Chapter 1

The Art, Act, and Science of Knowing

From the Dark Ages (ca. 476 to 1000 A.D.), during the Renaissance (ca. fourteenth through seventeenth centuries), at the center of the Age of Reason/Age of Enlightenment (ending ca. 1800), and right on up through the Industrial and Information ages, the history of humans has been one of ever-increasing knowledge. Wanting to know and eliminating not knowing is a big part of the history of our species. We have spent 1,000-plus years seeking to eliminate ignorance.

Why are Humans at the Top of the Food Chain?

Have you ever wondered why humans sit on the top of the global food chain? If we did the classic SWOT analysis (strengths, weaknesses, opportunities, and threats) for humans vis-à-vis other animals, our species would come up short on just about every dimension. Humans are at the top of the food chain because of our capacity to know. Our eyesight is not exceptional. We possess no ability to see the ultraviolet light that

guides butterflies. We have none of the night vision that aids owls and ocelots. We cannot see as far as eagles. We have none of the echolocation by which bats and whales hunt and orient. We are olfactorally challenged, having a very primitive sense of smell. We cannot run as fast as the antelope or swim as well as the dolphin; nor do we possess the strength of the lion. So why aren't we lunch?

Mythology tells us that Epimetheus—whose very name evokes lack of foresight—forgot the human species when it came to doling out features and functions. By the time deeper-thinking deities arrived, it was too late: While other animals were well provided for, humans stood naked and defenseless. In desperation, Prometheus stole from the gods the tools of fire and crafts and gave them to humanity. Whatever the reason, humans are, by nature, deprived of natural qualities. Other animals are naturally equipped to survive. Humans owe their survival to empirical, technical, and moral knowledge, which they acquire progressively. The trait that separates us from the lower orders, the thing that generates our interspecies competitive advantage, and the behavior that places us at the top of the food chain is our ability to know.

Recent History of Knowing

The Information Revolution did not start with the Internet. Alfred D. Chandler, the respected business historian at the Harvard Business School, argues that Americans have been on the information highway for at least 300 years.[1] My former boss, futurist Alvin Toffler, was one of the first to situate the Information Revolution in relation to the long waves of history.[2] William Wolman, editor at *BusinessWeek*, and Anna Colamosca believe that "by endowing libraries across the country, Andrew Carnegie created an earlier knowledge revolution in the United States whose scope at least matches that of the information revolution created by Bill Gates and his competitors."[3] Tom Standage, science and technology writer at *The Guardian*, business editor at *The Economist*, and author of *The Victorian Internet* weighs in:

> Today, we are repeatedly told that we are in the midst of a communications revolution. But the electric telegraph was, in

> many ways, far more disconcerting for the inhabitants of the time than today's advances are for us. If any generation has the right to claim that it bore the full bewildering, world-shrinking brunt of such a revolution, it is not us—it is our 19th century forbears.[4]

The nineteenth century was a great age for facts but not necessarily a great age for understanding what the facts actually meant or for acting efficaciously. Charles Dickens's Mr. Gradgrind, the notorious headmaster in the novel *Hard Times*, has become a symbol for the excesses of out-of-context, fact-based reasoning: "What I want is facts. . . . Facts alone are wanted in life." What is wanted in life today is not just facts but the meaning of what the interrelationships of those facts mean.

Collecting or moving information around certainly is not new. Humans have been attempting to extract insight from rudimentary data sets for a very long time. Sara Igo at Princeton University tells us that gathering social statistics "useful for governing" goes way back: "Rulers have counted, administered, and made 'legible' populations for military service and taxation stretching back at least as far as William the Conqueror's *Domesday Book* of 1086."[5]

The knowledge industry is changing. In my periodic role as a professor, I am perpetually attempting to convince students that the reason we are going through the learning exercise is not for the grade, it is for the future period action that the knowledge imparted during class enables (which may or may not have something to do with the letter grade received). I. I. Rabi, a great man at the great Columbia physics department (he received his Nobel Prize in 1944 for finding a method of measuring the magnetic properties of nuclei), is remembered for his science, his many kindnesses, and a famous quote: "If you decide you don't have to get As, you can learn an enormous amount in college."

The path to knowledge is changing. Outside of America, access to knowledge has been quite a structured thing.

> In South Africa . . . I had waited obediently year after year to get to the level at which "they" would begin to teach "me" the things I was able to handle. It has never occurred to me that I could learn what I wanted when I chose. In America,

> I was alarmed to see students who set about learning things on their own. I'm still embarrassed to admit to myself that I almost never studied anything I wasn't officially taught.[6]

The Internet makes self-teaching—and lifelong learning—the rule rather than the exception.

Historians ultimately will come to consensus on what to call the time period between the frenzy that was the dot-com bubble and the period before society finally enters the data cloud. For want of a better phrase, I call the 20-year interregnum we currently inhabit (1995–2015) the Age of Little Information. I come to this label not because the age exhibits a lack of information. Quite the contrary, it is during this epoch that information—previously locked away in analog form—is becoming widely digitized.

The New Know has changed our reality along 10 fundamental dimensions.

New Know Reality #1: You Will Be Expected to Do Something with Information

All this newly digitized information has had, relatively speaking, little impact on behavior and little impact on organizational outcomes. Shareholders learned recently that digitized information does not necessarily mean managed and/or acted-on information. We are now exiting a historical moment of undermanaged and only occasionally acted-upon information to an environment requiring much more active, much more intense, much more aggressive information management. You as an executive will be held much more accountable for your data management behaviors. You will be expected to transform "data lead" into "knowledge gold" via the expeditious sensemaking leading to efficacious action. In the Age of Little Information, we were data vegetarians. In the New Know we will have to become information and knowledge carnivores.

Perhaps the thing that sets the New Know most apart from previous eras is that because there is more information and more ways of knowing, there is *more* competitive advantage to be generated from the informed and creative management of information and information technology. This flies directly in the face of some industry observers who contend that technology—being a purchasable commodity—has

nothing to do with competitive advantage. With more things to know there are more places to exert knowledge leverage and more tools to create competitive advantage. Increasingly, your success in business, your standing in the community, and your physical/emotional well-being are related to the facility with which you and your enterprise can connect and then convert heretofore unimaginably large, complex, litigatable, and accessible sets of data into time- and context-appropriate action.

New Know Reality #2: There Really Is More to Know

The New Know will be awash with data. Attendees at technology conferences around the world are barraged with charismatic sound bites telling us how much data, how much storage, how much bandwidth, and how much computer power we have at our fingertips:

> [M]more transistors were produced, and at a lower cost, than grains of rice.[7]
>
> [T]he number of transistors shipped in 2003 was 10 quintillion, or 10 to the 18th power—about 100 times the number of ants estimated to be stalking the planet.[8]
>
> The "pixel to pupil ratio" is so far skewed in favor of the pixels that only a small fraction of imagery can actually be processed.[9]
>
> Our ability to collect and store data exceeds our current capability to thoroughly process and exploit it. But, that's just the tip of the data iceberg.[10]
>
> Data storage—oh my gosh—the data was everywhere. Our CEO [chief executive officer] became a little cranky when he could not find how much we gave to the United Way one year.[11]
>
> [I]f all six billion people on earth used hand calculators and performed calculations 24 hours a day/seven days a week, it would take them 46 years to do what the top supercomputer can do today in one day.[12]
>
> A new blog is created every second of every day.[13]
>
> When I came to MIT 40 years ago there was one computer shared by thousands of students that cost $11 million. Your cell phone today is a million times cheaper; a million times smaller and

> a thousand times more powerful. That is a billion-fold increase in capability in price/performance. We will make another billion-fold increase in price/performance of information technology over the next 25 years.[14]

Stephen Baker has written one of the seminal works in the field of analytics: *The Numerati*. In the book, we are frequently reminded about just how much information contemporary executives have to deal with:

> [T]he very air we breathe is teeming with motes of information. Sloshing oceans of data, from e-mails and porn downloads to sales receipts, create immense chaotic waves. In a single month, Yahoo alone gathers 110 billion pieces of data about its customers, according to a 2008 study by the research firm comScore. Each person visiting sites in Yahoo's network of advertisers leaves behind, on average, a trail of 2,520 clues.[15]

The network of remarkable people engaged in a variety of world-changing projects who annually assemble at the PopTech Conference in Camden, Maine (www.poptech.org) have historically used a subset of these factoids as base planning info-benchmarks:

1 billion PC chips on the Internet	1 million e-mails per second
1 million instant messages per second	8 terabytes per second traffic
65 billion phone calls per year	20 exabytes magnetic storage
1 million voice queries per hour	2 billion location nodes activated

600 billion radio-frequency identification (RFID) tags in use

Just about everywhere you look and everything you read touches on the topic of information inundation. Educators worry that information inundation imperils our children. Public safety officials—the designers of police cars—complain that there is not enough room in a car for all the communications equipment that needs to fit into it. Aviation experts worry about information overload in airplane cockpits. (The magnificent new Boeing Dreamliner has over 300 computer systems on board.) NASA scientists have a whole lot of data on their hands. For example, the VW Beetle–size Landsat 5 launched in 1984 has circled Earth at an altitude of about 700 kilometers more than 130,000 times. Sensors on the polar-orbiting craft collect data at seven

different wavelengths from near ultraviolet to the far infrared. Except for central Antarctica and far northern Greenland, the satellite passes over each spot on land once every 16 days and can distinguish features as small as 30 meters across. Since Landsat 1 launched in 1972, 2.3 million images have been gathered.[16] The National Security Agency is rumored to overhear far more information than it can make sense of. Race car engineers are overwhelmed by the amount of information relayed back to them from sensors on the cars. Oil wells are now so heavily instrumented that they produce geysers of data points that are harder to process than the oil. Warfighters, formerly thought to be isolated in foxholes by the fog of war, now have so much information available that a special project, Force XXI, has been developed to help cope with foxhole overload.[17]

Processing power doubles every 18 months. Storage capacity doubles every 12 months. Bandwidth throughput doubles every 9 months. The cumulative impact of this is that within our lifetime, every molecule on this planet will be IP (Internet protocol) addressable. There will be an incomprehensible, mind-explodingly massive expansion in the amount of information floating around. There is more to know. Julianne Conry, an educational psychologist who studies ability testing at the University of British Columbia, pointed out that each time U.S. testing companies revise their tests, "You have to know more to be average."[18] It doesn't matter whom you talk to—storage vendors, strategy consultants, futurists, subscription research firms, or your teenage children—everyone knows that in the future, there will be *more* information. What exactly does this mean, given that "raw human intelligence is probably no greater today than in ancient Greece"?[19]

One of the immediate implications of the New Know is that professionals skilled in augmenting human cognition will fare well moving forward. A recent survey at *Network World* places modeling, data mining, and optimization in the top 10 skill sets for the new age.

Jobs are plentiful for workers who understand data mining and related fields, such as information on demand, content management, and unstructured information management, experts say.

> "The world revolves around data. Anything you can do to develop data analysis, data mining and information on demand skills is

> incredibly critical," IBM's [Kevin] Faughnan says. . . . "There's a broad range of issues involved with managing very large amounts of data and being able to process it and extract knowledge from that data," Professor Peter Lee, head of the Computer Science Department at Carnegie Mellon University says. "One of the things we are starting to see from leading-edge places like Google is the need for graduates with the understanding and skill to cope in the new world of data intensive computing."[20]

Organizations are having trouble keeping up—and, sadly, the fact that there are more facts arriving at a faster rate of speed is not even the tip of the cognitive iceberg. Soldiers fighting battles with projectile weapons speak of the "fog of war" (e.g., confusion about what is going on). Info-warriors speak of the "fog of facts" (e.g., confusion about what information is to be believed, what information sources are credible, and what version of reality is to be acted on). In a world of multiple sources of information and 24-hour decision making, the very character of information is changing. A "fact" is no longer a "fact."

There are entirely new categories of knowledge available that were previously off most executive radar screens.

New Know Reality #3: You Will Have to Know More about Knowing

The typical time-starved, information-overloaded, regulation-complying, mission-obsessed, multitasking contemporary executive probably does not give much thought to how the organization thinks, or even how he or she thinks within the organization. The New Know involves knowing more about knowing. A newborn infant has very little appreciation about the stages of sensemaking whereby a sensory input of an apple somehow emerges as an understanding of what an apple is or that it is good to eat. Receptors in the toddler's retina collect data, which is converted into information, knowledge, and understanding. All of this sensemaking is, for the most part, invisible to our conscious selves.

In a similar fashion, the way organizations come to understand their environment is, for the most part, currently invisible to most individuals in the organization. The New Know is defined by making visible organizational

sensemaking. It certainly is not headline news that information has become the single most important asset in most organizations. Many organizations are not where they want to be or have to be regarding the skills, mindset, technology base, business processes, or reward system/culture needed to best protect, manage, and share this critical asset.

One of the major changes defining the new competitive environment is the requirement to know more about knowing. You are going to have to expand your ability to think critically about your own thinking. Experts sometimes refer to this as metacognition: knowing about knowing. The latest research on executive decision making posits that the best predictor of good judgment isn't intuition or experience or intelligence. Rather, it's the willingness to engage in introspection—specifically thinking about thinking.[21] We are on the cusp of a revolution in enterprise-scale thinking, decision making, and problem solving. A "ThinkQuake" looms on the horizon. Society is about to undergo a tectonic shift in how it thinks about thinking.

Driving this cognitive plate shifting are the RSS feeds, podcasts, blogs, old-media headlines, and evening news programs, which are increasingly filled with images and instances of current-generation leaders being asked by dissatisfied next-generation voters, customers, and shareholders the rhetorical question: "What were you thinking?"

Looking beneath the surface, those next-generation customers, sources of capital, and policy makers are *really* asking: "How were you thinking? Via what processes, using what data, and assisted by what tools did you arrive at your course of action?"

ThinkQuake Task 1: Cognitive Cartography. For a powerful exercise, try to draw a series of maps that depict how your organization thinks. Be aware not only of what your organization thinks; also be granularly aware of *how* your organization thinks. How are decisions actually being made? Where are they made? Who's making them? And what's prompting the decisions?

Also, and more subtly, be aware of how your organization thinks about how it thinks. Do employees think they're being led? Or do they think they're scrambling through their days without much thought? Do they think they're thinking, or do they think the organization's

managers and executives are doing most of the thinking for them? Take some time and think about these things.

ThinkQuake Task 2: Cognitive Reengineering. Readers will remember the frenzy of process reengineering projects initiated in 1990, which aimed to modify or eliminate non–value-added activities from the workplace. I forecast a similar surge of cognitive reengineering in organizations around the world, which will result in the deconstructing and rearranging of assumptions, rules of thumb, data sets, information sources, and decision-making algorithms that support key processes.

New Know Reality #4: Brain Science and Decision Science Are Converging

Scientists do not know how the brain works—yet. But they are sneaking up on it. Readers may be surprised to learn that neuroscience has been around for over 100 years. Neuroscience has progressed to the point that we at least know what we do not know.

The brain has been discovered to be a very complicated place. There are 10 to the eleventh power neurons, 10 to the fourteenth power synapses. Psychological research tells us that at "any given moment our five senses are taking in more than 11,000,000 pieces of information."[22] Human behavior is thought to be the product of physical processes in the brain.

The field of neuroscience began to nudge its way into general public awareness about 20 years ago with the advent of brain-imaging tools of all kinds—from computed tomography, to functional magnetic resonance imaging, magnetocephalography, event-related brain potentials, positron emission tomography (PET), near-infrared spectroscopy, and single photon emission computed tomography. With these tools, the human brain itself could be studied. Humans were now front and center and directly under the scientist's eye.

Every day, neuroscience is making advances in understanding the human mind. Brain-imaging techniques now show not just the structure of the brain but its inner workings. Advances in neuroscience are providing us with an expanding understanding of how the brain generates complex thought and behavior. We move toward a closer

understanding of how the brain enables action (everything from a simple movement to a thought). To some extent, it is a simple truism that the brain is involved with all things that comprise our human existence. It follows, loosely, therefore, that understanding the brain will help us understand the human condition more fully.

As the workings of the brain become known, the legal system will reflect these changes. "The law is mainly about brains or, at least, the mind," said Stanford law professor Hank Greely, one of the directors of the year-old MacArthur Foundation–funded Law and Neuroscience Project. "If my fist hits your chin, what, if anything, I was thinking is crucial. If I was in an epileptic fit, if I was thrown from a car when I hit you, you don't convict me of a crime. . . . If I'm mad at you, we do."[23]

We are still in the early days. "This is baby science, first-step science, like genetics in the 1950s," says Dr. Michael S. Gazzaniga, a neuroscientist at the University of California at Santa Barbara and member of the President's Council on Bioethics.[24] Understanding thinking, argues Vanderbilt law professor Owen Jones, involves more than understanding how the parts operate. "There is more to thought than blood flow and oxygen demand."[25]

The big news is that the brain is not a blank slate. The brain possesses innate qualities that influence individual experience and opinions. There are things that can be known—that need to be known by executives seeking to maximize value from the knowledge assets available to the enterprise.

The example of the political polling industry may be an early indication of where all this brain research is taking us. Studies suggest that our basic political attitudes—liberal, conservative, or otherwise—may have genetic or physiological origins.[26] In the very respected journal *Science*, a group of scholars presented data that indicates that while no one has yet discovered a gene for, say, supporting the war in Iraq, there does seem to be an association between a person's biology and her politics. The researchers demonstrated that the brains of liberals and conservatives are physically and functionally distinctive, suggesting that people on either side of the ideological divide are actually wired differently.

Kevin Smith, a University of Nebraska political scientist who coauthored the *Science* study, says: "Our research shows that these reactions are so deep-seated, they're partly biological. Our biological makeup

contributes to our political attitudes."[27] The work of Smith and his colleagues is driving an emerging field, sometimes called political physiology, that challenges traditional views of politics. What we know about what we know and how we think is changing.

Japanese researchers at ATR Computational Neuroscience Laboratories in Kyoto have evidently found a way to capture images from the mind's eye. Yukiyasu Kamitani and his team first scanned for patterns in their subjects' brain activity. Subsequently, those brain activity patterns were used to re-create what subjects were visualizing, and the output, while crude, was readable.

> "By analyzing the brain signals when someone is seeing an image, we can reconstruct that image," said Kamitani. "By applying this technology," said an institute statement, "it may become possible to record and replay subjective images that people perceive, like dreams." Added said Dr. Kang Cheng, a researcher from the RIKEN Brain Science Institute, "These results are a breakthrough in terms of understanding brain activity. In as little as 10 years, advances in this field of research may make it possible to read a person's thoughts with some degree of accuracy."
>
> The implications have not escaped the scientists. "If you have a technique that allows you to read out what people are thinking, we need clearer ethical guidelines about when and how you are able to do this," said John-Dylan Haynes of the Max Planck Institute for Human Cognitive and Brain Sciences in Leipzig, Germany. "A lot of people want their minds to be read—take for example a paralyzed person. They want us to read their thoughts. But it shouldn't be possible to do this for commercial purposes."[28]

New Know Reality #5: The Environment Is Changing Our Brain

The information flood should be viewed as a permanent macroenvironmental change. Thinking in Darwinian terms, what adaptive pressures does this environmental change place on us? "Daily exposure to high technology—computers, smart phones, video games, search

engines—stimulates brain cell alteration and neurotransmitter release, gradually strengthening new neural pathways in our brains while weakening old ones. Because of the current technological revolution, our brains are *evolving* right now—at a speed like never before."[29]

Gary Small is the director of the Memory & Aging Research Center at the Semel Institute for Neuroscience & Human Behavior and the Center on Aging at the University of California—Los Angeles. His research indicates that Internet searching and text messaging has made brains more adept at filtering information and making snap decisions. "The average young person now spends nine hours a day exposing their brain to technology. What we are seeing is technology affecting our evolution."[30]

New Know Reality #6: Information Management Is the Essence of Leadership

In her stump speeches, Carly Fiorina, former CEO at Hewlett-Packard, talks about how, as an undergraduate at Stanford studying medieval history and philosophy, she was required to read one of the great works of western philosophy every week. These were big books written by deep thinkers, such as Aquinas and Maimonides. The students were told to distill these 1,000-page tomes into 2-page papers. Fiorina believes that distilling truth from overwhelming amounts of information is the essence of leadership. She believes that all of us are overwhelmed with information, and what sets great leaders apart is their ability to cut through the clutter and distinguish the truly important from the merely interesting.

While the public considers science as a field dealing with certainties, scientific observations actually reflect probabilities of occurrence. The proper representation of scientific finding is difficult. In a sense, the nature of science has been misinterpreted for years. How does scientific evidence get into court? Strict criteria regulate the introduction of scientific evidence.

In American courts, the judge has become the "gatekeeper" and allows "good" scientific evidence into the case while preventing "bad" scientific evidence (as well as irrelevant evidence) from entering the case. How should a judge, trained in the law, make such a determination?

Information management issues are just now exploding onto the sociopolitical radar screen. In the United States and around the world, the short-term legislative agenda will be heavily populated with information management–related bills. Many of these bills will become law. These budding changes and the associated societal awareness are emerging as a direct result of the fact that in a transparent and mondo-connected society, leaders are supposed to know things. And perhaps more important, they are supposed to do things about what they know. The persistence of known problems that remain unsolved is absolutely unacceptable to voters, consumers, and sources of capital.

But how do leaders—within the organization and within the political landscape—know things? And how can they change the ways they think about the things they know? Business analytics is at least part of the answer.

A major driver of the looming ThinkQuake is the existence and innovative use of information management tools for business intelligence and advanced analytics, which provide the ability to evaluate data and information in more detail than ever before. With these tools, organizations can not only rethink the ways they think, but they can also take control and rethink the ways they lead.

During the dot-com frenzy, strategy was said to be all about competing on the basis of business models. In the New Know, we will be competing on the basis of mental models: how we think, how we move from data to information, from information to knowledge, from knowledge to insight, and finally from insight to action.[31] Organizations will be required to make more transparent how the enterprise makes sense of its environment. We will be audited on what we know and how we came to know it.

John Seeley Brown, former director of research at the fabled Xerox Palo Alto Research Center (PARC) facility, repeatedly tells would-be innovators, "The job of a leader is not just to make decisions, it is to make meaning." I believe the role of the new leader in the New Know is to create an environment (tools, practices, incentives, culture) that enables employees/contributors to make sense of the world(s) they confront every day. The signal-to-noise ratio for many people in the workplace is out of whack. They don't know what is important. They don't know how the pieces fit together. They are not just looking to

you to tell them what to do; they are looking to you to help them make sense out of this sea of data/information.

You might ponder what traits and capacities will generate competitive advantage in the totally searchable, panoptically surveilled, information-flooded future. Additionally, you need to ask yourself: "Is your organization ready for all this data?"

I was fortunate enough to meet and learn from Ram Charan, the CEO-whisperer, lecturer-extraordinaire (winning the Bell Ringer best teacher award at General Electric's famous Crotonville Institute), and academic (winning Best Teacher Award at Wharton *and* Northwestern). Professor Charan is quite adamant that:

> You need information that is detailed, up to date, and unfiltered, obtained quickly and at the source. This is what I call *ground-level intelligence.* The most important type of ground-level intelligence has to do with customers. Take, for instance, Wal-Mart's observation that for the first time ever its sales of baby formula were coinciding with twice-monthly pay periods, indicating that consumers were under severe stress and living from paycheck to paycheck. That's ground-level intelligence.[32]

Good data, the kind of data that generates powerful insights, is not just lying around waiting to be bumped into. Leaders have to be able to discern the "wish it were true" from the "is true" haystack. "Truthiness" was the American Dialect Society's 2005 word of the year, defined as "the quality of stating concepts or facts one wishes to be true, rather than concepts or facts known to be true."[33] Low-cost communications give rise to almost toxic levels of spin, hype, and empty rhetoric. Leaders are able to cut through all the noise. Does your organization filter its data?

New Know Reality #7: A More Connected World

Kevin Werbach, assistant professor of legal studies at The Wharton School, University of Pennsylvania, points out: "We've gone from zero to close to three-and-a-half-billion people who have a mobile device and are connected to each other."[34] One of the transformational elements moving society to the New Know is something analysts at

Forrester Research call the "groundswell."[35] In today's infoverse, not only must we manage data, we must also sense and respond to how constituents sense and respond to data about our products, services, and situation. Josh Bernoff, vice president at Forrester, contends: "There's so much information flowing out of the groundswell, it's like watching a thousand television channels at once. To make sense of it, you need to apply some technology, boiling down the chatter to a manageable stream of insights."[36] There is so much information—six hours of video are uploaded to YouTube every minute—it would take you a whole year to view one day of uploaded content.[37] The new scarce resource in the next economy will be the human attention needed to make sense of information. The question is: How will we be able to keep up?

New Know Reality #8: Math Matters

Whether in science or popular culture, math is in ascendancy.

Mathematics is now so widely accepted as the arbiter of truth in the modern world that it has become the backbone of disciplines ranging from physics (of course) to economics and sociology. Backing up a statement with mathematics gives it an aura of validity, even if the topic has to do something as mathematically messy as human behavior. The popular CBS television series *Numb3rs* provides a good illustration of the western world's belief in the power of mathematics. In each episode, two mathematical geniuses are brought in by the FBI to solve intractable cases. By using the magical power of complicated mathematics, they can predict anything from the location of a hostage to where a sniper will strike next. Like modern dragon slayers, the mathematicians always save the day . . . and the hostage.

Of course, *Numb3rs* is theater. In the real world, predicting human behavior is enormously complicated. Just ask the people who utilize math programs in an attempt to predict how people will vote or the next big thing in the stock market. Reading chicken entrails or going with a gut feeling often can be just as effective as attempting to crowbar human behavior into a mathematical model.[38]

However, many otherwise "normal" executives have a pathological aversion to math. This is not just unfortunate, it is dysfunctional. Some intuition about numbers, counting, and mathematical ability is basic to almost all animals. An approximate number sense is essential to brute survival: This is how birds find berry-rich (many) versus berry-poor patches of berries. This is how primates traveling as a couple know not to attack a gang of six. People use math to make decisions every day. We rely on our basic number sense to choose which subway car to ride in or which grocery line to wait in (based on a quick estimate of the number of people).

In the early stages of his career, Charles Darwin wasn't much of a mathematician. In his autobiography, he writes that he studied math as a young man but also remembers that "it was repugnant to me." Darwin ultimately came around concluding at the end of his autobiography that he wished he had learned the basic principles of math, "for men thus endowed seem to have an extra sense."[39]

A new study ranking the 200 best and worst jobs in the United States by CareerCast.com ranked mathematician the best job (lumberjack was the worst) according to five criteria inherent to every job: environment, income, employment outlook, physical demands, and stress.[40]

"In an age where you need to be numerate to do almost anything (from building bridges to conquering disease), governments anxiously compare their performance in mathematics with that of competitor nations."[41]

Math has some surprising uses. Math has helped add clarity to the existential question of how long we humans will exist. Princeton astrophysicist J. Richard Gott III, working only semi–tongue-in-cheek, piggybacks on the Copernican method (i.e., we humans are not privileged observers of the universe—we don't occupy a particularly unique place in space or time) to calculate that our species should last for at least another 5,100 years but less than 7.8 million years.[42] Gott begins with the assumption that you and I, not living in a special time, are probably living during the middle 95 percent of the ultimate duration of our species. In other words, we're probably living neither during the first 2.5 percent nor during the last 2.5 percent of all the time that human beings will have existed.

New Know Reality #9: There Are Significant Downsides to Not Knowing

Michel Eyquem de Montaigne, a French Renaissance statesman (1533–1592) is famous for his question: "*Que sais-je?*" ("What do I know?"). That was the sixteenth century. Success in the twenty-first century requires materially expanding what you know and adding precision and efficiency to the processes (analytics) whereby you come to know. Or what? Here is a metaphor to keep in mind as you think about the New Know. If you are locked in a room with an elephant, it is useful to know where it will step. Every key process in your enterprise is locked in a room with an elephant—a critical process, serving a critical customer. Business analytics tells you where that elephant will step. In our elephant-in-locked-room metaphor, business analytics saves your toes. In real-life business, analytics will keep you from being sued.

Litigation occurs when an event causes one party to believe it has suffered damages as a result of the negligence (in this case, not knowing) of another party. The U.S. tort system cost $252 billion in 2007, which translates to $835 per person.[43] International observers contend, "America manages to be more unbalanced than other countries. This is partly because its legal system is out of control—an unstoppable clanking machine that has lost any ability to draw the line or respect common sense."[44] Lord Peter Levine, chairman of Lloyd's of London, was concerned that such costs were rising at a rate of 10 percent annually. One of the downsides to not knowing is exposure to possible litigation.

Another is the opportunity cost associated with misallocating resources. Perhaps the most fundamental challenge facing any enterprise is how to invest its resources: Which is the best reward or goal to pursue at a given moment? Classical economics would tell us that the solution seems straightforward: Consider all options, and pick the best. However, rarely will a decision maker have equal information about all options. Typically, the nature and likelihood of rewards associated with status quo behaviors are better known than those associated with more novel/less familiar initiatives. The challenge always seems to come down to whether to persist on the current course or

to shift to another. This problem—often referred to as the exploration-exploitation trade-off—is ubiquitous, appearing at all levels and domains of decision making.

New Know Reality #10: Knowing Can Change the World

If knowledge is power, then "knowledge about power should be especially empowering," says John Murrell, the very-much-in-the-know editor of *Good Morning Silicon Valley*.[45] He is talking about the new Google initiative designed to "display near-real-time information on your household's electricity consumption." The plan is to display overall household use, allowing comparison by hour and day and some extrapolation about patterns and appliances. About 30 Google employees have been testing the feedback mechanism. Studies indicate that access to home energy information results in savings between 5 to 15 percent on monthly electricity bills.[46] Murrell explains that while "it may not sound like much, but if half of America's households cut their energy demand by 10 percent, it would be the equivalent of taking eight million cars off the road."

Residents of Massachusetts are also involved in a New Know energy pilot. Using 15,000 meters, a subset of National Grid Customers will be able access their energy-use information via the Internet, by a thermostat readout, or through text messaging, and use the data to change their consumption patterns. "The whole point of doing this is to finally create a two-way conversation with our customers," said Marcy Reed, a senior vice president at National Grid. The company's pilot program is expected to cost consumers about $57 million, or less than a dollar a month for each of National Grid's 1.3 million electric customers. But program participants are expected to save 5 percent, or about $70 a year, on their energy bills.[47]

Change advocates from all fields of endeavor are excited about the possibility of putting new information in front of people in the hopes of changing behavior. Ken Peterson, communications director for the Monterey Bay Aquarium, was excited about his layer in Google Earth that shows the location of various types of fish, along with ratings for people about whether they should eat those varieties or substitute others.[48]

Notes

1. "A close look at the record clearly demonstrates that North Americans got on the Information Highway in the 1600s and by the late 1700s they were experiencing traffic jams. To carry the analogy further, Americans by 1800 could see highway construction underway [the U.S. postal system and roads for the mail to travel on], traffic regulations [copyright laws], and a variety of information vehicles cluttering the roads [e.g., newspapers, books, pamphlets, and broadsides]. During the 19th century Americans applied electricity and creative tinkering to invent or highly develop key information technologies used around the world: telegraph, telephone, phonograph, and motion pictures, among others. In the 20th century, they continued to add more vehicles to the Information Highway, most notably the computer and its smaller version, the ubiquitous personal computer. In short, Americans have been preparing for the Information Age for more than 300 years. It did not start with the introduction of the World Wide Web in the early 1990s." A. D. Chandler and J. W. Cortada, eds. *A Nation Transformed by Information* (New York: Oxford University Press, 2000), v.
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