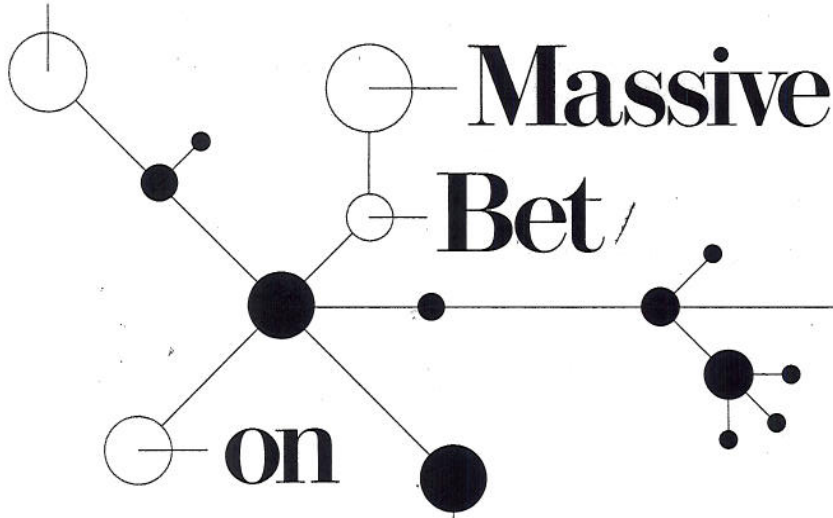


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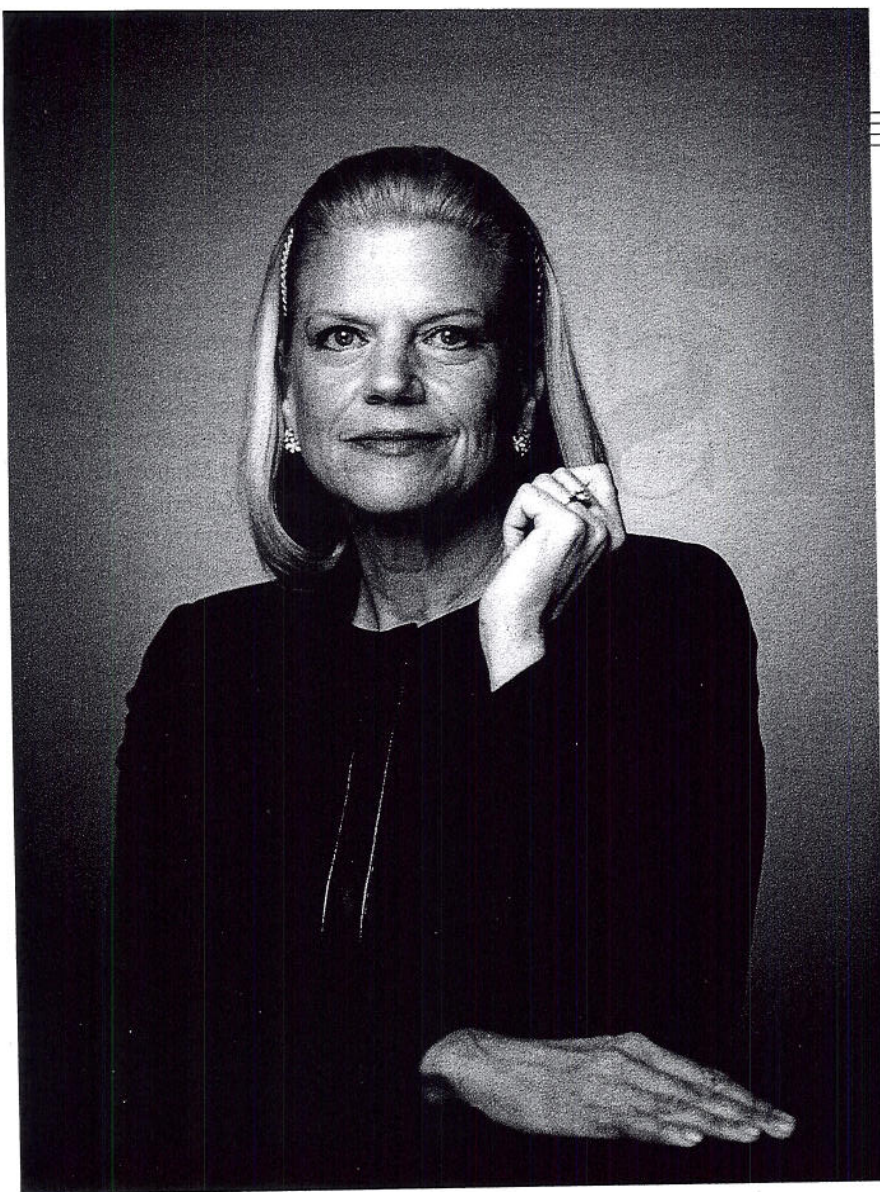


Watson

YOU KNOW IT AS THE SUPERCOMPUTER THAT BEAT THE BRAINIACS ON *JEOPARDY*. NOW CEO VIRGINIA ROMETTY SAYS IT REPRESENTS THE FUTURE OF IBM—AND COMPUTING.

DR. MARK KRIS is among the top lung cancer specialists in the world. As chief of thoracic oncology at Memorial Sloan-Kettering (MSK) Cancer Center in New York City, he has been diagnosing and treating patients for more than 30 years. But even he is overwhelmed by the massive amount of information that goes into figuring out which drugs to give his patients—and the relatively crude tools he has to decipher that data. “This is the standard for treatment today,” he says, passing me a well-worn printout of the 2013 treatment

BY
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Information will be to the 21st century what steam, electricity, and fossil fuel were to the prior centuries,” says Rometty. She calls Watson the “very pinnacle” of innovation.

IBM CEO Virginia Rometty

guidelines in his office. We choose a cancer type. A paragraph of instructions says to pair two drugs from a list of 16. “Do the math,” he says. It means more than 100 possible combinations. “How do you figure out which ones are the best?”

It’s a huge problem. More than 230,000 Americans will be diagnosed with lung cancer this year. Almost all of them will receive chemotherapy. As crude as the existing guidelines are, says Kris, they won’t be followed more than half the time. If we bumped up adherence by just 10% to 20%, he says, as many as 30,000 people might live longer. Never mind curing cancer—shouldn’t we be able to get the best available combinations of medications to sick people now?

That’s the question that led Kris to IBM. He saw that more information was not the answer. What doctors needed was a better brain—one that could instantly vacuum up facts, draw deeper connections between data points, and remember everything. They needed Watson.

Watson, of course, is the supercomputer that gained attention a couple of years ago for trouncing *Jeopardy’s* grand champions. IBM CEO Virginia Rometty calls what it does “cognitive computing.” She believes Watson is nothing less than the key to IBM’s future—and the dawn of a new era of computing. “It will create new markets,” she says. “It will create new buyers. People will be able to solve different problems and new problems.”

Watson has already spawned new products: In February, IBM, in partnership with MSK and insurer WellPoint, introduced a cloud-based adviser for oncologists who treat lung cancer. To build it, Kris and his colleagues worked with IBM researchers to feed Watson 600,000 pieces of medical evidence and 2 million pages of text from journals and clinical trials. Doctors will soon be able to press an ASK WATSON button on their computers, and Watson will sift through all that information in just a few minutes to

provide recommendations for treatment. Think of it as an instant second opinion delivered by an erudite and exceptionally polite colleague with a photographic memory and a storehouse of knowledge that would put Google to shame.

IBM's other customers are eager to apply this technology. Already dozens of companies are testing aspects of it. Macy's uses it to better target millennials by interpreting their social signals. Kroger employs elements of it to anticipate customer questions and provide faster answers at its call centers. BNSF Railway CEO Matthew Rose believes Watson will be able to help detect faulty sections in the company's 32,500 miles of track before they break. "In a few years," he says, "we're going to look back on this period and say, 'Wow, how did we ever do things before cognitive?'"

Rometty has bet her tenure on Watson, and IBM needs it to succeed. The company has spent a whopping \$24 billion over the past eight years on research and the acquisition of data analytics startups to build and bolster the technology/IBM is capable of rolling out a project this substantial because it is immense, with \$104.5 billion in 2012 revenues.

That vast size also means the company must find big growth areas. It generated \$17.6 billion in profits last year, a gain of 8%. Just to maintain that pace, it will need to find an additional \$1.4 billion in profit this year. Big Blue's shares have idled recently as investors question whether it can continue its stellar performance. Rometty is a believer. She calls Watson "an embodiment of innovation and higher value. I view it as the very pinnacle."



YOU CAN FEEL IBM'S 102 years inside its low-slung, mid-century-modern headquarters in Armonk, N.Y. When I arrive, Rometty, who goes by Ginni, practically sprints into the majestic reception area to welcome me. We stride down a long central corridor flanked by glass cases holding IBM products from years past and pause before photos of the 1997 match in which one of Watson's progenitors, Deep Blue, defeated world chess champion Garry Kasparov. "You get a real sense of the history of this place," she says, gesturing behind her.

There, standing as high as my elbow, is a 405 Electric Accounting Machine. It was IBM's flagship product in the 1930s and '40s, part of what Rometty calls "the first era of computing"—machines that could calculate. Farther up the hall are what followed: programmable devices, which respond to instructions. Those are computers as we know them today, and they've steadily become faster and more powerful. But even the most sophisticated can only respond to detailed directions from humans.

That's what makes Watson a giant step forward: It

learns on its own. Named for IBM's modern founder, Thomas Watson, it digests massive amounts of information. It can understand natural language—the words we speak and tweet and type into emails. It grasps puns, slang, and jargon. It knows *a* cloud from *the* cloud. It can incorporate the signals picked up by the sensors that pepper the world, and it doesn't need a complex code of ones and zeroes commanding its every move. Watson programs and reprograms itself as more information is presented.

That's crucial because it means Watson can extend its "thinking" beyond what a human brain can manage (more on that later) and also because the supercomputer does sometimes make mistakes. Even as it triumphed on *Jeopardy*, for example, Watson bungled one question about Chicago's airports. But unlike most computers and many humans, Watson can learn from its flubs.

In the 2½ years since it appeared on *Jeopardy*, Watson has simultaneously slimmed down (in form) and bulked up (in capabilities). It once consisted of 90 servers parked on 10 racks taking up roughly the space of a large room. Today it fits into a server roughly the size of four pizza boxes and it runs 240 times as fast.

"Watson," it should be noted, refers not only to the hardware—several dozen have been sold so far, according to IBM—but also to an array of software products that work with it. Experts anticipate the system will get even speedier and shrink to the size of a mobile device. Already it is being made available as a service through the cloud. (IBM declines to give specifics on what Watson costs, citing huge variations depending on which services are included; suffice it to say that even the most bare-bones contract runs into tens of millions of dollars.)

Part of Watson's genius is that, unlike past computing tools, it doesn't provide a correct answer. Instead, it offers possibilities, which it ranks by probability, and the evidence for its opinion. In an MSK demonstration to treat a theoretical 37-year-old lung cancer patient, Watson lists three courses of treatment, expressing 95% confidence in the first, 45% in the second, and 8% in the third. Tap the button next to each option, and a pop-up window provides the support for Watson's view—often a highlighted passage in a journal article or analysis from a clinical trial.

Watson has arrived in the nick of time. If a primary challenge of the 20th century was accessing information, the challenge for the 21st century will be navigating the ensuing complexity. More information has been generated in the past two years than in all prior human history, and there's every reason to believe that the pace will only accelerate.

AT AGE 56, ROMETTY knows Watson's full transformative effect won't occur until long after she has retired from the company. (Historically, IBM CEOs have stepped aside at 60.) It's her job to prepare IBM and its customers to



John Kelly, IBM's director of research

capitalize on Watson technology. It's such an important mission that Rometty has offered to sit for her first formal press interview since becoming CEO in 2012.

We've settled into her office, where she sips from her beverage of choice, a Starbucks venti skim chai. The decor is spare in the way you'd expect for a tech CEO. There isn't a filing cabinet or even a piece of paper in view, and there's just a hint of femininity in the office's lavender accents. This is the workspace of a woman who is both extremely organized and spends most of her time on the road.

Rometty is an anomaly—a computer-science grad whose signature headband gives her the air of the sorority president she once was. She's as formal as you'd expect an IBM CEO to be, yet warm at the same time. Rometty is the sort of person who simply can't stomach the notion of bragging. She became a master saleswoman—clients adore her—by *listening* rather than holding forth. Indeed, it's quickly clear that she would much rather ask about me than answer questions about herself. But get her talking about Watson, and enthusiasm quickly creeps into her voice.

Rometty lays out her vision of the successful enterprise of the future. She believes it will be defined by three characteristics. First, data will drive every decision. Take, for example, managing attrition, an area long considered as much art as science. How do you keep talented people from leaving? In 2011, IBM launched a pilot program in one division, using Watson's technology, to answer that question. The program examined the obvious factors, including compensation, benefits, work-life balance, and opportunities for career development. But it also made connections to data that humans might not consider. For

example, the software noticed that a woman working as an industry consultant was making social media connections with people who work on cloud computing. To keep her engaged, IBM assigned her a new mentor who was senior in its cloud business. "Not only did the attrition reduce by 75%," says Rometty of the pilot, but "what we spent in the right places went down by \$100 million." (That number factors in what it would cost to recruit, replace, and train people over several years.) IBM now uses this process throughout the company.

Second, Rometty predicts that companies will use their wealth of information to create new types of goods and services. To help that along, she says, IBM will open pieces of Watson's software code to outside developers by the end of the year so they can fuse their own good ideas with it.

Third, according to the CEO, the new enterprise will make a giant leap in its ability to nurture one-on-one relationships directly with consumers. Whereas today a business can slice and dice data to the point that it can target, say, a 23-year-old single female college graduate in St. Paul, the volume of data and the ability to manage it will escalate to the point that a company can target, say, Cindy Davis of 110 Maple St. in St. Paul. (How consumers will feel about that level of attention is another matter.)

To pave the way for the looming reality, Rometty is teaching new constituents to be technology consumers. She has begun encouraging IBM's traditional customers, chief information officers, to work more closely with peers in other domains, creating events that showcase how CMOs and CFOs can embrace technology. Rometty must also reform IBM's culture so it's prepared to reach those new customers faster and better meet their needs. To bring Watson to market, its research department is working more in tandem with its consulting division in service to clients. Some 500 IBM employees have attended Watson Academy, a weeklong training program in Austin and Boston, with thousands more expected to attend virtually.

IBM's leader must do these things without losing the confidence of shareholders, who expect reliable performance and have enjoyed a 20-fold return over the past two decades. Rometty has relied on the same formula as her predecessors: IBM issues five-year road maps with ambitious goals and then meets its targets, usually ahead of schedule. Rometty has focused on jettisoning low-margin hardware businesses while doubling down in higher-margin software opportunities. The company regularly replaces employees in high-cost markets with people from lower-cost markets or in some cases with technology. And it uses its cash to repurchase stock. Big Blue has boosted its earnings per share by double digits every year for the

past decade, and Rometty has promised the company will deliver \$20 in EPS by 2015, up from \$15.25 in 2012.

In the spring investors shuddered when IBM missed Wall Street's profit estimates for the first time since 2005. Some analysts argue that IBM can cut headcount for only so long and suggest that the company's cloud business may not be as robust as it will need to be to deliver continued growth. For her part, Rometty says the company is on track with its five-year plan. Veteran analysts have faith that it can meet its goals. "IBM has a really disciplined financial model," says Toni Sacconaghi, a senior analyst at Bernstein Research. Sure enough, when IBM announced its earnings in July, it had beaten its projections.

PLENTY OF TECH PLAYERS have developed elements of Watson's expertise. Google has incorporated machine learning into its search algorithms. Apple's Siri can answer natural-language questions. And a half-dozen startups run by Ph.D.s are marketing sentiment-analysis software and advanced data analytics.

But none of those outfits have invented anything with the breadth of Watson. That is where IBM's combination of size, experience, resources—and ambition—pays off. With a legacy of groundbreaking products and a \$6 billion research budget, the company is uniquely positioned to think big thoughts. And with an estimated 50,000 consultants on staff, it has the troops to bring them to market. IBM's deep customer relationships and long-term contracts give it the latitude to take a chance on something new and important.

In May, IBM introduced the first product it expects to be rolled out in volume: the Watson Engagement Advisor. The supermarket chain Kroger is testing it in call centers; right now Watson is consuming all of Kroger's customer information. Imagine that a customer calls in with a question about where he can use the points from his Kroger fuel rewards program. A call center employee would ordinarily have to skim the program rules, find instructions about where points can be used, and review the customer's account. That's hard to do in a few seconds. That's why half of the 270 billion annual calls to call centers, according to IBM, either are unresolved or require supervisors to get on the line. Soon a Kroger call center employee will be able to hit an ASK WATSON button to provide faster, more accurate, and more helpful support. Says Kroger chief information officer Chris Hjelm: "This can make everybody an expert."

SO FAR, WATSON'S PRODUCTS have helped clients to have faster and better access to what they already know. But there is a more revolutionary possibility: Watson could

venture beyond the frontier of human knowledge. That's the promise that drives John Kelly, head of IBM's 3,000 researchers. "We're trying to extend humans' ability with these new systems into areas we just humanly can't do," says Kelly, 59. He's a scientist's scientist, with a master's in physics and a doctorate in materials engineering, and the gift of making complex ideas accessible to lay audiences.

The sound of buzz saws cut into our conversation this summer as workers constructed co-working labs below us, where customers have since started to embed for weeks at a time to collaborate with IBM researchers on how to best apply Watson. Kelly says customers are fascinated by "what correlations are out there, what white spaces are out there for discovery—a new drug, a new metal, a new whatever business they're in." Watson could mean, say, identifying the right streets to salt in advance of a winter storm. And it could provide new possibilities for consumers. IBM's senior vice president of global business services, Bridget van Kraljingen, describes a smartphone app (she says it works in the lab but hasn't yet been commercialized) that scans a grocery store's cereal selection and tells shoppers which option is healthiest.

If IBM's longer-term vision plays out, humans will forge an intimate new relationship with machines. "It's not like we're going to be the overlord of the system anymore," Kelly says. (Presumably Watson will be better behaved than HAL, the rogue computer who revolted against his master and took command of a spaceship in *2001: A Space Odyssey*.) "We're going to learn much, much faster with these systems, and these systems are going to learn much, much faster with us," he says.

But if a computer can get better and better at grasping all of human knowledge and speaking to us in our language, it eventually may not need us that much. It's striking that, unlike older technology, which eliminated manual jobs, Watson may well reduce the need for sophisticated, highly trained knowledge workers. Today the ASK WATSON button provides a second opinion for oncologists. But as it grows more reliable, might it replace some of them entirely? Watson could easily become a tool that facilitates huge job cuts (along with, inevitably, creating some new jobs too). Artificial intelligence could have as large an impact on our economy as the steam engine did in the 19th century.

Ultimately, those questions don't fall to IBM to answer. The company is in the business of technology: It innovates, and then, as the technology commoditizes, it innovates again. "To be 100 years old, you can never define yourself by a product," Rometty tells me as we wrap up our conversation. But if it's possible for IBM's supercomputer to extend the limit of knowledge, maybe questions about the future of work are better posed to Watson. ■