Management by the Numbers
Stephen Baker

THE SCIENCE OF MANAGEMENT

From a stopwatch to mathematical models

TAYLORISM

1911 A Philadelphia engineer named F.W. Taylor publishes *The Principles of Scientific Management*, a guide to increasing the efficiency of factory workers. His methods, known as Taylorism, dominate industrial work through much of the 20th century, from auto plants to McDonald's.

OPERATIONS RESEARCH

1940 Researchers in Britain and the U.S. build mathematical models of North Atlantic shipping lanes. Their goal: to find an optimized approach for getting convoys safely past Nazi U-boats. The result is operations research, a math discipline that now runs the logistics of the modern world, including the deployment of cell-phone towers and helicopter routes in Iraq.

STAT PROCESS CONTROL

1950 W. Edwards Deming begins teaching statistical management in Japan. His thesis: Meticulous control of quality also leads to lower costs. His methods contribute to startling advances in Japanese manufacturing, which later spread through the world.

SIX SIGMA

1986 Motorola institutes Six Sigma, a management strategy heavily influenced by Deming. It focuses on verifiable data, including consumer satisfaction and financial returns. It becomes the winning formula for GE and drives statistical managing into the ranks of office workers.

MODELING WORKERS

2005 IBM embarks on research to harvest massive data on employees, and to build mathematical models of 50,000 of the company's consultants. The goal is to optimize them, using operations research, so that they can be deployed with ever more efficiency.

BusinessWeek*'s 2006 Cover Story, "Math Will Rock Your World," announced a new age of numbers. With the rise of new networks, the story argued, all of us were channeling the details of our lives into vast databases. Every credit-card purchase, every cell-phone call,*

every click on the computer mouse fed these digital troves. Those with the tools and skills to make sense of them could begin to decipher our movements, desires, diseases, and shopping habits—and predict our behavior. This promised to transform business and society. In a book expanding upon this Cover Story, The Numerati*, Senior Writer Stephen Baker introduces us to the mathematical wizards who are digging through our data to decode us as patients, shoppers, voters, potential terrorists—even lovers.*

One of the most promising laboratories for the Numerati is the workplace, where every keystroke, click, and e-mail can be studied. In a chapter called "The Worker," Baker travels to IBM (IBM), where mathematicians are building predictive models of their own colleagues. An excerpt:

On a late spring morning I drive up into the forests of Westchester County, N.Y., to the headquarters of IBM's Thomas J. Watson Research Center. It sits like a fortress atop a hill, a long, curved wall of glass reflecting the cotton-ball clouds floating above. I have a date there with Samer Takriti, a Syrian-born mathematician. He heads up a team that's piecing together mathematical models of 50,000 of IBM's tech consultants. The idea is to pile up inventories of all of their skills and then to calculate, mathematically, how best to deploy them. I'm here to find out how Takriti and his colleagues go about turning IBM's workers into numbers. If this works, his team plans to apply these models to other companies and to automate much of what we now call management.

Takriti, a slim 40-year-old with wide, languid eyes, opens the door of his small office. He wears a rugby shirt tucked tightly into blue jeans. I tell him that being modeled doesn't sound like much fun. I picture an all-knowing boss anticipating my every move, perhaps sending me an e-mail with the simple message, "No!" before I even get up my nerve to ask for a raise. But Takriti focuses on the positive. Imagine that your boss finally recognizes your strengths, he says—maybe ones that are hidden even to you. Then he "puts you into situations where you will thrive."

COMMODITIZING WORKERS

Still, Takriti confesses that he's nervous. His assignment is to translate the complexity of highly intelligent knowledge workers into the same types of equations and algorithms that are used to fine-tune shipping or predict the life span and production of a mainframe computer. With time, he and his team hope to build detailed models for each worker, each one complete with a person's quirks, daily commute, and allies, perhaps even enemies. These models might one day include whether the workers eat beef or pork, how seriously they take the Sabbath, whether a bee sting or a peanut sauce could lay them low. No doubt, some of them thrive even in the filthy air in Beijing or Mexico City, while others wheeze. If so, the models would eventually include this detail, among countless others. The idea is to build richly textured models that behave in their symbolic realm just like their flesh-and-blood counterparts. Then planners can manipulate them, looking for the most efficient combinations.

Takriti's team is hardly starting from scratch. IBM has long been a leader in converting all kinds of complex systems into numbers. Right after World War II, Big Blue used a new science called Operations Research to construct a mathematical model of the company's industrial supply chain. It included its costs and capabilities, as well as limitations, or constraints. Once the supply chain existed as numbers, engineers could experiment with it—optimizing it—and later incorporate the improvements in the real-life version. This drove efficiency and lowered costs.

It was wonderful for manufacturing. But now, as IBM has shifted its focus to services, the corporate supply chain is made up less of machine parts than of people—Takriti and some 300,000 of his colleagues. His job, quite simply, is to start optimizing his co-workers.

To put together these profiles, Takriti requires mountains of facts about each employee.

He has unleashed some 40 PhDs, from data miners and statisticians to anthropologists, to comb through workers' data. Personnel files, which include annual evaluations, are off-limits at IBM. But practically every other bit of data is fair game. Sifting through résumés and project records, the team can assemble a profile of each worker's skills and experience. Online calendars show how employees use their time and who they meet with. By tracking the use of cell phones and handheld computers, Takriti's researchers may be able to map the workers' movements. Call records and e-mails define the social networks of each consultant. Whom do they copy on their e-mails? Do they send blind copies to certain people?

These hidden messages could point to the growth of informal networks within the company. They may show that a midlevel manager is quietly leading an important group of colleagues—and that his boss is out of the loop. Eventually, say experts, e-mail analysis may single out workers whose behavior places them outside the known networks. Are these outliers depressed, about to jump ship, consorting with the competition? In companies around the world, the Numerati will be hunting for statistical clues.

Even without reading all the e-mails, managers can automatically spot the most common words that circulate within each group of workers. This permits them to establish the nature of each relationship. They can also see how communications shift with time. Two workers may discuss software programming Tuesday through Friday but spend much of their time on Monday sending e-mails about the past weekend's football games. "The next big step," says Kathleen M. Carley, a lead researcher in social networks at Carnegie Mellon University, "is to take tools like this and tie them to scheduling and productivity programs."

Takriti's scheme is even more ambitious. He is not given to bold forecasts. But if his system is successful, here's how it will work: Picture an IBM manager who gets an assignment to send a team of five to set up a call center in Manila. She sits down at the computer and fills out a form. It's almost like booking a vacation online. She puts in the dates and clicks on menus to describe the job and the skills needed. Perhaps she stipulates the ideal budget range. The results come back, recommending a particular team. All the skills are represented. Maybe three of the five people have a history of working together smoothly. They all have passports and live near airports with direct flights to Manila. One of them even speaks Tagalog.

Everything looks fine, except for one line that's highlighted in red. The budget. It's $40,000 over! The manager sees that the computer architect on the team is a veritable luminary, a guy who gets written up in the trade press. Sure, he's a 98.7% fit for the job, but he costs $1,000 an hour. It's as if she shopped for a weekend getaway in Paris and wound up with a penthouse suite at the Ritz.

DO THE MATH

Hmmm. The manager asks the system for a cheaper architect. New options come back. One is a new 29-year-old consultant based in India who costs only $85 per hour. That would certainly patch the hole in the budget. Unfortunately, he's only a 69% fit for the job. Still, he can handle it, according to the computer, if he gets two weeks of training. Can the job be delayed?

This is management in a world run by Numerati. As IBM sees it, the company has little choice. The workforce is too big, the world too vast and complicated for managers to get a grip on their workers the old-fashioned way—by talking to people who know people who know people. Word of mouth is too foggy and slow for the global economy. Personal connections are too constricted.

Managers need the zip of automation to unearth a consultant in New Delhi, just the way a generation ago they located a shipment of condensers in Chicago. For this to work, the consultant—just like the condensers—must be represented as a series of numbers.

Eventually, companies could take this knowledge much further, using the numbers, in a sense, to clone us. Imagine, says Aleksandra Mojsilovic, one of Takriti's close colleagues, that the company has a superior worker named Joe Smith. Management could really benefit from two or three others just like him, or even a dozen. Once the company has built rich mathematical profiles of Smith and his fellow workers, it might be possible to identify at least a few of the experiences or routines that make Joe Smith so good. "If you had the full employment history, you could even compute the steps to become a Joe Smith," she says. "I'm not saying you can recreate a scientist, or a painter, or a musician," Mojsilovic adds. "But there are a lot of job roles that are really commodities." And if people turn out to be poorly designed for these jobs, they'll be reconfigured, first mathematically and then in life.

DIFFERENT STROKES

Sound scary? It may depend on where you're perched on the food chain. Remember the $1,000-per-hour consultant who almost got dispatched to the Philippines? He didn't end up going, and instead, in IBM's scheme, he remained "on the bench." Takriti smiles. "That's what we call it," he says. "I think the term comes from sports." The question, of course, is how long IBM wants to have that high-priced talent gathering splinters. If there isn't any work to justify his immense talents, shouldn't they put him on something else, just to keep him busy?

Not necessarily, says Takriti. Job satisfaction is one of the automatic system's constraints. If workers get angry or bored to tears, their productivity is bound to plummet. The computer keeps this in mind (in a manner of speaking). As you might expect, it deals very gently with superstars. Since they make lots of money for the company during short bursts of activity, they get plenty of time on the bench. But grunt workers in this hierarchy get far less consideration. They're calculated as commodities. Their skills are "fungible." This means these workers are virtually indistinguishable from others, whether they're in India or Uruguay. They contribute little to profits. It pains Takriti to say this, because humans are not machines. They have varying skills and potential to grow. He appreciates this. But looking at it mathematically, he says, the company should keep its commodity workers laboring as close as possible to 100% of the time. Not much kickback time on the bench for them.

Where is this all leading? I pose the question one afternoon to Pierre Haren. A PhD from Massachusetts Institute of Technology and a prominent member of the Numerati, he's the founder and chief executive of ILOG. It's a French company that uses operations research to fine-tune industrial systems, charting, for example, the most efficient delivery routes for Coors beer. ILOG makes allowances for all kinds of constraints. For example, a few years ago, the Singapore government wanted to avoid diplomatic spats at its new airport. So officials asked ILOG to synchronize the flow of passengers, making sure that those from mainland China wouldn't cross paths with travelers from Taiwan. Haren speaks in a strong French accent. We're talking in the lobby of a Midtown hotel in New York, and he has to yell to make himself heard over a particularly loud fountain.

DATA SERFDOM?

Haren says the efforts under way at places like IBM will not only break down each worker into sets of skills and knowledge. The same systems will also divide their days and weeks into small periods of time—hours, half-hours, eventually even minutes. At the same time, the jobs that have to be done, whether it's building a software program or designing an airliner, are also broken down into tiny steps. In this sense, Haren might as well be describing the industrial engineering that led to assembly lines a century ago.

Big jobs are parsed into thousands of tasks and divided among many workers. But the work Haren is discussing is not done by hand, hydraulic presses, or even robots. It flows from the brain. The labor is defined by knowledge and ideas. As he sees it, that expertise will be tapped minute by minute across the world. This job sharing is already starting to happen, as companies break up projects and move big pieces of them offshore. But once the workers are represented as mathematical models, it will be far easier to break down their days into billable minutes and send their smarts to fulfill jobs all over the world.

Consider IBM's superstar consultant. He's roused off the bench, whether he's on a ski lift at St. Moritz or leading a seminar at Armonk, N.Y. He reaches into his pocket and sees a message asking for 10 minutes of his precious time. He might know just the right algorithm, or perhaps a contact or a customer. Maybe he sends back word that he's busy. (He's a star, after all.) But if he takes part, he assumes his place in what Haren calls a virtual assembly line. "This is the equivalent of the industrial revolution for white-collar workers," Haren says.

It's getting late in Takriti's office. I can see that he's concerned about my line of questioning. This virtual assembly line sounds menacing. The surveillance has more than a whiff of Big Brother. For those of us who aren't $1,000-per-hour consultants, life bound to a mathematical model is sounding like abject data serfdom.

Here's Takriti's counterargument. As the tools he's building make workers more productive, the market will reward them. We already use math programs to plot our trips and look for dates. Why not use them to map our careers—and negotiate for better pay? (Takriti, it turns out months later, masters these market dynamics: He was able to shop his gilded Numerati credentials to several Web companies and banks, and finally leaves IBM in late 2007 for a post as a top mathematician at Goldman Sachs. Work on the modeling project continues apace, says IBM.) All sorts of workers will be able to calculate their own worth with more precision. Let's say analytical tools show that a consultant's value to the company topped $2 million one year. Shouldn't she have access to that number and be free to use it as a negotiating tool? In a workplace defined by metrics, even those of us who like to think that we're beyond measurement will face growing pressure to build our case with numbers of our own.

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