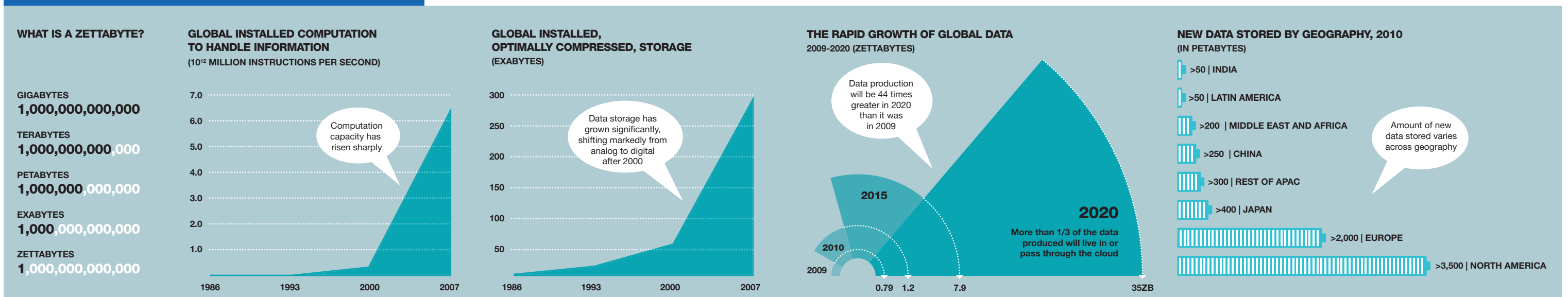
The most prominent advocate of Singularity-based futurism is inventor and author Ray Kurzweil, who published *The Age of Spiritual Machines: When Computers Exceed Human Intelligence* in 1999 and *The Singularity is Near: When Humans Transcend Biology* in 2005. Born in New York, the son of Austrian Jews who had fled from Europe before World War II, Kurzweil founded the Singularity University in Silicon Valley along with Google and the NASA Ames Research Center. In 2012 he was appointed Google's Director of Engineering. Central to Kurzweil's ideas are Moore's Law, which predicts that overall computing capacity will double every 18 to 24 months, and what he calls the Law of Accelerating Returns, according to which the rate of change in a wide variety of evolutionary systems (including the growth of technologies) tends to increase exponentially. To illustrate, Kurzweil often describes how during his undergraduate days at the Massachusetts Institute of Technology all the students shared a computer that took up half a building, whereas the computers in our cellphones today are "a million times cheaper and a thousand times more powerful. In other words, there's been a billionfold increase in price-performance of computing" since the late 1960s.

Some of Kurzweil's predictions include: "By 2029 we will have reverse engineered, modeled and simulated all the regions of the brain, and that will provide us with the software and algorithmic methods to simulate all the human brain's capabilities, including our emotional intelligence. Computers at that time will be far more powerful than the human brain, and we will be able to create machines that really do have the subtlety and suppleness of human intelligence." This will combine with the already established power of machines to do things better and faster than humans: whether it's scanning invisible areas of the human body, observing sidereal movements and modeling the evolution of the universe, or accessing "all of human knowledge at a keystroke."

TOBIAS MEYER

HOW MUCH DATA IS OUT THERE?

WHAT IS A ZETTABYTE?

GIGABYTES	1,000,000,000,000
TERABYTES	1,000,000,000,000
PETABYTES	1,000,000,000,000
EXABYTES	1,000,000,000,000
ZETTABYTES	1,000,000,000,000

GLOBAL INSTALLED COMPUTATION TO HANDLE INFORMATION
(10^12 MILLION INSTRUCTIONS PER SECOND)

Computation capacity has risen sharply

7.0 6.0 5.0 4.0 3.0 2.0 1.0

1986 1993 2000 2007

GLOBAL INSTALLED, OPTIMALLY COMPRESSED, STORAGE
(EXABYTES)

Data storage has grown significantly, shifting markedly from analog to digital after 2000

300 250 200 150 100 50

1986 1993 2000 2007

THE RAPID GROWTH OF GLOBAL DATA
2009-2020 (ZETTABYTES)

Data production will be 44 times greater in 2020 than it was in 2009

2015
2010
2009

2020
More than 1/3 of the data produced will live in or pass through the cloud

0.79 1.2   7.9   35ZB

NEW DATA STORED BY GEOGRAPHY, 2010
(IN PETABYTES)

>50 | INDIA
>50 | LATIN AMERICA
>200 | MIDDLE EAST AND AFRICA
>250 | CHINA
>300 | REST OF APAC
>400 | JAPAN
>2,000 | EUROPE
>3,500 | NORTH AMERICA

Amount of new data stored varies across geography

Whatever you may think of Kurzweil and others' so-called transhumanist ideas, no one who hasn't been stone-cold unconscious for the past two decades can help but be amazed at how fast humans' capacity to process information has grown. If the early 20th century saw a physical revolution led by electrification and speed of travel, then the early 21st century is witnessing an analogous revolution in terms of what technologists like to call "intelligence" or "consciousness" – though a more accurate and less controversial label would be "information processing." This revolution affects almost every area of our lives: from our ability to remember (how many phone numbers does the average person now store in his or her brain compared to a quarter century ago?) to our emotional expectations regarding communication (gone are the days when we would eagerly wait weeks for the arrival of a long distance love letter; today, in an age when lovers curse a bad Skype connection, such a delay would signal an intolerable level of indifference) to our health (recently the feat of gene mapping allowed actress Angelina Jolie to base her decision to undergo a preventative double mastectomy on the presence of a faulty inherited gene, which greatly increased her risk of developing cancer). And if the progress in technology does not amaze, then perhaps the blasé matter-of-factness with which we accept the miracle of human flight or the teleportation of sound and image might at least give transhumanism a little credence.

One truism about the future, however, is as old as the human species: Information is power. The power inherent in having access to information has not only transformed our daily lives, it has generated fierce competition among those who would process that information. The current buzzword for this rush to parse, process and profit from so much information that has become accessible, harvestable and analyzable thanks to sheer computational power is "big data." According to Kenneth Cukier, data editor for *The Economist*, who co-authored with Viktor Mayer-Schönberger the 2013 book *Big Data: A Revolution That Will Transform How We Live, Work and Think*, the term big data broadly means "that society has more information than ever before, and we can do things when we have a large body of information that we simply couldn't do when we only had smaller amounts." Moreover, he adds, "We are taking things that have always been informational in society and we are rendering it into data. One example is location. It's always been a matter of information where somebody or something is. But it's only been fairly recently that we know the location of people at all times everywhere in the world – certainly if they're holding on to a smartphone – and datifying location."

In their *Foreign Affairs* essay "The Rise of Big Data," Cukier and Mayer-Schönberger point out that "datafication is not the same as digitization, which takes analog content – books, films, photographs – and converts it into digital information… Datafication is a far broader activity: taking all aspects of life and turning them into data. Google's augmented-reality glasses datafy the gaze. Twitter datafies stray thoughts. LinkedIn datafies professional networks."

Governments, especially, need to keep up with big data. The United States government already owns six of the world's top ten supercomputers. The recent revelation in June by signals intelligence analyst Edward Snowden, who was sub-contracted by the National Security Agency (NSA), of PRISM – the US government's program of mass surveillance of data collected by Google, Facebook, Apple, Yahoo and at least two major phone carriers – has shaken the foundations of big data's private colossi. Fearful of damaging their brands, these companies must now balance cooperation with the government spy agencies against consumer distrust.

But given the geopolitical reality of the times, it's doubtful that any government would sacrifice the security benefits of access to so much information. The NSA is in the process of building a massive complex in the state of Utah. The heavily fortified $2 billion center should be up and running in September 2013. It will specialize not only in trawling what is known as the "deep web" but primarily in cryptography, or code-breaking. The NSA is currently caught up in the crosshairs of a very public international debate regarding the surveillance of digital information and data. But the NSA, officially a branch of the US military, has long been developing its capacity to eavesdrop on any communication, domestic and foreign, as part of a top-secret program codenamed Stellar Wind. To do so, according former NSA official William Binney, the agency has circumvented the US Constitution and coerced telephone companies ATT and Verizon to literally open their databases in a manner that would allow the NSA to eavesdrop on "over a billion and a half calls a day."

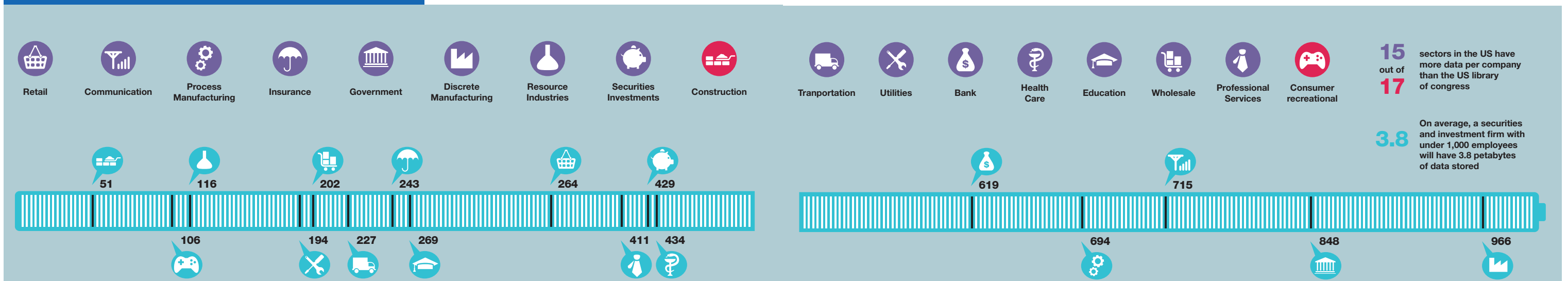These revelations have upset the American Civil Liberties Union, which fears the potential for a Orwellian surveillance of individuals. In response to the controversy, President Barack Obama emphasized that there are trade-offs involved. "You can't have 100% security and also then have 100% privacy and zero inconvenience," he said. "We're going to have to make some choices as a society." The surveillance, he added, helps us prevent terrorist attacks, and "the modest encroachments on privacy" are worth it.

As if in retort, Snowden touched on the contrasting side of the polemic: "We managed to survive greater threats in our history… than a few disorganized terrorist groups and rogue states without resorting to these sorts of programs," he told the *Washington Post*. "It is not that I do not value intelligence, but that I oppose omniscient, automatic, mass surveillance… That seems to me a greater threat to the institutions of free society than missed intelligence reports, and unworthy of the costs."

Framed in these terms, the security-vs.-privacy debate hinges on what is perceived to be a greater threat: "disorganized terrorist groups and rogue states" (i.e., al-Qaeda and/or Iran with WMD) or "modest encroachments on privacy" (i.e. shades of Big Brother).

Leaving Big Brother aside, the most obvious and remarkable uses of datafication have been occurring in the world of science. According Pierre Delort, President of France's Association Nationale des Directeurs des Systèmes d'Information, decoding the human genome had originally taken 10 years to achieve; now it can be achieved in less than a week. DNA sequencers have divided the sequencing cost by 10,000 in the last 10 years, which is a factor of 100 compared to Moore's Law. Another example takes place in research done at the European Organization for Nuclear Research

**DATA SECTOR AND AMOUNT OF STORED DATA BY SECTOR
2009 (IN PETABYTES)**

| Retail | Communication | Process Manufacturing | Insurance | Government | Discrete Manufacturing | Resource Industries | Securities Investments | Construction | Tranportation | Utilities | Bank | Health Care | Education | Wholesale | Professional Services | Consumer recreational |

15 out of 17 sectors in the US have more data per company than the US library of congress

3.8 On average, a securities and investment firm with under 1,000 employees will have 3.8 petabytes of data stored

51   116   202   243   264   429   619   715

106   194   227   269   411   434   694   848   966

(CERN) in Switzerland, where the Large Hadron Collider experiments involve about 150 million sensors delivering data 40 million times per second. Moving from the subatomic level to the cosmic, the Sloan Digital Sky Survey in New Mexico began collecting astronomical data in 2000 and amassed more in its first few weeks than all data collected in the history of astronomy. A similar process of datafication is going on at the NASA Center for Climate Simulation (NCCS) with its new Discover supercomputer. Discover-hosted simulations span time scales from days (weather prediction) to seasons and years (short-term climate prediction) to decades and centuries (climate change projection).

Whereas governments conduct their work in hidden labyrinths and scientists rarely stray from their ivory towers, it's in the private sector that big data is making itself felt in peoples' everyday lives. Google, the search engine whose explicit mission is "to organize the world's information," is in most people's minds the embodiment of the wonders of big data. Just type in "How to spy on your boyfriend/girlfriend" and in an instant you get relevant articles and video links appearing on your monitor. Keep clicking and you'll also wind up with advertisement links to micro-cameras, eavesdropping equipment and private investigators. With its superior page-ranking algorithms, Google managed in the early days of internet to blow all the other search engines out of the water. In gaining what was nearly a monopoly over internet searches, it managed to datafy the world's curiosity and parlay it into a gold mine based on targeted advertising. It didn't just transform the advertising business, it transformed how average people learn and think. Google has since become a

verb, and you rarely get a dinner party dispute these days without someone "googling" the issue on his or her smartphone to see who's right.

About a decade before Google came into existence, Wal-Mart, the colossal American retail outlet, was a pioneer in taking advantage of big data. It gathered simple but valuable information about conditions in the world at large – what could be made where and when, and who would buy what and for how much. By running the information through massive computers it could figure out the bare minimum manufacturers and distributers were willing to accept. Over time their orders became so huge that they could practically dictate price and delivery targets. The end result was a double-edged sword: on the one hand you got the convenience of one-stop shopping for all manner of incredibly cheap consumer goods and food; on the other hand, the Wal-Martification of any landscape tended to expedite the demise of mom-and-pop stores and local markets.

While more secretive than Wal-Mart or Google, the banking and financial world has also been completely transformed by big data. Information is not only power, it is also money. By gathering up vast amounts of information and making correlations that can predict market trends, an investment bank or quant hedge fund obviously has an edge. But the ever-increasing power of computers has also led to such phenomenon as high-frequency trading, in which algorithms help investors game the system by exploiting structural or legal weak spots – for example, by having algorithms automatically enact trades in distant markets, thus taking advantage of market closing times. Sheer computational power has added another new dimension to

finance in the creation of ever more sophisticated financial instruments, especially in the area of risk securitization. The downside – as we saw in the subprime fiasco, which triggered the Great Recession – is that such sophisticated number-crunching can seem like magic to less sophisticated players downhill from the supercomputers. The risk of lending money to someone you know can't pay it back suddenly becomes acceptable because that risk has been "securitized" by a platoon of geeks and their algorithms.
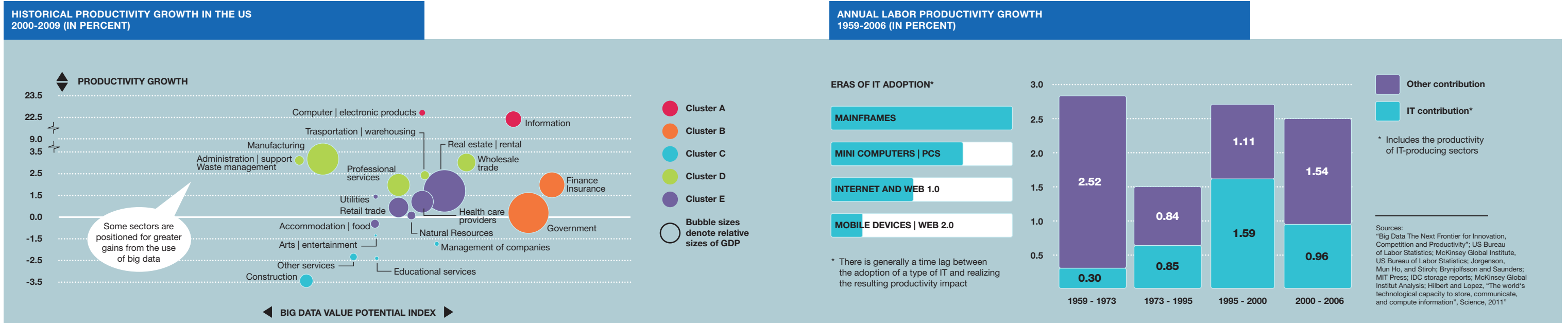
In the near future, there will be little in our lives that won't be conditioned by big data. Already much of the food we eat, or at least the food eaten by the animals we eat, is genetically engineered. More and more couples are meeting through online dating services, which are essentially mini-versions of Google trying to correlate our needs, tastes and desires with other needy, tasteful and/or desirous potential partners.

Ultimately, whether we like it or not, technology and big data will transform what it means to be human. Much the way the development of writing changed how humans remember, learn and think, the advent of computer-generated artificial intelligence (AI) is making us transhuman.

AI has already changed our approach to processing information. Cukier and Mayer-Schönberger point out three major changes. First, when it comes to gathering information, we are moving from selective samples to massive data harvesting. This inevitably leads to the second development: We are becoming increasingly comfortable with messy landfills full of information that in the past would have been considered garbage. We no longer need or always expect neatly packaged and curated blocks of information as would be found

in a newspaper, book or TV program. Indeed, most people's information gathering habits have become more eclectic, with print media and TV supplemented by YouTube videos, opinionated blogs, links from Facebook, and a host of smartphone apps ranging from finding the best restaurant in a particular neighborhood to monitoring your heartbeat and stride length while you jog. The third development relates to how we analyze the information: We are focusing less on causation and more on correlation. "This represents a move away from always trying to understand the deeper reasons behind how the world works to simply learning about an association among phenomena and using that to get things done," the authors write. One example would be in healthcare. Rather than using limited amounts of information to take a stab at finding the cause of a pathology, the ability to monitor the body with many sensors would allow a computer to detect correlations of symptoms and compare them to a database. So rather than looking for a cause, which may or may not become evident, we focus on adjusting the body's current state. The same process already occurs in cars. Sensors detect overheating or excessive vibration and tell the driver to replace a part. The cause of the heat or vibration may not be known, but the database shows that by replacing a specific part the car will return to optimum functioning.

In terms of ontology (or at least anthropology), this means that we are beginning to treat the human being less like a discrete self-contained entity and more like an ongoing process of interrelations. And these interrelations are by no means restricted to other human beings, they also involve the environment and its organisms – not to mention the increasing number of pros-

HISTORICAL PRODUCTIVITY GROWTH IN THE US
2000-2009 (IN PERCENT)

PRODUCTIVITY GROWTH

Computer | electronic products
Information

Trasportation | warehousing
Manufacturing
Real estate | rental
Administration | support
Wholesale trade
Waste management
Professional services
Finance Insurance
Utilities
Retail trade
Health care providers
Accommodation | food
Government
Natural Resources
Arts | entertainment
Management of companies
Other services
Educational services
Construction

Some sectors are positioned for greater gains from the use of big data

◀ BIG DATA VALUE POTENTIAL INDEX ▶

- Cluster A
- Cluster B
- Cluster C
- Cluster D
- Cluster E

Bubble sizes denote relative sizes of GDP

ANNUAL LABOR PRODUCTIVITY GROWTH
1959-2006 (IN PERCENT)

ERAS OF IT ADOPTION*

MAINFRAMES
MINI COMPUTERS | PCS
INTERNET AND WEB 1.0
MOBILE DEVICES | WEB 2.0

* There is generally a time lag between the adoption of a type of IT and realizing the resulting productivity impact

- Other contribution
- IT contribution*

* Includes the productivity of IT-producing sectors

	1959 – 1973	1973 – 1995	1995 – 2000	2000 – 2006
Other contribution	2.52	0.84	1.11	1.54
IT contribution	0.30	0.85	1.59	0.96

Sources:
"Big Data The Next Frontier for Innovation, Competition and Productivity"; US Bureau of Labor Statistics; McKinsey Global Institute, US Bureau of Labor Statistics; Jorgenson, Mun Ho, and Stiroh; Brynjolfsson and Saunders; MIT Press; IDC storage reports; McKinsey Global Institut Analysis; Hilbert and Lopez, "The world's technological capacity to store, communicate, and compute information", Science, 2011"

theses and tools (computers, cars, cameras, pacemakers, electricity, et al.) we can no longer live comfortably without.

Yet the darker side of big data can be extremely dark. There's an old adage that when the only tool you have is a hammer, all the world's problems begin to look like a nail. In this vein, post-Newtonian thinkers during the Industrial Revolution tended to treat humans like complex mechanical machines. Similarly, technologists in the current Information Revolution tend to treat human consciousness like binary software, and its relationship with the body as analogous to that between software and hardware. While this metaphor may be very useful (as the mechanical machine metaphor before it was) it is still a metaphor. And metaphors always belie the full nature of the things they represent.

The earliest victims of the Information Revolution have been those who produce things that can now be easily be copied into digitized form – musicians and photographers, foremost among them. Since the advent of digital music files that could be copied in a split second, the fate of musicians has become increasingly grim. During the golden age of recorded music, many talented musicians could live off studio work or album sales. With the music industry a tailspin, they must now "sing for their supper" on a regular basis by performing live. Photographers, too, have seen their profession overwhelmed by digital photography and the sheer abundance of free or nearly free images available on the internet. Consequently, ancillary businesses such as record companies, record stores and photo agencies have either suffered or disappeared.

Next in line is the print media. In the post-Gutenberg age, journalism, like photography and music, is fast becoming a hobby rather than a profession. Aspiring novelists are heading in droves to work for the more remunerative medium of TV. Thanks to desktop publishing software and telecommuting, publishing a magazine that once required dozens of full-time employees can practically be done singlehandedly.

Of course, every advance in technology implies a disruption in the economy. In fact, in Silicon Valley, the very word "disruption" and its derivatives conjure the scent of opportunity and the attention of venture capitalists. However, latter-day Luddites (descendants in spirit of the English textile artisans who protested against newly developed labor-saving machinery from 1811 to 1817), like to invoke Moore's Law in trying to convey the disruptive effects of big data. The reasoning goes like this: As technology increases exponentially, so will the disruptive effects of technology. After the disappearance of record stores and bookstores, in favor of iTunes and Amazon, comes the disappearance of many physical universities in favor of cheaper online ones. Soon self-driving vehicles will disrupt the transportation industry; software-based 3D printing will eat away at manufacturing; many healthcare industry workers will be replaced by robots, and so on. A domino effect will lead to unprecedented disruption, which will happen faster than human beings' capacity to adapt and learn more marketable skills. The resulting upheaval will inevitably lead to mayhem and dystopia.

When combined with security forces' ability to create a virtual panopticon (the prison designed by 18th-

century English philosopher Jeremy Bentham, in which all inmates can be observed at all times without the observers being seen), any such upheaval could lead to unsettling scenarios. For example, if in the future we develop the ability to record with a camera and microphone everything we see and hear in our daily lives and store the information in some computer cloud, then we will get to the point where those who do not take advantage of this mnemonic technology will be at a social disadvantage. So everyone winds up recording everything, just in case you need to remember (and of course you *will* be expected to remember, just as you are expected to answer your Blackberry or iPhone at all sorts of ungodly hours). Questions inevitably arise: Who owns these prosthetic traces? Do they fall under the same property laws that are the foundation of liberal democracies? And if those democracies are deemed to be threatened, can government security services examine the digital traces without permission? Can they intervene – perhaps even preventatively – based on something found in those traces? These are just some of the issues.

Even optimists like Kurzweil concede that there is huge potential for disaster in the maleficent or simply misguided use of big data. For instance, genetically modified bacteria or viruses can be turned into terrifying biological weapons. In fact, Kurzweil has been working with the US Army to develop a rapid response system to deal with the possible abuse of biotechnology. In his book *The Age of Spiritual Machines*, the guru of the Singularity quotes a passage written by Ted Kaczynski, the "Unabomber" arrested in 1995, to provocatively raise the specter of machines evolving to

make decisions for humans, who would then be at the mercy of their intellectually superior masters: "If the machines are permitted to make all their own decisions, we can't make any conjectures as to the results, because it is impossible to guess how such machines might behave. We only point out that the fate of the human race would be at the mercy of the machines. It might be argued that the human race would never be foolish enough to hand over all the power to the machines. But we are suggesting neither that the human race would voluntarily turn power over to the machines nor that the machines would willfully seize power. What we do suggest is that the human race might easily permit itself to drift into a position of such dependence on the machines that it would have no practical choice but to accept all of the machines' decisions. As society and the problems that face it become more and more complex and machines become more and more intelligent, people will let machines make more of their decisions for them, simply because machine-made decisions will bring better results than man-made ones. Eventually a stage may be reached at which the decisions necessary to keep the system running will be so complex that human beings will be incapable of making them intelligently. At that stage the machines will be in effective control. People won't be able to just turn the machines off, because they will be so dependent on them that turning them off would amount to suicide."

Granted, the above passage was written by a psychopathic terrorist. Nevertheless, Kurzweil felt obliged to address the issue Kaczynski brings up. Leaving aside the bleak tone of the Unabomber's screed, Kurzweil in-

GEORGE FREY/GETTY IMAGES

sists that the promise of technology outweighs the peril; our lives, thanks to technological advances – and despite many people's technophobia – are immeasurably better compared to when human life was "very hard, disaster-prone, labor-filled and disease-filled." In any case, we need to accept the inexorable fact that we are past the point of no return – humans cannot live without computers – so we must ensure that our cyborg future becomes more humane as it becomes less human.

A less dramatic, but equally disturbing scenario is proffered by another Silicon Valley denizen. Jaron Lanier, a computer scientist now working for Microsoft, who is best know for his work in virtual reality, a term he even coined, is one of Kurzweil's fiercest critics. As an advocate of what he calls technological humanism, Lanier, who is also a professional musician and collector of rare and exotic musical instruments, had somewhat of a conversion experience when he realized that the Information Revolution as envisioned by his colleagues in Silicon Valley and his own youthful self would lead to society's progressive dehumanization (in the sense of lost dignity rather than cyborgification). Best known for his "manifesto" *You Are Not a Gadget*, Lanier criticizes what he views as a romanticized quasi-anarchic notion of "free information," which he claims is a

misnomer for "freely copyable information."

In his most recent book, *Who Owns the Future*, Lanier elaborates his vision of how the information economy, bent on disruptively increasing efficiency, is steadily shrinking the economy. We can see the beginning of this with a sort of structural unemployment becoming entrenched in the developed countries. As the information economy's "Siren Servers" (a term he coins to refer to "an elite computer, or coordinated collection of computers, on a network, [which] gathers data from the network, often without having to pay for it") become exceedingly rich and powerful, there is the risk of a polarization in society. Not only will the wealth gap increase, but so will the value gap. From the perspective of someone working within the very belly of the corporate information economy, Lanier attempts to map out how to adjust the mechanisms of big data so as to maintain an adequate enough level of human dignity to support a stable middle class, which he believes is essential for a well-functioning free market democracy. Much of what he suggests – such as a system of nanopayments for information gleaned from the internet, that is used in turn to make money – would raise the hackles of techno-libertarian capitalists and Marxists alike, because it would probably mean the end of free search engines, music, media downloads, and a

host of other free stuff, which Lanier feels is leading to a collective suicide of the creative classes. But this system of nanopayments would also revitalize the free market economy (because, as all champions of the free market know, "there is no free lunch") as well as the middle class that is the foundation of democracy. The underlying premise is that in economic terms, human contributions to a Siren Servers' wealth-generating capacities should be remunerated proportionately. Also, social levees (analogous to copyright laws, unions, university tenure, et al.) should be created to keep those who have rapidly accumulated wealth and power from doing so at the expense of human dignity. The technology and computational power is already there, it's just a matter mustering up the will.

To the new age motto of "Information wants to be free" Lanier retorts: "Information is alienated experience… Experience is the only process that can de-alienate information.

"Information of the kind that purportedly wants to be free is nothing but a shadow of our own minds, and wants nothing on its own.

"But if you want to make the transition from the old religion, where you hope God will give you an afterlife, to the new religion, where you hope to become immortal by getting uploaded into a computer, then you

have to believe information is real and alive. So for you, it will be important to redesign human institutions like art, the economy, and the law to reinforce the perception that information is alive. You demand that the rest of us live in your new conception of a state religion. You need us to deify information to reinforce your faith."

Ultimately, we may be doomed by our underestimation of human potential. The bottom line is that we cannot avoid reconsidering what being human means – in relation to information, intelligence and the very physical bodies we seem to possess. In doing so it will be necessary to examine not merely how a human brain transmits bits of information, but how the human spirit interacts with and interpenetrates the universe. Otherwise we will be forced into a very sorry state, asking ourselves, as T. S. Eliot did: "Where is the wisdom we have lost in knowledge? Where is the knowledge we have lost in information?"

The new NSA data center in Bluffdale, Utah, June 10, 2013. The center, a large data farm set to open in the fall of 2013, will be the largest of several interconnected NSA data centers spread throughout the country.

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