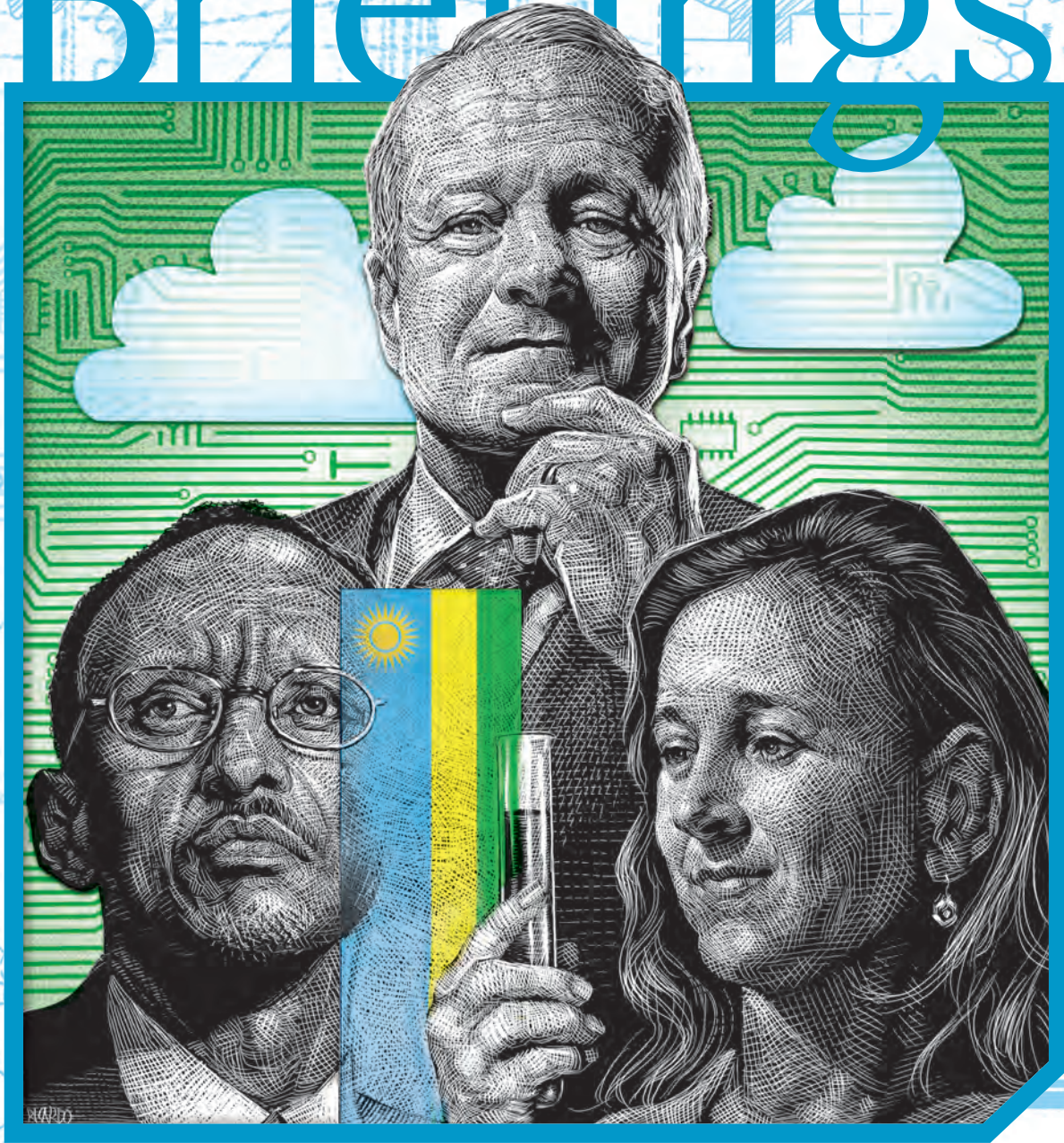


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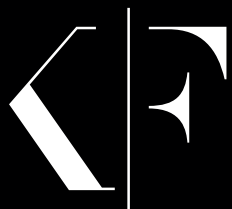


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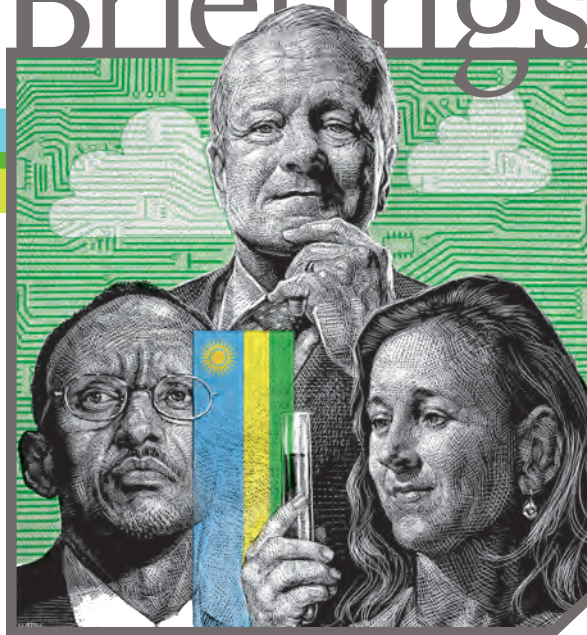
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KORN/FERRY Briefings



THE SEARCH
FOR GROWTH

A special issue
dedicated to
global growth:
Strategy, People,
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Implications



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*"This is a company that
has a healthy paranoia
about whether we're
wrong about something,
but we have no fear
about taking on almost
unsolvable challenges and
finding a way to do them."
—John Chambers, CEO, Cisco*

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We will not rest



Hash Marks on the Wall: The Measure of \grōTH\

HASH MARKS ON THE WALL... tiny handprints in concrete ... are any measures of growth more universal? 🌟 Over the years, I've recorded the progress of my children as they topped four feet, five feet, and beyond.... through pen markings on a wall.

Such growth never progresses at an even pace — spurts are interspersed with modest gains. We can only appreciate that pattern with PERSPECTIVE, over time. (Once, with my heart in my throat, I stopped a painting crew that was about to obliterate a dozen years of hash marks.)

We see the same patterns in economies. If we line up the GDPs of developed and developing countries against the wall of economic expansion, we'll see emerging markets with double-digit spurts and mature ones whose progress is measured in decimals.

Ebbs and flows should come as no surprise. Economies (like children and trees and other “natural” things) do not grow like magic beanstalks, without hitting plateaus and pauses. And, in the no-growth fallow times, facts become clearer, especially in business. Unproductive offshoots are pruned,



while the more promising get added attention. Such discernment, though, is difficult during the beanstalk days, when everything is popping all at once.

And even when there is no growth in one dimension—overall GDP, the height of a young adult—there is often expansion in another. A new technology may be skyrocketing while yesterday's plummets to-

ward its twilight. That late teen or early 20-something who has reached full height is growing intellectually and in emotional maturity.

Every stage of growth brings a new normal. Economic cycles are healthy — much like a wildfire in the forest — providing renewal and rejuvenation. Change is more likely to succeed when the organization and its employees have a reason to change. Today, there is certainly a reason.

Over the past year, I've had numerous conversations with CEOs and world leaders about what they see in their markets. One leader of a Fortune 100 company put it best: “What we're seeing and living through now is what we ought to expect going forward. But that's not so terrible. We can work with that.” In other words, companies will adapt, reconfigure and survive when economic tailwinds are absent or weak.

“We need to keep a firm grasp on ‘now,’ because change can only be appreciated in context of what remains the same.”

These wise words from a longtime chairman and CEO reflect a healthy realism about the present, which keeps the future in perspective.

When I was a youngster, the citizens of my hometown of McPherson, Kan., buried a time capsule filled with photographs, mementoes and historical records—what they thought people of the future should know about our community. Looking back, I wonder about our choices, given the fact that the world has changed more in the past 20 years than it has in the past 50. Surely we have exceeded the wildest dreams of those who came before us in some areas (the Internet for example), yet elsewhere we have, no doubt, fallen short. (An old-timer in McPherson was certain we’d be living on the moon by 1999—an entire colony of University of Kansas Jayhawks fans; alas, we are still earthbound.)

We all try to encapsulate the past in our own way. I still have a box of newspaper clippings from my childhood and teen years, from Armstrong’s walk on the moon to Nixon’s resignation. Those headlines remind me where I was—and what I expected the future to be.

Whether our idea of the future, ultimately, inspires or disappoints depends largely upon our ability to accept today. As Buddha is quoted as saying,

“Do not dwell in the past, do not dream of the future, concentrate the mind on the present moment.” We need to keep a firm grasp on “now,” because change can only be appreciated in context of what remains the same.

In other words, leaders in this time of elusive growth must have a clear vision of today if they are to paint a landscape of tomorrow. But, that won’t be enough. Over the past five years, in this supposed recovery, many have been left behind – employees included. Employers continue to ask fewer workers to do more for less money. Organizational capabilities and strategies must be agile, and leaders must trumpet purpose – the WHY of an organization – and celebrate progress, even when growth may at first appear negligible.

Only by measuring and comparing against a fixed point—where the “index” of our observation rests at zero—can we judge how far we’ve gone. The hash marks on the wall remind us that—for trees and teenagers, ecosystems and economies, alike—life is precious and growth is relative.... relative to the past, relative to the horizon, but mostly relative to your PERSPECTIVE. In 2014.... in this fight for \grōTH\ and relevancy, leadership will mean balancing purpose and perspective, celebrating along the way. 

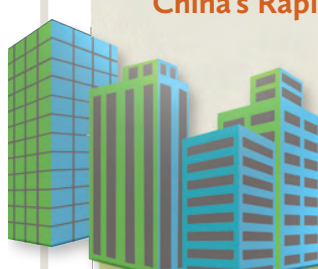
A QUICK LOOK AT GLOBAL GROWTH



**72
MILLION
JOBS**

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**25.8 K COMPANIES
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\$2,000,000,000,000**

Source: McKinsey, 2012 / Kauffman Foundation, 2009



The Latest Thinking

A Better Return on Self-Awareness

Companies with higher rates of return on stock also have employees with fewer personal blind spots. By David Zes and Dana Landis

SELF-AWARENESS—a characteristic essential to career success and improved executive leadership—also appears to correlate with overall company financial performance. A new analysis of results from Korn/Ferry International’s ProSpective Assessment shows that public companies with a higher rate of return (ROR) also employ professionals who exhibit higher levels of self-awareness.

Korn/Ferry searched 6,977 self-assessments from professionals at 486 publicly traded companies to identify the “blind spots” in individuals’ leadership characteristics, revealed by a disparity between answers in two separate parts of the test. The frequency of such blind spots was then gauged against the ROR of those companies’ stock. The analysis demonstrated that, on average:

- *Poorly performing companies’ em-*

ployees had 20 percent more blind spots than those working at financially strong companies.

- *Poor-performing companies’ employees were 79 percent more likely to have low overall self-awareness than those at firms with robust ROR.*

Stock performance was tracked over 30 months, from July 2010 through January 2013. During that period, the companies with the greater percentage

of self-aware employees consistently outperformed those with a lower percentage.

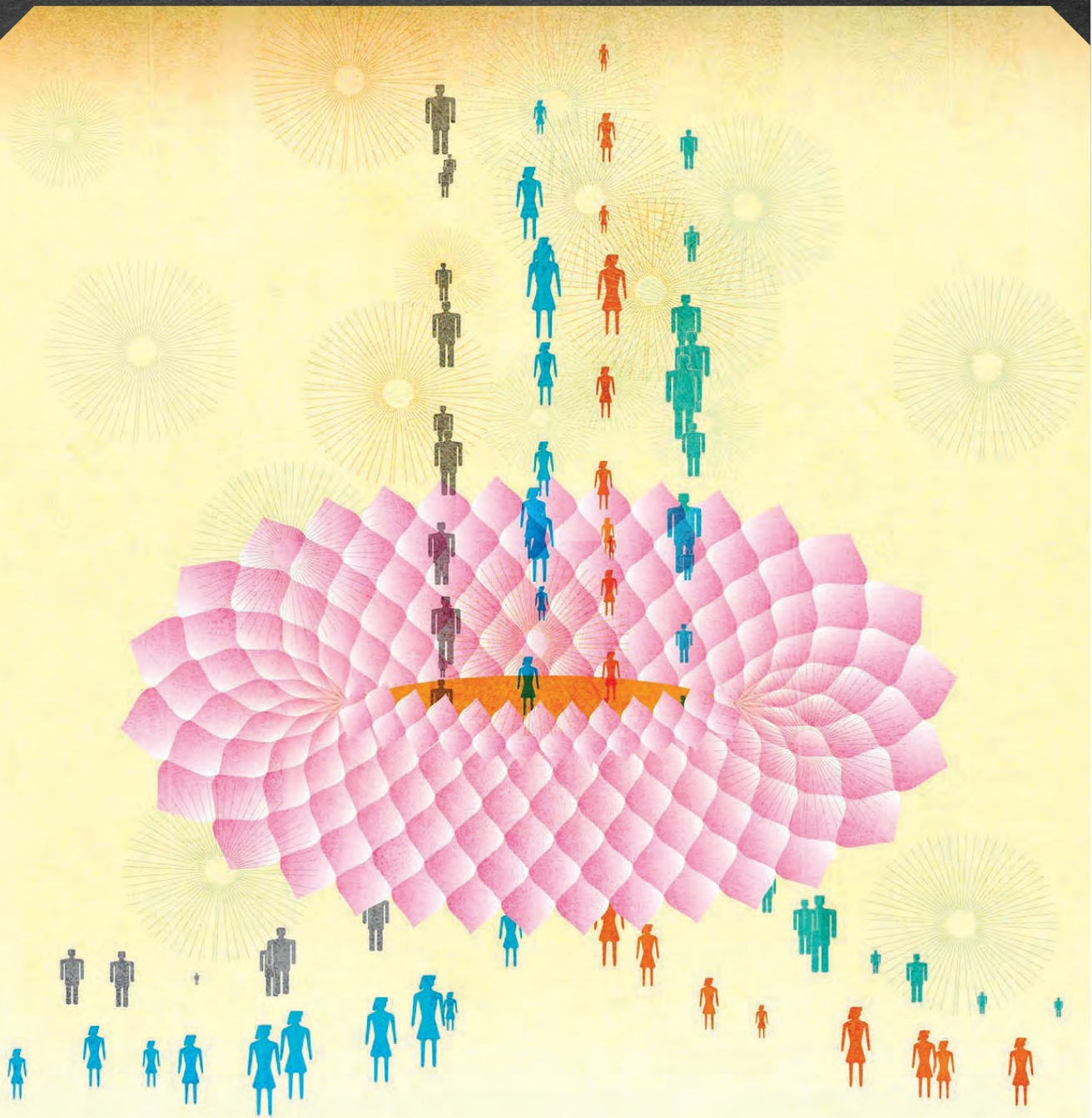
Despite its close association with high performance and career success, self-awareness is generally in short supply (Orr et al., 2010). Initial outcomes from the ProSpective Assessment in 2012 revealed that 79 percent of those evaluated online had at least one blind spot—a skill that an employee counted

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Too often, boards lack the appetite for risk that healthy growth requires

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Growth companies are looking for better ways to generate ideas that create value



••• A HIGHER LEVEL OF CONSCIOUSNESS •••

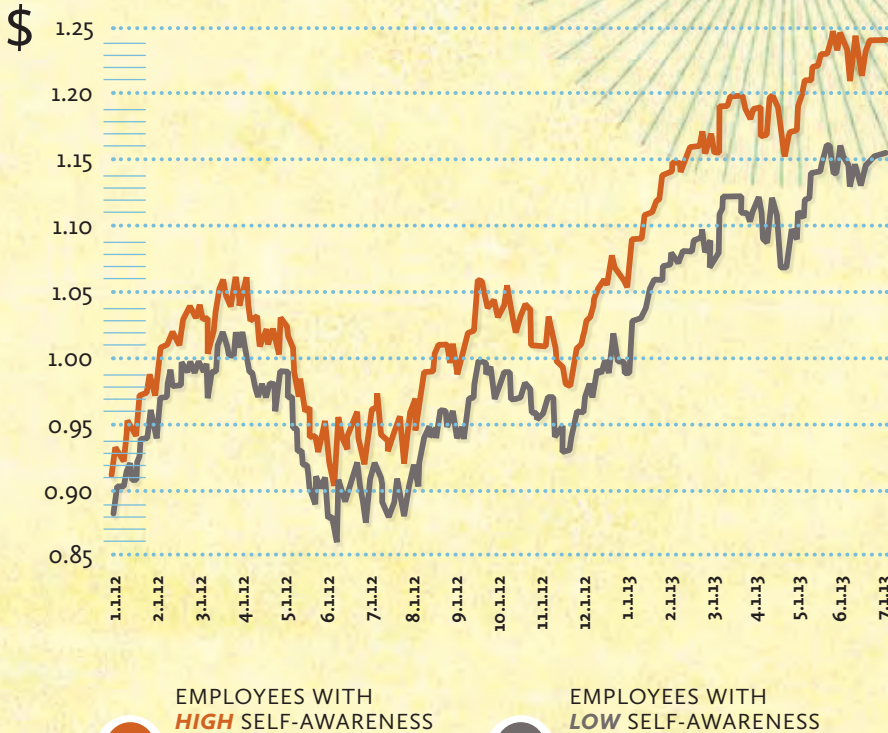
● **THE CONCEPT** / High levels of self-awareness, long acknowledged as contributing to individual effectiveness and good leadership, also correlate with corporate performance.

● **MEASURED WITH** / Korn/Ferry's online ProSpective Assessment and financial data on public companies.

● **IMPORTANT BECAUSE** / Self-awareness—knowledge of one's strengths and weaknesses, ability to admit mistakes and tendency to reflect—can be developed in leaders. Fostering a healthy culture of feedback might be one way to leverage human capital to drive corporate performance.

••• HIGHER RETURNS •••

Stock Returns Based On Self-Awareness



EMPLOYEES WITH **HIGH** SELF-AWARENESS

EMPLOYEES WITH **LOW** SELF-AWARENESS

Korn/Ferry created an aggregate model of how companies with highly self-aware employees performed over 30 months compared with those whose workers have more blind spots. The chart above illustrates the final 18 months of the model.

among his strengths when co-workers cited that same skill as one of his weaknesses (Orr, 2012). For this new study, Korn/Ferry considered people exhibiting three or more blind spots to have low self-awareness.

Self-awareness has generally been viewed as an individual attribute. Psychologist and “Emotional Intel-

ligence” author Daniel Goleman (1998) pioneered the idea that “the ability to recognize and understand your moods, emotions and drives, as well as their effect on others,” was a hallmark of effective leaders. Self-awareness can directly translate into better professional and personal choices, and result in more-fulfilling careers. On the other hand, those with low self-awareness tend to scramble the messages they receive concerning improvement, interpreting them as a threat rather than an opportunity. Even in these cases, an employee’s level of self-awareness can be increased through 360-degree perfor-

mance appraisals paired with effective coaching. This in turn drives improved performance and greater work satisfaction (Luthans and Peterson, 2003).

Korn/Ferry’s findings further broaden the potential importance of self-awareness. Addressing blind spots and increasing self-awareness have long been seen as positives for individuals. Now we have statistical findings that suggest benefits also exist at the macro level of an organization. Leaders with higher self-awareness not only have greater job satisfaction and commitment to their employer personally, but that effect also appears to trickle down to a manager’s direct reports (Luthans and Peterson, 2003). In the constant drive for competitive advantage, it turns out that helping employees to better understand themselves and fostering a culture of healthy feedback could also help to improve an organization’s overall performance. **K/F**

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Too often, boards lack the intestinal fortitude for risk that healthy growth requires

No Guts, No Growth

THE FINANCIAL CRISIS OF 2008 rattled corporate boards of directors. In his recent book, “The Future of Boards: Meeting the Governance Challenges of the Twenty-First Century,” Harvard Business School professor Jay Lorsch wrote that the economic shock of that year caused many directors to consider what they should do

differently. They chose to hunker down. They focused on compliance, cost cutting and purging themselves of insiders in an attempt to boost the bottom line, short-term shareholder value and public perception.

Now, five years on, that formula is outdated. Companies are changing quickly to focus on top-line growth, which will be less about mergers and acquisitions and more about innovation, less about increasing market share and more about finding new markets. This requires boards to play a different role.

Despite efforts to increase their impact on strategy—by seeking greater independence, diversity, industry knowledge, regulatory expertise and international experience—fewer than 20 percent of directors consider their boards to be effective at it, according to a National Association of Corporate Directors survey. Martin Coyne, the lead independent director at Akamai Technologies and author of “How to Manage Your Board

While Your Board Manages You,” believes many boards have little impact on strategy because they have a myopic view of it. “Strategy is never a one-time event,” he said. “Almost every board discussion topic has some connection to company strategy. Boards must constantly challenge assumptions [and] evaluate the effectiveness of strategic execution.”

Melanie Kusin, vice chairman in Korn/Ferry International’s Board & CEO Services, believes that “growth objectives will force new behaviors for overly conservative boards and greater examination of the fitness of directors to contribute to the challenges of the top line. If you look at companies and CEO’s that are performing well today, there is inevitably support at the board level to pursue smart strategies, even if they involve considerable risk. In those companies, board engagement is high and directors have a global view and enough market comprehension to debate and fuel necessary initiatives.” Kusin points

to Church & Dwight and Estée Lauder as examples of such companies. At Estée Lauder, for instance, presiding director Irv Hockaday sees his main role as integrative, getting beyond the fragmentation of focus that can arise from a committee mentality and ensuring that the board as a whole remains engaged and effective on strategic issues.

Kusin, along with Jeffrey Sonnenfeld, the founding CEO of Yale’s Chief Executive Leadership Institute, and Elise Walton, a former Yale-Korn/Ferry senior research fellow, conducted extensive interviews with veteran chief executives, seeking to find out from the CEO perspective what is keeping many boards from being as effective as they need to be. One of their key findings: Many CEO’s believe boards often lack the intestinal fortitude for the level of risk-taking that healthy growth requires.

“The risk appetite is out of balance,” one CEO told the researchers. Another said boards were stocked with too many “academics, money guys and No. 2’s” who were unable to see the whole playing field and “synthesize.” Some voiced concern that boards have too many “professional directors”—by some estimates, now a third of all members—who have retired from full-time employment



and whose ambitions often include protecting their board seats and the associated income. “Board members are supposed to bring long-term prudence to a company,” said another CEO. “But this often translates to protecting the status quo and suppressing the bold thinking about reinvention that enterprises need when strategic contexts shift.”

In short, the research made it clear that most boards are not working as well as they should, and the impetus for improvement needs to come from the boards themselves. They need to create more rigorous and regular methods of self-evaluation, to ask themselves if they are good enough to help the business go where it needs to. If the answer is no, they need effective mechanisms to enact timely change.

A recent survey by Agenda, a weekly news service from the Financial Times, found that although most boards conduct annual self-assessments, only about a third of directors considered their evaluations “very effective.” Many directors said the “1 to 5” rating approach is too wide-ranging and general. They also said feedback is “sugarcoated” or “watered down,” and that there isn’t enough follow-through after the evaluations. “It is time to move beyond check-the-box board reviews and start to seriously evaluate the board’s effectiveness,” David Larcker, professor

at the Stanford Graduate School of Business, told Agenda. “[Then] once you have this information, the chairman or lead director has to be ready to have the difficult conversation about how a director can improve, or whether it is better for him or her to step down.”

Better assessments are only half the battle, said Kusin. “Many in our study argued that [even when] annual board reviews were thorough and probing, there is no consistent rigor around removing underperforming directors. That sluggishness could be alleviated by

the ability to know what is innate to the business and see where it can be taken. Given the significant degree to which boards can enable—or stifle—that effort, the same kind of rigor should be applied to very concretely evaluating how a director’s aptitude and behaviors align with the long-term strategic platform of a company.”

Kusin says personal attributes should become an increasingly important focus of that evaluation process. Her research strongly suggests that what makes a director most valuable and effective,

beyond the requisite knowledge and experience, is the capacity to work effectively in a group. As former SEC chairman and Aetna CEO William Donaldson has said, “The most important part of what’s really

“If you look at companies and CEO’s that are performing well today, there is inevitably support at the board level to pursue smart strategies, even if they involve considerable risk.”

— Melanie Kusin, vice chairman in Korn/Ferry International’s Board & CEO Services

putting more specific ‘teeth’ in director accountabilities and tying performance to continuing service. Embracing enforceable criteria along with term limits could move the needle on creating more-dynamic board cultures.”

To move that needle, Kusin believes boards should borrow a page from the CEO succession playbook: “We need to start applying everything we are learning about profiling the competencies of CEO’s to the selection of board members—gathering the same kinds of data, doing the same kinds of vetting. We are in an era where every CEO is asked to be ‘transformative’—to have

going on in that boardroom [is] the least examined. The board is a social entity. And the human beings on it act like human beings do in groups.” Therefore, said Kusin, the best directors “turn out to be those with a broad portfolio of innate personal strengths: natural curiosity, diligence, studiousness, self-awareness, level-headedness and a balanced ego. These, in turn, are the bedrock of other much sought-after competencies such as comfort with ambiguity, rationality in a crisis, confidence, consensus-building skills and—perhaps most importantly—the courage to take smart risks.” K/F



Growth companies are looking for better ways to generate ideas that create value

Beyond Brainstorming

EVER SINCE ADVERTISING EXECUTIVE Alex Osborn introduced “brainstorming” to the corporate lexicon 65 years ago, it has been used as a generic term for group creativity and viewed as a panacea for organizations in search of innovation and growth. The premise was that problems are best solved when “taken by storm” by the unrestricted, free-associating input of a group. Participants are supposed to

generate as many ideas as possible, firing off uncensored notions, unusual approaches and odd perspectives like human sparklers, all the while deferring judgment and consideration of constraints. This idealization of brainstorming persists today, dovetailing neatly with contemporary culture’s unquestioning faith in all things social and collaborative.

The problem is, it has been clear almost since the inception of the idea that brainstorming does not work. In “59 Seconds: Think a Little, Change a Lot,” author Richard Wiseman wrote, “Over 50 years of research shows that people often reach irrational decisions in groups ... and biased assessments of the situation. ... People are more creative away from the crowd.”

The first empirical test of Osborn’s technique, conducted at Yale in 1958, showed that students thinking on their own came up with twice as many solutions as the brainstorming groups, and those solutions were deemed more feasible and effective. Numerous studies

since then have come to essentially the same conclusion. Among the most recent, researchers from the University of Texas at Arlington and Texas A&M found that creativity is stifled

Nicholas Kohn. “Thus, you become less creative.” Other studies have pointed to similar behavioral and cognitive impediments: “Social blocking” occurs when the very act of one person speaking has

a dampening effect on the thought processes of others; “social loafing” or “free riding” occurs when individuals tend to cede the stage to more active, aggressive members; social anxiety and fear of rejection are common limitations to brainstorming.

Researchers seeking ways to improve the model have generally concluded that brainstorming works better when it is less voluble and more rigorous. In a forthcoming article in *The Journal of Product Innovation Management*, professors from Oxford University’s Saïd Business School and Babson College in Massachusetts

assert that high-performing teams engage in comparatively fewer but more-disciplined brainstorming sessions, usually complemented by other ideation techniques such as prototyping.



in brainstorming groups. “Fixation to other people’s ideas can occur unconsciously and leads to suggesting ideas that mimic those of brainstorming partners,” explained lead researcher

Another recent study from INSEAD and the Wharton School of the University of Pennsylvania demonstrated that brainstorming is more effective when individuals generate their ideas independently, before meeting in a group.

Findings like these have led to variations on the brainstorming theme. Former McKinsey consultants Kevin P. Coyne and Shawn T. Coyne developed the concept of “brainsteering,” in which discussion is guided by tightly focused questions. Participants are selected less for their unique perspectives and more for their knowledge and experience regarding the problems at hand and the goals and capabilities of the organization. Peter Heslin, a psychologist at Southern Methodist University’s Cox School of Business in Dallas, introduced “brainwriting,” in which participants are also asked to address specific questions, but on their own and in writing. Each person’s ideas are then passed around among the other group members for annotation, critique and embellishment, again in writing. This may go on for several rounds before any group discussion takes place. “Electronic brainstorming”—the exchange of ideas via a variety of devices and platforms, as done in Web-based, open-innovation projects—has proven to be successful because it combines elements of individual and group ideation.

For the past decade, perhaps the most touted approach to generating ideas in organizations has been “design thinking.” While managers have traditionally operated using the scientific method, analyzing a problem and deriving from that the parameters of a solution, designers start by imagining a desired condition, then working to define the ways that it can be achieved. In an organizational context, design thinking is essentially a highly process-oriented approach to brainstorming. To imagine new products or market opportunities, design thinkers use modeling

tools and techniques to understand the customer’s total experience—problems, values, aspirations, social networks—then seek ways to optimize that experience. “Design thinking imbues innovation activities with a human-centered ethos,” said Tim Brown, CEO and president of IDEO, a consulting firm that focuses on design and innovation. “[It is] powered by direct observation, of what people want and need in their lives.”

One of the foremost exemplars of design thinking has been Nike, the perennially growth-oriented \$24 billion maker of sporting apparel and equipment that tops the *Fast Company* 2013 list of the 50 most-innovative

“Social blocking” occurs when the very act of one person speaking has a dampening effect on the thought processes of others.

companies. For years, Nike has sought to capture or even predict the zeitgeist of the marketplace by doing what it calls “deep dives” into the aesthetics of disparate subcultures, from cars to hip-hop to origami, seeking inspiration for new Nike markets and products. The company’s well-known “Innovation Kitchen” is essentially a cross-functional SWAT team of programmers, engineers and designers—professional innovators whose job is to continually ask “What if?” and draw consumers and athletes into an iterative process of making it happen.

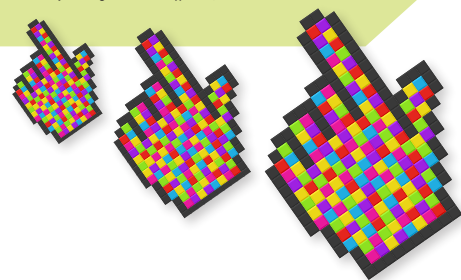
Some, however, view the process orientation of design thinking in busi-

SAY WHAT?

Digiphrenia (n.)

How technology lets users be in more than one place—and sometimes more than one version of themselves—at the same time.

Source: “Present Shock” by Douglas Rushkoff, 2013



ness as a bastardization of creativity. Bruce Nussbaum, a former assistant managing editor for *Business Week* who was once one of design thinking’s biggest advocates, now believes it has been turned into “a linear, gated, by-the-book methodology that delivers, at best, incremental change and innovation.”

Others argue that is precisely the point. “Any manager will tell you that design thinking in business is not about creativity,” said Jeanne Liedtka, author of “Designing for Growth” and a professor at the University of Virginia’s Darden School of Business. “Businesses [need] to produce a stable and predictable stream of products, services and profits. Creativity is only a way station on the route to what really matters: creating new value for real human beings. If we have to bring simplicity and linearity to the design process in order to make [businesses] comfortable enough to try something new, then so be it.”

Roy Luebke, head of innovation and strategic growth consulting at Genedge Alliance, thinks there’s still work to be done on that score. “The driver for growing businesses in the coming years is to deliver not just more new things, but more *relevant* new things to the market. We are a long way from having repeatable, learnable innovation processes [that will do that] embedded within organizations.” R/F



Cisco's
Growth
Strategy?



CHAMBERS:





JOHN T. CHAMBERS joined Cisco in 1991 when the company was a \$70-million maker of routers, simple black boxes that allowed computer networks with differing protocols to communicate. Since 1995, when he assumed the role of chief executive officer, he has helped grow Cisco from \$1.2 billion to record revenues of \$46 billion in fiscal 2012. In 2006, Chambers was named chairman of the board in addition to his CEO role.

Cisco's growth has come from internal innovation and an aggressive acquisition strategy, a combination that has made the company a dominant supplier of the critical hardware underlying the Internet, the World Wide Web and social media. It was briefly the most valuable company in the world, and still commands a market capitalization of \$127.5 billion.

Yet like other technology giants, Cisco must adapt to a new world where software and services are playing an increasingly larger role than conventional computer hardware. Cisco has been a beneficiary of so-called cloud computing, because many of those service providers buy its routers, servers and other equipment. But to sustain growth the company must provide more value-added service of its own.

Toward that end, Chambers has been extolling a vision of the future that the company calls the Internet of Everything, in which sensors and network connections are ubiquitous, and trees send data to climate scientists while cars communicate with traffic signals. As "things" add capabilities like context awareness, increased processing power and energy independence, and as more people and new types of information are connected, he foresees unprecedented opportunities as well as new risks.

As Chambers positions Cisco to seize its share of those opportunities, the company faces competition from decades-old players like I.B.M. and Hewlett-Packard as well as companies like Google and Amazon, which did not exist when he joined. Briefings contributing editor Lawrence M. Fisher spoke with Chambers about how Cisco stays on the cutting edge of the ever-evolving technology industry.

BUILD *AND* BUY



Your chief technology officer, Dave Evans, wrote a fascinating paper called "The Internet of Everything." That's a terrific slogan. What does it actually mean?

CHAMBERS Networking and IT are going to come together. They won't be separate. If you watch every technology company in today's market, all of them have major Internet and networking initiatives. The second key component is that the power of the network is the number of devices connected squared—Metcalf's Law. It's absolutely true: two telephones have a power of four, 10 is 100, and 100,000 is 10 billion.

JOHN
CHAMBERS

Q/A

“The Internet of Everything will probably be the greatest productivity driver of any we’ve seen to date.”



It's off the charts. The Internet of Everything will probably be the greatest productivity driver of any we've seen to date. Our first cut is \$14 trillion of profits to our customers over a 10-year time period. It will connect every organization, every device, and it will change almost every industry.

The opportunity is more than just being connected. How do you combine people with data, with sensors and with processes? It will mean that you and I get the information we need, right when we need it, as opposed to having a whole bunch of data that we don't know how to use dumped on us. So the next phase of the Internet is going to be pervasive, it's going to be very big, and it will be across all the industries.

What can organizations do now so that they are part of making that change happen rather than having it happen to them?

CHAMBERS It varies by industry. Manufacturing, for example, is already well on its way. There's almost 25 percent that totally get it, that see the potential return. But what all organizations can do is take a step back with their people, and whether it's with us talking to them or somebody else in the industry, they should really ask, "How does this apply to my industry and where we're going to go? And what are the business returns, what is possible, and what is not?"

Now what's been interesting is that even 12 to 24 months ago, even among smart people in connected industries, most CEO's did not pay a lot of attention when we talked about this. Almost every CEO I talk to now gets it. Everyone can grasp what this can mean for them.

A lot of these CEO's probably have bitter memories of other big initiatives, like E.R.P. (enterprise resource planning), where they spent a fortune and

often the systems didn't deliver. Do you find that they're a bit gun-shy?

CHAMBERS There were a lot of lessons learned from market transitions, and I think outlining a path to success means looking at what's doable today and how do you get there while maintaining control over your destiny, so it gives this concept a vision, a strategy, priorities and relevant metrics. But CEO's are remarkably good at grasping this. The E.R.P. system, maybe the CFO. kind of got it. You don't have to explain the Internet of Everything to Wal-Mart—what it's going to be like in terms of retail stores of the future and how does it impact inventory, their competitive edge, pricing and everything. So this might surprise you, that this initiative will be CEO-led at many companies, not by the CIO. or CFO., in terms of the real strategic undertaking.

A core part of the Internet of Everything is exponential change. Much of what they teach in business school—and much of management processes—is about linear change. What would management for exponential change look like?

CHAMBERS You know, you've hit the point. We have our top 13,500 people together virtually tomorrow all day, and what it means is innovation and speed that we have not seen before. And to do that successfully, you've got to prioritize very carefully and you've got to educate with world-class capabilities. That's the nice way of saying that if you use the technology the way you approached it before, you will probably be disappointed in your result. The speed of change, regardless of industry, the opportunity to bring innovation to bear, is dramatic, but the attention to discipline and process behind it is equally as important.



How can we ensure that the Internet of Everything preserves privacy and enhances government transparency, rather than allowing government to intrude in citizens' lives?

CHAMBERS Very good question. We use the word a little bit differently. We talk about trust, not as much as a privacy issue as a security issue. It needs to be an opt-in as opposed to an opt-out mentality. That will be a fundamental part of the companies who implement this capability. We've had this discussion very actively with the steering committee of the Internet of Everything.

It's got to be around trust and protecting privacy and security. It means moving to an opt-in for sharing data rather than an opt-out. So if you don't get a verifiable consent authorizing you to do it, and usually people will consent in return for free bandwidth or whatever, you don't do it. The customer gets to decide if your offering is worth it.

You've said that education and the Internet are the two great equalizers. Tell us what you mean by that, and how education and the Internet can create greater equality in the world.

CHAMBERS My parents were both doctors, and they taught me from the very beginning that you had to be fortunate enough to be in the right geography, but if you were in the right geography with the right education, there were almost no limits on what you could accomplish. But the key word here was "geography." What the Internet does is level that geography issue, and it's inclusive of everyone, so all of a sudden time and distance is no longer a factor. Education expanded with the power of the network effect of the Internet can change not just a small segment of society; it can increase the opportunities of all society.

When I talk to government leaders around the world—it doesn't matter if I'm here in the U.S., or with Cameron in the U.K., Harper in Canada, Putin

“Access for education is video... For that you need **high bandwidth**, not the slow Internet...”

or Medvedev in Russia, Singh in India, where I was just a short time ago, or the president of Indonesia, who I'll be seeing in a week and a half—they all get it. And so the combination of the two can have huge impacts on countries. And you know what the priorities of government leaders are? First are jobs. And then second is education for jobs. And third is how do you increase the standard of living for the population? How do you educate and innovate in ways that speak to the importance of priorities for a country leader or for a business leader?

.....○ **United States students don't lack for Internet access, yet their performance continues to lag. What kind of reform do you believe is needed in our schools?**

CHAMBERS You're right in terms of Internet access in the least sense of the word. But Internet access for education is video—top-quality video, multiple streaming capabilities. For that you need high bandwidth, not the slow Internet connection you often find in the U.S. And that kind of leads into the second part of the equation. When we seek increased productivity in business, you and I both know from experience, if all we do is automate what was being done before, our productivity is maybe improved by a third or a fourth. But if you automate and change the process, that's where you get dramatic productivity gains.

And so if you watch what is occurring in society, and you watch these massive open online courses [MOOCs], that's just the beginning of what's going to occur. You're going to be able to teach your courses online and live in the classroom, virtually or physically, and be able to collaborate and learn together. So it's almost the reverse of the way that you and I went to school. Secondly, it does require that we teach students more the way that they learn as opposed to ways that we learned or our parents' parents learned. And that's a much more interactive, social networking type of approach.

On another issue, even a casual walk around the campus of any Silicon Valley company makes very visible the contribution that skilled immigrants make to this country, yet many of these people live in a kind of immigration limbo. What policies can we implement beyond the H-1B visa?

CHAMBERS The H-1B is a very important and necessary first step. The second is a green card [proof of permanent resident status]. Once you get an H-1B visa, it's got to be a reasonably fast process to

get your green card approved. Today, it is 10 years, so the people live in limbo the whole time. They can't move. It's hard to get other jobs. It's hard for their spouse to find work. It puts pressure on the kids. So streamlining this to match the speed at which all innovation is now moving is very, very appropriate. So I hope that our country is going to come to that issue in a constructive way this time.

You've said that the U.S. is one of the most difficult countries to do business in, and that countries like Canada are easier. What does the U.S. get wrong? What do these other countries get right that we might emulate?

CHAMBERS Well, first, let's use Canada as an example, but I don't mind you also using the U.K., or Russia or China. What Canada does remarkably well is they understand the importance of businesses and government working together, and that translates into jobs. It translates into innovation. It translates into inclusion. It translates into solving their health care challenges and education challenges. They're willing to take good business risks with businesses to make that happen, and they encourage businesses to grow and expand in their area, and to develop joint win-win scenarios where their country might describe the win-win as job creation, innovation and creating new startups, and health care. And then companies like Cisco might describe it in terms of industry leadership, growth, revenues and profits. But they actually go hand in hand.

And the atmosphere toward that in Canada means they're the easiest place for me in the world to do business. And surprise, surprise, we're growing faster there, even though the weather's a little bit more challenging—faster than the U.S. Same thing in Russia—we found that even with all the restrictions and challenges going on there, they make it much easier to do business. They understood the value in





THE INTERNET OF THINGS

Sometime in the 1990's, when the Web was young, the savants at Xerox PARC connected a drinking fountain to the Internet such that the height of the stream provided a real-time indicator of their parent company's stock performance throughout the day. While this watery exercise might have seemed little more than a stunt by zany nerds with too much time on their hands, it was a harbinger of things to come, indeed of the Internet of Things.

The PARC people didn't use that phrase back then, but their leader at the time, John Seely Brown, often spoke of ubiquitous or pervasive computing. The premise was that as microprocessors found their way into more "things," we would soon live in a world where computation was everywhere. Like a lot of

bright ideas from PARC, this one was slow to gain traction. After all, who needed a microprocessor-controlled, Internet-connected refrigerator to tell them the milk was past its sell date?

But now that microprocessors have proliferated, the Internet of Things has gone from vague hypothesis to strategic imperative. Networking giant Cisco, which prefers the term Internet of Everything, projects that the coming ubiquity of computation and connectivity will generate at least \$613 billion in global corporate profits during calendar year 2013, and that \$14.4 trillion of value (net profit) will be at stake globally over the next decade, driven by connecting the unconnected—people-to-people, machine-to-people and machine-to-machine—via the Internet of Everything.

That would certainly be good news for Cisco, which as a leading purveyor of Internet infrastructure is positioned to reap a substantial portion of those profits, almost regardless of how the scenario shakes out. Of course, that depends on Cisco following a coherent strategy and executing with few fumbles, and many a dominant incumbent has stumbled at such an inflection point.

If Cisco and other tech-savvy prognosticators are correct, we are about to enter, or have already entered, an era of exponential growth accompanied by exponential change. New fortunes will be made on the right side of that equation, long-held hegemonies lost on the other. And if the Internet of Things got off to a slow start, it is now moving very fast. →



business and government coming together to create jobs in new industries, because their young people are leaving the country. And when your educated young people leave the country, the country has a tough future. They're addressing the issue for their country long-term, in terms of job creation, to keep the young people at home in a very positive way.

monumental challenge. I think it's a million-plus men and women in the service coming back to our country, and to do this at that scale, public-private partnerships are the only way. And I want to really applaud the first lady on her leadership. But you see Wal-Mart jumping into this in a very positive way, hiring 100,000 veterans. You see JPMorgan Chase and us and others jumping into it.

What Canada does remarkably well is they understand the **importance of businesses and government working together,** and that translates into jobs.

Are there steps that the United States could take to make that relationship more mutually beneficial?

CHAMBERS Absolutely. Absolutely. There are many steps. Let me mention one that we're doing together with the first lady [Michelle Obama] for veterans. This is for multiple companies to be very aggressive in terms of how we both retrain and realign the veterans who have protected our country at so much sacrifice for them and their family. They have to get a job when they come back here, and so we are rethinking how you do education for them. We want to do a program perhaps in a month or two at the end of their service that would normally be done in 12 months or 24 months of school, to create capabilities where the jobs are. We want to help them with the transition and translation between a resume in the services and a resume in the private sector, which is like French and German.

The result is 50 percent of the people who have gone through this have achieved a job offer in their first job fair—so you see the ability to truly partner between business and government, and to partner to solve a

That's what public-private partnerships are about—and they have been intermittently powerful. But our country has not done that well on scale. They do it transactionally, and there's almost not a level of trust between the groups.

You've been a very visible player in Republican politics, particularly the last two presidential campaigns. Do you have political ambitions of your own?

CHAMBERS I don't mind you asking, and several of my friends over the years have pushed me very hard to do this. I just don't enjoy politics. Politics—the definition is what I don't want at the company. I want to just do big stuff and do what's right for our customers, our employees, our shareholders and our partners. The second is even though I'm a strong Republican, I actually support a lot of Democrats, including Nancy Pelosi and Barbara Boxer. They are people that I'm very proud to support. And at the same time, I've been very strong behind John McCain and Mitt Romney.

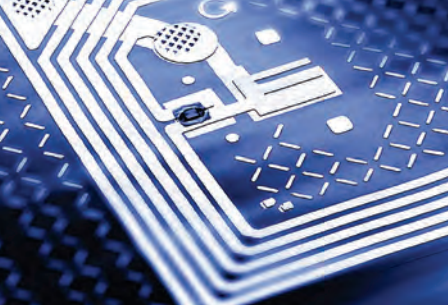
So I think these issues we've been talking about today don't relate to politics. I think the Democrats get it just as well as the Republicans. In terms of

FIRST THERE WAS RFID

The phrase Internet of Things dates to June 1999, when a British technologist named Kevin Ashton gave a presentation with that title at Procter & Gamble. Ashton jointly founded the Auto-ID Center at the Massachusetts Institute of Technology (M.I.T.). The center devised a system of global standards for radio-frequency identification (RFID) and other sensors. Linking the new idea of RFID in P&G's supply chain to the then-red-hot topic of the Internet certainly caught the assembled executives' attention, but Ashton believed that much more was at stake.

"The fact that I was probably the first person to say 'Internet of Things' doesn't give me any right to control how others use the phrase," Ashton wrote in a 2009 article for RFID Journal. "But what I meant, and still mean, is this: Today computers—and, therefore, the Internet—are almost wholly dependent on human beings for information. Nearly all of the roughly 50 petabytes (a petabyte is 1,024 terabytes) of data available on the Internet were first captured and created by human beings—by typing, pressing a record button, taking a digital picture or scanning a bar code. Conventional diagrams of the Internet include servers and routers and so on, but they leave out the most numerous and important routers of all: people. The problem is, people have limited time, attention and accuracy."

Ashton argued that our economy, indeed our survival



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as a society, depended less on the ideas generated by people and distributed on the Internet than it did on physical things. But today's information technology, dependent as it is on data originated by people, knows much more about ideas than it does about things, which until recently had no way to communicate. He called for a new computing vision that went far beyond conventional uses of RFID, as a sort of bar code on steroids, to incorporate computation and communication in seemingly mundane things.

Ashton's initial presentation spawned dozens if not hundreds of papers on the Internet of Things, some laudatory and utopian, some projecting a deeply disturbing future in which technology imperceptibly influences moral decision-making and reduces human agency.

WHEN THINGS GAIN SMARTNESS

But many of the new nodes on the Internet of Things are benign, even friendly. Consider Nest, a smart thermostat. Nest, the company, was founded and is headed by Tony Fadell, who led the team at Apple that created the first 18 generations of the iPod and the first three generations of the iPhone. As iconic as those devices are to the Internet

as we know it, so is the Nest for the Internet of Things. A Nest costs \$250, but unlike those \$20 thermostats sold at Home Depot, it programs itself in about a week, by observing and interpreting how you use your heating and cooling systems. It creates a personalized schedule based on the temperature changes you've made and continually adapts to your needs, automatically balancing comfort and energy savings. When you leave the house, Nest senses you are gone and automatically adjusts the temperature to avoid heating or cooling an empty home. And it connects via Wi-Fi to the Internet so you can make remote adjustments with your smartphone or laptop.

That sounds like a neat toy for tech geeks, but Nest's Web site is full of testimonials from consumers who have saved enough energy to recoup the device's cost in a few months. Independent tests by organizations like CNET have confirmed the savings, and as with all devices based on microprocessor technology, the Nest will inevitably drop in price, gain in capability or both as time goes on. Fadell said his aim was to produce a game changer for the many, not a clever device for the few.

"First, we wanted to make a great thermostat that people actually cared about, that helped them use less energy," Fadell said upon winning the World Economic Forum's Tech Pioneer award for 2014. "Then we wanted it to change the world. That's always been the plan. Nest was created to disrupt an

industry, to revolutionize the way people used energy, to start something big."

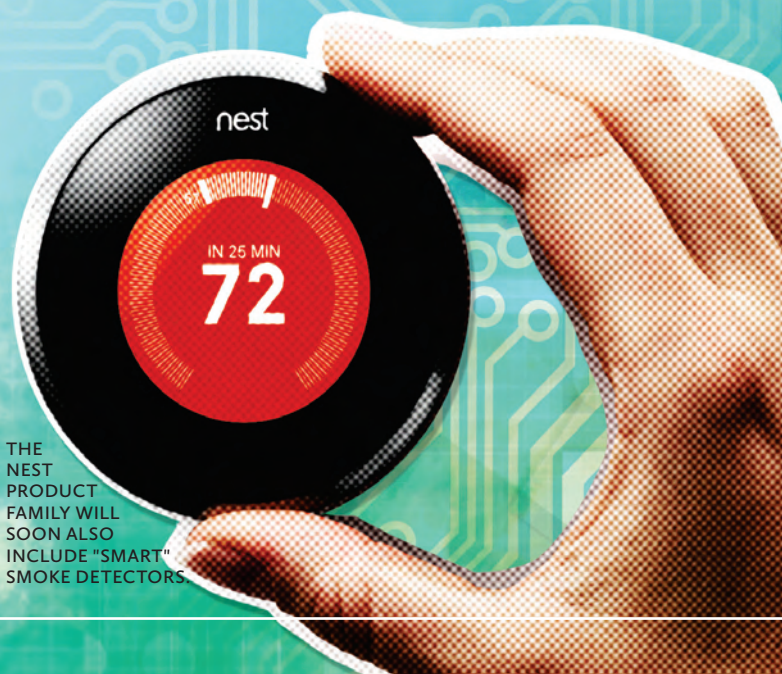
Some of the things connecting to the Internet are even more personal than your home's HVAC system. Devices from Fitbit, Nike+ and Garmin allow users to monitor their activity levels, calorie consumption and sleep habits, and to store and share that data over the Internet. Wonder how your speed over a favorite jogging or cycling route compares with other fitness addicts? It's a mouse-click away. Does drinking less wine with dinner improve your sleep? Ditto. And the purveyors of these digital nags are openly seeking to influence users' behavior. As Fitbit puts it: "The Fitbit family motivates you to stay active, live better and reach your goals."

Still more personal and potentially life-altering are Internet of Things innovations in health care. In August 2012, Proteus Digital Health received U.S. Food and Drug Administration approval for the company's "ingestible

sensor." The one-square-millimeter device—the size of a grain of sand—is imbedded in a pill. Ingest it at the same time that you take your medication and it will go to work inside you, recording the time you took your dose. It transmits that information through your skin to a stick-on patch, which in turn sends the data to a mobile phone or other devices and on to your doctor or nurse.

The idea is to improve patient compliance—drugs don't work if you don't take them—but more advanced sensors could one day monitor how drugs are metabolized and enter the bloodstream, providing valuable data on safety and efficacy. While the current Proteus chip is embedded in a placebo pill taken along with an active medication, the company hopes to get its technology placed inside commonly used drugs. Proteus has partnered with major drug companies, including Novartis and Otsuka, to further develop what it calls digital medicines.

Swallow a sensor along with your medication and you can monitor compliance;



THE NEST PRODUCT FAMILY WILL SOON ALSO INCLUDE "SMART" SMOKE DETECTORS.

my own view, if I were going to go into politics, I would have had to do it about 12 years ago. I probably would have started at the state level, and seen if I could make a serious run at the governor, and then see where it went from there. But I would have had to do it over a decade ago.

You're going to be 64 this year. What kind of succession planning do you have in place?

CHAMBERS We outlined last summer a crisp process in terms of what we were going to do, how we will review it with the board, where we will go. And we outlined it in detail, because for the first time I said two to four years as opposed to three to five. We also said at that time this would be the last update until we do an update when we're probably six months out from making the change.

You have had about a 20-year run, building one of the most successful companies on the planet. What would you like to have people say about John Chambers?

CHAMBERS The legacy to me is not that important. All I want is for Cisco to be even more successful as the company grows up than it was under my leadership, and that's really the most important factor, period. I've been very fortunate and privileged to be in the right spot at the right time and to be part of this. And so this is a family that I believe in. We have very, very wide and deep leadership. All I want is for Cisco to be even more successful with the next group of leaders than they were with the first group.

Cisco has a reputation as an incubator of leadership, and Cisco's been around long enough now that we've seen many Cisco people go off and run their own companies. What would you say are the characteristics of a great Cisco leader?

CHAMBERS So you just hit the real heart of the question. I've maybe lost five senior leaders the entire time I've been here over 20 years. And it was time for them to go, either because they weren't going to go further in the company, or it wasn't quite the right mix for us. We hold our talent unbelievably well. And many of the names that have been mentioned in the industry, with almost no exception, would not even be considered for the top leadership positions here.

But back to the very specific question at hand and a more positive approach. The characteristics that are really important to us are that we are results-oriented. That's part of our working culture. We are a company that prides ourselves in building and developing great leaders and then repaying them. We always have our cultural badge right next to our company ID badge, and at the top it says we're a company that wants to change the world. Halfway down it talks about win together, innovation, respect and care for each other, and always do the right thing. To this day, I still follow every serious illness of every employee, their spouse and their children, and we're there for them in a way that no one else is. And I call almost half of them myself, which takes a lot of time and commitment and is also very emotionally draining, but it is who we are. And we're not perfect, and we know that.

So it really comes back to great leaders here get results. They're hardworking. They are very good at building, developing and keeping talent. They drive our culture. They understand our industry. They are open to collaboration with other groups. And they work together as a team in ways that I think others do not. And they have no fear. This is a company that has a healthy paranoia about whether we're wrong about something, but we have no fear about taking on almost unsolvable challenges and finding a way to do them. **K/F**

attach a sensor to a tree or plant and you can monitor wind velocity, fire danger or even carbon uptake. Treesensor.com uses sensors to help ensure that trees remain securely rooted and healthy even when buffeted by winds. M.I.T. researchers are developing a power-scavenging system for small wireless sensors that detect forest fires. Each sensor's battery is trickle-charged with the electricity generated by the imbalance in pH between the tree and the soil. The Internet of Things is also helping biologists in Australia determine which types of grain grow best in a wide variety of conditions. From more than a million plots all over the country, a wireless sensor network sends data to the High Resolution Plant

FITBIT'S RANGE OF WEARABLE TRACKING DEVICES ALLOW USERS TO CHART EVERYTHING FROM PHYSICAL ACTIVITY TO DEEP SLEEP.



Phenomics Centre in Canberra, which runs the experiments.

Automobiles have long depended on sensor and microprocessor technology to reduce emissions and enable systems like anti-lock brakes. New cars increasingly feature Internet connectivity, which allows more microprocessors to find the best route in current traffic conditions, locate a free parking space and even drive the car itself. While Google's

THE INTERNET OF THINGS



SENSORS COULD ONE DAY MONITOR HOW DRUGS ARE METABOLIZED... PROVIDING VALUABLE DATA ON EFFICACY.

autonomous automobiles still seem a Silicon Valley novelty, in September Mercedes-Benz unveiled a specially equipped version of its S-Class sedan that it said could enter production as soon as regulatory changes permit. “Autonomous driving is here today; we just can’t quite give it to you yet,” Dieter Zetsche, Mercedes-Benz’s chief executive, said at the Frankfurt Auto Show. He said the company’s goal is “fully automated driving for all.”

LET A TRILLION NODES BLOOM

Adding microprocessors to things allows them to do all sorts of cool stuff, but that alone would not explain the inexorable growth of pervasive computing. There is a stronger imperative, as Peter Lucas, Joe Ballay and Mickey McManus explain in their 2012 book, “Trillions: Thriving in the Emerging Information Ecology”: it saves money. They note that as early as 2002, the world was producing more transistors than grains of rice, and cheaper. And they estimate that semiconductor manufacturers now produce 10 billion microprocessors a year, more than the total number of people alive. Only a tiny percentage go into computers, tablets or smartphones; the rest go everywhere else.

Consider washing machines. Most washers that are at least 10 years old have the familiar knob and pointer that you pull and turn to set the cycle, controls that are intuitive and easy to use. But

“behind them is a complex series of cams, clockwork and switch contacts whose purpose is to turn on and off all the different valves, lights, buzzers and motors throughout the machine,” Lucas, Ballay and McManus write. “It even has a motor of its own, needed to keep things moving forward. That knob is the most complex single part in the appliance.” Newer washers have touch buttons and a digital readout, which are typically harder to use. But behind them is a microprocessor and software, which is much cheaper to produce. Money-saving is a powerful engine for change.

“We have pursued this notion of the trillion-node network, where literally every device has some capability of computation; that’s going to happen one way or another, because it’s just cheaper that way,” says Lucas, who co-founded MAYA Design Inc. in 1989 to “remove disciplinary boundaries that cause technology to be poorly suited to the needs of humanity,” according to his biography. “Trillions of computers is a done deal. We can do it well or we can do it poorly, but it’s going to happen.”

WHAT COMES NEXT: FROM THINGS TO EVERYTHING

In late 2012, Dave Evans, Cisco’s chief futurist and chief technology officer, wrote a paper titled “The Internet of Everything: How More Relevant and Valuable Connections Will Change the World.” Evans’ thesis is that computation and connectivity are about to become even more ubiquitous, turning information into actions that create new capabilities, richer experiences and unprecedented economic opportunity for businesses, individuals and countries.

“In terms of phases or eras, Cisco believes that many organizations are currently experiencing the Internet of Things, the networked connection of physical objects and one of the many technology transitions creating greater value for organizations that embrace the Internet of Everything,” Evans wrote. “As things add capabilities like context awareness, increased processing power

and energy independence, and as more people and new types of information are connected, the Internet of Things becomes an Internet of Everything—a network of networks where billions or even trillions of connections create unprecedented opportunities as well as new risks.”

Evans foresees a world in which people become nodes on the Internet, data becomes information and things become aware, helping people and machines make better decisions. He sees the Internet of Everything already transforming cities, as with the smart-screen technology that provides real-time information about public transit and other services. In the future, he sees the proliferation of sensors and microprocessors helping to solve intractable problems, like climate change, world hunger and the scarcity of drinkable water. But he adds that these advances may not come easily.

“Of course, IoE will face many hurdles as it comes to fruition over the next 10 years,” Evans writes. “Some of these challenges will be familiar, including security, privacy and reliability, while other problems will require us to have open social and political discussions. To overcome these challenges, government organizations, standards bodies, businesses and even citizens will need to come together with a spirit of cooperation. When the history of the Internet of Everything is written, its success or failure will be determined by answering one question: How did the Internet of Everything benefit humanity? In the end, nothing else matters.” K/F



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New Engines of Growth By Christopher R. O'Dea

SCIENCE MATH BIOLOGY

you could take a simple test to find out what might ail you, would you take it?

Anne Wojcicki is betting that you will.

The Yale-educated biologist is co-founder and CEO of 23andMe, a genetic analysis company that can tell you whether you're at risk of passing on some 50 inherited conditions, contracting 120 serious diseases or having an adverse reaction to more than 20 drugs.

Sign up online for just \$99, and 23andMe will send you a test kit. Spit in the test tube, mail it back, and in six to eight weeks, you'll receive a report on your genetic makeup. Your personal genotype will summarize the probability you might someday contract any of those ailments, as well as outline your ties to certain genetic families, such as Neanderthals, who went extinct about 34,000 years ago.



ALONG WITH YOUR

you'll get a ticket on the Brin family's voyage into the future of human biology—because 23andMe is no ordinary biotech start-up. Co-founder Wojcicki is married to Google co-founder Sergey Brin, and Brin and Google Ventures hold sizable stakes in 23andMe. Wojcicki's company says its mission is Googlesque: "to be the world's trusted source of personal genetic information." But earning that trust will be a tall order, and dominating the industry will be challenging, even for a venture backed by Google's financial resources and computer know-how.

A high-profile company in the direct-to-consumer personal genomics industry, 23andMe is an amalgam of science and personal health services that wraps basic DNA informa-


tion in a Silicon Valley model of online community sharing and crowdsourced research. It presents personal genomics as a way to predict health problems while also sharing neat stuff about your ancestors and, by the way, contributing your genetic information to the greater cause of disease research. While that sounds simple, the business of providing genetic information to retail customers raises nettlesome privacy, regulatory and policy issues. The issues—some mind-bendingly technical, some intuitively troubling—are being hashed out in medical schools, law schools, Food and Drug Administration hearings and the genomics industry itself.

Wojcicki is betting that, eventually, millions of customers will take 23andMe's test, creating a database that the company's legion of scientists can analyze with statistical software to find gene irregularities that point to potentially serious conditions. It's a burgeoning field called bioinformatics; 23andMe itself has identified previously unknown links, called "associations," between damaged genes and serious conditions.

Sergey Brin took the test and found he's predisposed to Parkinson's disease. But don't mistake 23andMe for a billionaire's vanity play. The driving force of progress in genomics is Big Data—the computational biology and bioinformatics tools that researchers use to create and analyze databases of genetic information that are growing exponentially. While privacy concerns about gene databases remain in flux, researchers



COURTESY 23ANDME

A black and white portrait of Anne Wojcicki, smiling, with her arms crossed. She is wearing a dark, sleeveless top and a necklace. The background is a blurred image of a bookshelf filled with books.

ANNE WOJCICKI
is a biotech
analyst, biologist,
and co-founder of
23andMe.

GENOTYPE,

have used large-scale genetic studies to revolutionize understanding of some of the deadliest cancers, and personal genomics is being integrated into medical practice by blue-chip providers, including the Scripps Institute and the Cleveland Clinic. And with China moving into the U.S. genomics market, no company is better suited for a Big Data battle than Google.

The direct-to-consumer (DTC) genomics industry, which arose as genetic research technology made consumer testing feasible, has been volatile since its inception about 10 years ago. Regulators have questioned genomic companies' claims that consumers can use the test results to make health and medical decisions. Privacy and ethical concerns abound. The past year saw major upheaval, as pharma companies paid top dollar to buy DTC players, hoping to use the technology to leapfrog competitors in disease research and drug discovery. Reflecting the high stakes, investors

have challenged one recent deal, claiming insiders enriched themselves at the expense of public shareholders. Another DTC competitor recently opted out of the consumer market and now requires patients to buy its tests through a doctor.

What's more, the cost of full DNA sequencing is falling fast, and some hospitals use Chinese systems to provide full genome scans. Wide availability of full genomes could render obsolete the basic genotyping—which only shows general tendencies—that 23andMe provides. Driving the cost reduction is BGI Shenzhen, a sort of Foxconn of bioscience, with large facilities and low wages. BGI owns more than 150 gene sequencers and could be producing 10 to 20 percent of all genetic data globally. Last year BGI bought Complete Genomics, a U.S. company that was struggling financially despite having invented a complex sequencing method. The declining cost of genomics technology has

attracted a new DTC competitor, which avoids regulatory scrutiny by offering “information only” reports to genomic do-it-yourselfers.

It doesn't sound like an industry anyone would want to dominate, especially entrepreneurs as relentlessly successful as Google's founding family. But as the dust settles after Round 1 in the DTC genomics arena, Anne Wojcicki and Sergey Brin are the last pair standing. And this summer, Wojcicki doubled down on her DTC bet, launching a national television advertising campaign to raise awareness of personal genetic testing.

“23andMe assembled 3,426 cases and 29,624 controls to track down two new genes that contribute to Parkinson's disease... That's hardly frivolous. It's crowdsourcing science.”

—Ricki Lewis, Ph.D.

Family Ties

PERHAPS it's fitting that the Brin family is leading the consumer genomics expedition, because in no other sector of American life is Big Data having such a widespread, yet often unnoticed, impact. Computational biologists are the Jedi Knights of genomics: scientists and medical researchers who generate petabytes of experimental data at an astonishing rate with low-cost, high-throughput instruments; concoct algorithms that tease insights out of titanic data sets; and invent computing infrastructures capable of routing data and calculations to geographically dispersed supercomputers and research teams.

23andMe, seeking to build a database of genetic samples by providing basic tests directly to consumers, sits at the center of a paradigm that it's helping to create, combining data creation and analysis with a Web-based approach to disease research. Five years since the birth of the consumer genetics industry, 23andMe is the sole pure-play company in the sector. The company entered 2013 with new capital from a \$50 million financing in late 2012, which funded a major Web site revamp and an aggressive communications plan to close the nation's newfound “genetic literacy gap.” And while competitors have receded in the face of regulatory scrutiny, 23andMe has not only persevered, it's the only



DTC genetics company to request FDA approval for some of its health-related tests. One more thing: It was awarded a patent for a method of identifying exposure to Parkinson's disease based on variations at two genetic sites that previously hadn't been known to have a role in the condition. The patent research also validated 23andMe's research approach by confirming known associations, and demonstrated how Web contact could accelerate research by allowing people far from medical centers to participate.

“23andMe assembled 3,426 cases and 29,624 controls to track down two new genes that contribute to Parkinson's disease, much faster than would have been possible in academic medicine,” says Ricki Lewis, Ph.D., a geneticist and a genetic ethics professor who writes the DNA Science Blog for PLOS, an open-access publisher of scientific and medical research. “That's hardly frivolous. It's crowdsourcing science.” Most importantly, she says, “it works.”

The software and IT techniques for creating and managing enormous life science databases are the basis for a booming new field, bioinformatics. In the past few years, the genomic Jedi have focused on developing industry standards to make it easier for research scientists to study genetic information. One such initiative is the Genome Analysis Tool Kit (GATK), developed by a team from the Broad Institute of M.I.T. and Harvard and Massachusetts General Hospital. The GATK uses a programming technique called MapReduce, which separates analytic calculations from the computer infrastructure management tasks that bring data back and forth from storage centers. Key researchers quickly adopted the tool kit, and the GATK now runs critical analysis programs for the 1000 Genomes Project and the Cancer Genome Atlas.

Perhaps not surprisingly, MapReduce was invented at Google, which holds a patent for the technique. Google executive chairman Eric Schmidt says the opportunity to transform and accelerate cancer research fits Google's mission of making the world a better place. He oversees Google's

effort to provide computational infrastructure to the Broad Institute team, whom he calls the smartest people he's ever known, working with databases so large that even he was surprised at the magnitude of the computing challenges.

The Big Data payoff has been powerful. Last April, researchers involved with one of the largest studies of DNA mutations in common cancers announced findings that fundamentally changed doctors' understanding of the disease. Researchers discovered that the genetic structure of the most dangerous cancer of the uterine lining closely resembles that of the worst ovarian and breast cancers—indicating that cancer will increasingly be seen as a disease defined primarily by its genetic profile rather than by the organ or tissue where it originates. The findings resulted from genetic analysis of hundreds of tumors as part of a National Institutes of Health project that had more than 100 researchers study DNA anomalies in common cancers. Doctors are revising testing and treatment protocols based on the study.

But there's a catch. The ability to extract insight from genetic databases also makes it possible to pick out an individual from the metaphorical genetic haystack—in effect removing the privacy and anonymity that have been central to medical research, and shaking the trust that research institutions, patients and study participants rely on. It's the ultimate disruptive technology.

The Big Data Paradox

THE DECISION by most companies to stop marketing directly to consumers, or provide consumers only raw data, highlights the privacy and ethical issues that the DTC genomic movement has surfaced. The use of genetic samples in research has generated considerable controversy, according to Megan Allyse, a

The ability to extract insight from genetic databases also makes it possible to pick out an individual from the metaphorical genetic haystack—in effect removing the privacy and anonymity...

professor at the Stanford Center for Biomedical Ethics. “Although the format may have changed with 23andMe's foray into genetic research, the issues have not,” she says. The key question is whether 23andMe is adequately disclosing what consumers are signing up for when they use a 23andMe test. The company is open about the existence of its research unit, she says, but questions remain about whether consumers have a proper opportunity to give informed consent to have their genetic information used in 23andMe research aimed at developing commercial products or services.

“Companies like 23andMe are engaging in a trade,” says Allyse. “Information about your genetic makeup in return for the use of your genetic material for research, publication and patenting.” This is similar to the trade that academic researchers sometimes offer, “except that in the case of 23andMe the research participant pays for the privilege.” That's a marked departure from the voluntary research participation that serves as the “cornerstone” of modern bioethics, says Allyse, and “commercial genetics companies will need to devote more attention to ensuring that their



customers are fully aware if the company intends to retain and to conduct research on the data from customer samples and claim intellectual property of the results.”

Genomics law recognizes that consumers have a right to know what researchers and institutions intend to do with their data. But Big Data raises new issues—the computer systems that are helping researchers find new treatments are also making it virtually impossible to guarantee privacy to consumers or patients who contribute their genetic information.

Genomics databases “pose several substantial legal and ethical problems,” according to Henry T. Greely, a Stanford Law School professor and director of the Center for Law and the Biosciences. “Neither the usual methods for protecting subject confidentiality, nor even anonymity, are likely to protect subjects’ identities in richly detailed databases.”

“In these settings,” says Greely, “anonymity is itself ethically suspect.”

In fact, some genomic Jedi warn that patient privacy is a thing of the past. “It is no longer clear that we can promise anonymity to participants,” according to a research team at the University of Washington in Seattle. The team was

drawn from three departments at the school—the Institute of Translational Health Sciences, the Department of Bioethics and Humanities and the Department of Biomedical Informatics and Medical Education. The researchers warned that despite the “best efforts of researchers to meet the demands of anonymization, a number of features of biorepository research have combined to make it increasingly hard to achieve in practice.” These include the primary benefits of Big Data science: the creation of detailed genotypic databases, linkage to detailed clinical data, and the use of bioinformatics tools for analysis.

Results of broad genome studies were available until recently on public Web sites because they were thought to reveal little about individuals participating in a study. But statisticians can infer from genetic data whether a specific individual or a close relative participated in a broad genomic study. In a paper in *Nature Genetics*, 13 researchers from leading U.S. genomics, cancer and biotech institutes published their approach and said, “This method could be used to determine if specific individuals participated in a clinical study.” The co-authors predict researchers’ ability



For those who want to know what the future is going to look like, 23andMe has an answer. Even as concerns mount about the implications of emerging biotechnologies that could lead to the creation of “designer babies,” 23andMe was awarded US

Patent No. 8543339 for a technique—the Family Traits Inheritance Calculator—that could let people select specific cosmetic, disease resistance, or personality traits for their offspring based on the genetic profiles of egg and sperm donors.



to pick out individuals in a genetic crowd is only going to increase: “Our results should be considered as a lower bound for the power to detect membership and phenotype in an aggregate genotype dataset, as more efficient methods may yet exist.” Going forward, the team emphasized the need for researchers to update policies and practices guiding genomic data sharing in order to “merit the ongoing trust of the research subjects who consent to participate in scientific studies.”

In what might be an indication of the future scope of consent disclosure, 23andMe’s privacy policy reflects researchers’ decreasing ability to hide the identity of individual subjects. In defining “Aggregated Genetic and Self-Reported Information,” 23andMe notes that its effort to ensure anonymity means only that an individual’s information will be “combined with data from a number of other users sufficient to minimize the possibility of exposing individual-level information while still providing scientific evidence.”

Regulatory Lines

GENOMIC scientists look for mutations in genes that might cause diseases or inherited conditions. In contrast to the full sequencing used in experiments like the NIH cancer study, which focus in detail on specific genes, consumer genomics services typically rely only on the basic technique of genotyping. Genotyping tells customers how their genetic profile differs from a standard model based on a limited number of comparisons between their DNA sample and well-known genetic markers on a baseline human genome. Full sequencing assesses the 3 billion letters in a person’s DNA, while genotyping only looks at several hundred thousand specific sites. As a result, genotypes “can only be used to infer slight increases in disease incidence, often described as ‘predisposition,’ ‘risk’ or ‘susceptibility’ factors,” according to Population Diagnostics, a New York company that makes a technology platform for discovery and validation of causative genetic biomarkers. On its Web page explaining genomic re-

ports, Illumina Inc., which manufactures gene-sequencing instruments, notes that “medical and research doctors’ ability to analyze and interpret genome information is still quite limited.”

In light of concerns that the limited predictive value of genotyping tests could be construed as medical advice, the U.S. Food and Drug Administration and some state regulators have been reining in what DTC genetics companies claim their tests can do for consumers, sometimes barring sales to consumers. In 2010,

the FDA sent 23andMe, as well as other DTC genomics services, a letter asserting jurisdiction over the 23andMe Personal Genome Service as a device intended for the diagnosis of disease: “23andMe has never submitted information on the analytical or clinical validity of its tests to FDA for clearance or approval. However, your Web site states that the 23andMe Personal Genome Service is intended to tell patients in advance how they will respond to certain medications...” The clincher: “Consumers may make medical decisions in reliance on this information.”

The Genomics Law Report notes that “direct-to-consumer” means a test or service “that an individual can order, receive, review and share with others without being required, at any stage in that process, to engage a healthcare professional as an intermediary.” The 23andMe Web site conveys a sort of personal genetic rights manifesto, endorsing individual control of genetic data and extolling the virtues of gaining insight into one’s DNA makeup in order to make better health care decisions. That said, 23andMe does make clear the limitations of the reports it provides, and provides customers with links to find nearby genetic counselors, a fast-growing health care profession.

While 23andMe’s pending FDA approval may resolve these issues, states are enforcing laws on the books. In Maryland, for example, state law prohibits any entity from offering lab testing except to medical professionals. The state Department of Health’s 2012 Annual Report and Staffing Analysis says, “Direct to consumer testing is dangerous because it occurs without physical examination or medical assistance. It can also lead to inaccurate diagnoses and a higher cost for the consumer for irrelevant testing.” Maryland ratcheted up enforcement in 2012, directing more than 50 Web sites offering DTC testing to add a disclaimer prohibiting ordering by Maryland residents. 23andMe restricts sales to Maryland residents as well as consumers in New York, which requires such tests to be performed by a company with a New York State lab license. The company won’t say whether it’s seeking legislative or regulatory changes in those states.



Climbing The Helix

DESPITE the regulatory focus at the consumer level, there's no doubt that unlocking secrets encoded in the double helix of DNA can lead to medical breakthroughs, and genetics experts are in demand. Merger and acquisition activity in the DTC genomics industry reached warp speed beginning in 2012. Navigenics, founded in 2006, by 2010 had opted out of the consumer market, choosing to sell through doctors. In 2012, Life Technologies acquired Navigenics, only to be acquired itself by Thermo Fisher Scientific for \$13.6 billion in April 2013. A week after the deal was announced, a shareholder challenged the sale, claiming the price was too low.

One-time DTC player Pathway Genomics now requires consumers to order its tests through a doctor; its Web site tells users "we will reveal your genetic factors relevant to many common conditions so that you and your doctor can use this information to make better health choices." deCODE Genetics, a strong competitor in computational genetics, had

"Our goal is to close the genetics literacy gap and help educate people about the basics of genetic inheritance."

—Joanna Mountain, Ph.D., senior director of research at 23andMe

difficulty attracting consumers and wound up in bankruptcy in 2009. deCODE had identified new targets for Alzheimer's disease and built a whole-genome database on 70,000 Icelanders, attractive assets for a big company seeking genomics expertise. Amgen acquired deCODE for \$415 million in cash in 2012; its 2013 strategy highlighted a new "pick the winners" approach to research and development, "which takes advantage of our industry-leading position in human genetics that has resulted from our acquisition of deCODE."

Having competitors taken off the market might look like a boon for 23andMe. But in late 2012, Gene by Gene Ltd. launched a unit called DNA DTC, using technology similar to 23andMe's to offer full genomes without any interpretation or analysis, the first time a company had done so, according to the Genomics Law Report. While providing only raw data appears to avoid the need for regulatory approval, a new entrant signals that Round 2 in the consumer genetic testing battle might be getting under way.

Doctor, Doctor, Give Me The News

WHILE Big Data tools have highlighted—and perhaps amplified—the trust and privacy issues in medical and genetic research, 23andMe projects a groundswell of consumer demand. In a study released on DNA Day, the anniversary of the publication of the paper confirming the structure of DNA, 23andMe said 73 percent of Americans who hadn't had a genetic test would like to do so in the future.

But only 2 percent of Americans have had such tests, and most don't understand the fundamentals of genetics or how DNA operates. 23andMe plans to fix that. "Our goal is to close the genetics literacy gap and help educate people about the basics of genetic inheritance," said Joanna Mountain, Ph.D., senior director of research at 23andMe. The company plans to show consumers "the connections between DNA and health, and the potential benefits of genetic testing." It's a big opportunity—more than 70 percent of those surveyed said they'd like to find out which health conditions they're most at risk of developing, and more than 55 percent said they'd consider making diet, exercise and other lifestyle changes based on the results.

Almost as soon as DTC genetic tests hit the market, concerns arose that consumers might become depressed or panic after learning they were predisposed to serious diseases. "Genome scans give people considerable information about their DNA and risk of disease, yet questions have been raised



if these tests are ready for widespread public use,” says Dr. Eric J. Topol, director of Scripps Translational Science Institute. 23andMe cautions customers that their reports could contain troubling information. But those fears appear to be unfounded. In 2008 Scripps began a 20-year study of up to 10,000 participants, the Scripps Genomic Health Initiative, to assess how people respond to genetic testing. The initial results: Genetic screening didn’t induce anxiety in study participants. In fact, many who showed a high risk for developing a disease expressed strong intent to undergo the corresponding health-screening test. “Early detection is a critical factor in preventing most diseases, yet a lot of us don’t get our health screenings as recommended,” says Topol.


Genetic testing made headlines after film star Angelina Jolie’s decision to undergo a double mastectomy after learning she carried a faulty BRCA1 gene. The BRCA1 gene repairs damaged DNA. A faulty BRCA1 gene can allow defective cells to grow uncontrollably to form a tumor. In its summary of cancer risks, 23andMe calls BRCA1 problems a “rare but serious mutation.” Jolie’s mother died of ovarian cancer at age 56, and Jolie wrote in a *New York Times* op-ed piece that she herself had an 87 percent risk of developing breast cancer and a 50 percent risk of developing ovarian cancer.

23andMe’s genotyping test looks for smaller variations in genes that might someday form the basis of new tests that could indicate a propensity to develop cancer among women who don’t have the major risk factors for breast cancer. For now, the company points out that its tests have limited ability to tell women whether they’re predisposed to breast cancer, and suggests women heed family history. A highlighted text box on the page explaining breast cancer advises that “if you have a strong family history of breast cancer you should consider talking to your doctor, who may suggest getting a clinical genetic test. The effects of rare but serious mutations

“Early detection is a critical factor in preventing most diseases, yet a lot of us don’t get our health screenings as recommended.”

—Eric J. Topol, director of Scripps Translational Science Institute

in genes such as BRCA1 and BRCA2 far outweigh those of the [small variations] reported here.” While not specifically referring to any genomics company, Jolie wrote that many women “do not know that they might be living under the shadow of cancer. It is my hope that they, too, will be able to get genotyped, and that if they have a high risk they, too, will know that they have strong options.”

Jolie’s case highlights the power of genomics to improve health and save lives, and will almost certainly boost interest in clinical and DTC genetic testing. Despite regulatory challenges, fierce industry competition and its reporting of such whimsical factors as the consistency of a consumer’s earwax, industry observers say 23andMe has established DTC genetics as a platform for serious science. Blogging from the DTC panel at the 2012 annual meeting of the American Society of Human Genetics, Ricki Lewis predicted a bright future for the industry. “With consumers on board, scientists seeming to have accepted DTC testing, and doctors having to keep up with their patients who come in with test results, I think DTC genetic testing is here to stay”. And as Big Data expands its impact, Lewis wrote, the practice of genomic medicine is “poised to explode.” 

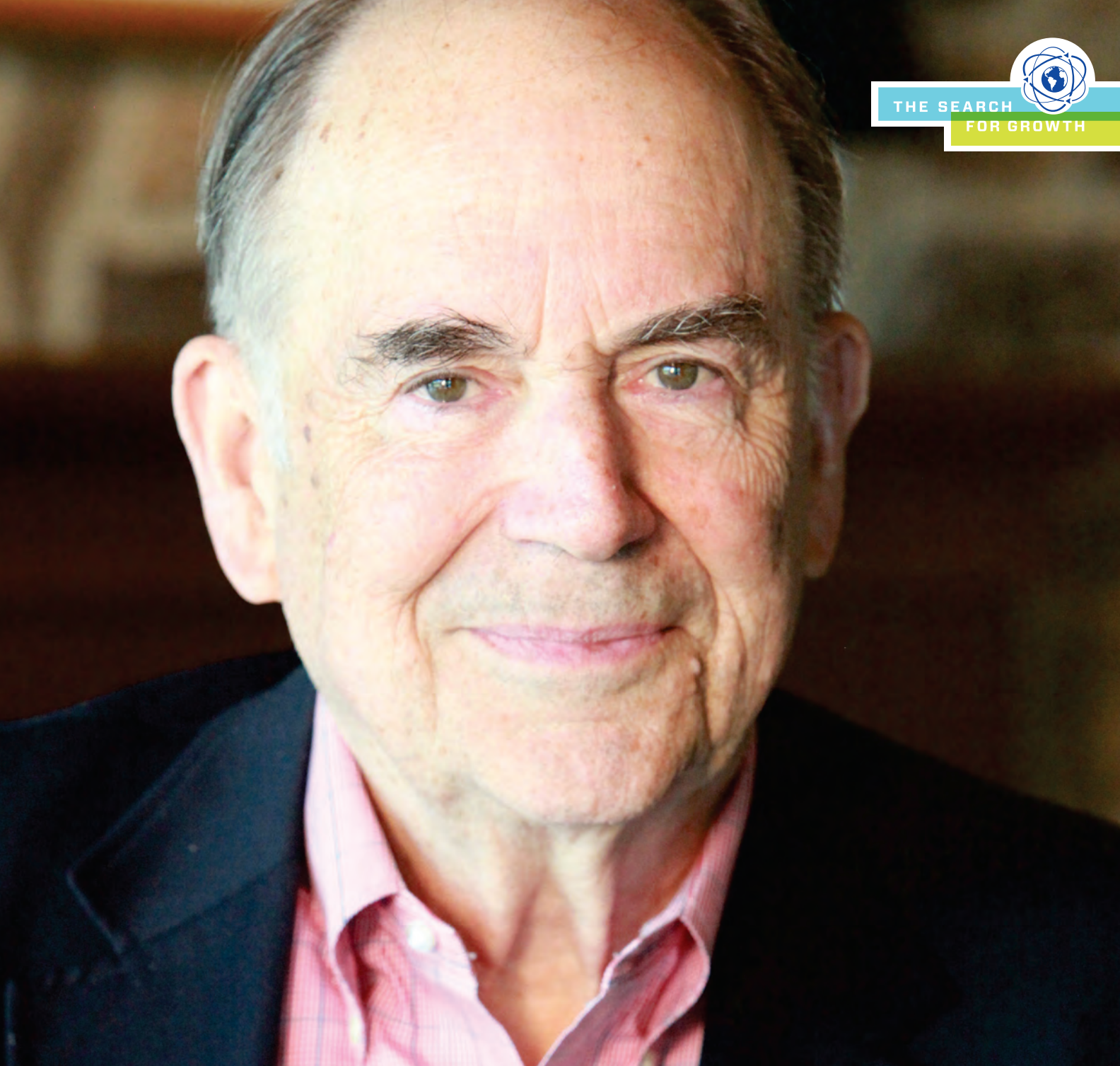


GROWTH THROUGH

COLLABO



THE SEARCH
FOR GROWTH



JOHN ABELE'S VISION

RATION

BY GLENN RIFKIN

JOHN ABELE HAS ALWAYS BEEN FASCINATED BY THE IMPACT OF COLLABORATION.

MUCH OF HIS OBSESSION STEMS FROM A LONG BATTLE WITH A DEBILITATING CHILDHOOD STAPH INFECTION CALLED OSTEOMYELITIS. HE SPENT MOST OF HIS TIME BETWEEN THE AGES OF 5 AND 8 IN A FULL BODY CAST IN THE HOSPITAL, UNDERGOING THREE SURGERIES AND 1,200 INJECTIONS. DOCTORS WEREN'T SURE HE WOULD SURVIVE. SPENDING COUNTLESS HOURS ALONE STARING AT THE CEILING AND INVENTING WAYS TO ENTERTAIN HIMSELF, ABELE, NOW 76, LONGED TO PLAY WITH OTHER CHILDREN. HAVING LOST HIS FATHER DURING WORLD WAR II (SEE "THE SEARCH FOR THE GRUNION," PAGE 44), ABELE, WITH TWO SUPPORTIVE OLDER BROTHERS, LEARNED AT AN EARLY AGE THE NATURE OF SELF-RELIANCE COUPLED WITH THE INFLUENCE OF TRUSTED PEERS.



AS COFOUNDER OF BOSTON SCIENTIFIC, the medical devices giant, Abele helped pioneer and foster the concept of minimally invasive surgery. Along the way, while building his company and becoming a billionaire, he regularly encountered accomplished inventors who relied on the collaboration of a host of often-disparate groups within the medical community. Great ideas didn't become innovations without the foresight and acceptance of key constituents. In the medical world, acceptance of a new paradigm was dependent on unrelated groups of participants, most of whom had no desire or reason to collaborate. A leader who can harness talent and drive collaboration in such an environment is rare.

Having helped generate the growth at Boston Scientific, from its founding into a \$7 billion firm, Abele believes collaboration made all the difference. In the case of Boston Scientific, which was producing innovative technology in a field where many didn't embrace change, gaining collaborative favor among physicians was crucial to the company's expansion. Getting a special group of risk-takers to collaborate led to innovation. The net result was not just growth for Boston Scientific but for the entire industry.

"Growth in a collaborative organization doesn't have to be any different than a non-collaborative organization, except that with a non-collaborative organization there is likely to be more turnover," Abele said. "And turnover costs money, it costs reputation and so on. So finding the right balance is the key."



Abele, who retired from Boston Scientific's board in 2011 to practice "venture philanthropy," majored in physics and philosophy at Amherst College and has been fixated on technology and organizational behavior ever since. This atypical mix of right- and left-brain prowess makes Abele ever curious and insightful about the future of collaboration. "I've always been fascinated with what makes people tick," Abele said.

That fascination figured in his decision to buy the Kingbridge Conference Centre just north of Toronto in 2001.

"I bought Kingbridge because I wanted to explore the idea of an experimental place where people could learn to communicate in a way that harnesses collective intelligence," Abele said. "And the biggest barrier to doing that is frequently pride, ego and sometimes fundamental conflict of interest."

In the medical field, where competition is intense and breakthrough ideas are guarded with ferocity, collaboration is often anathema. Yet Abele's success at Boston Scientific was built upon his ability to bring together extremely competitive intellects and create an environment where participants could meet and be candid about what they were working on, including the new techniques, the risks, the benefits and the strategies they employed.

"It was about really sharing what they were learning rather than lecturing about what they were teaching," Abele said. "That was powerful because it really accelerated the development of these new technologies in health care—such as revolutionary

steerable catheters—and I believed there must be more opportunities to apply this collaboration in a lot of different areas."

To that end, Abele has spent much of his post-Boston Scientific time hosting salons, conducting brainstorming sessions at places like M.I.T., holding weekend retreats at his Vermont estate on Lake Champlain and bringing curious minds to Kingbridge.

The motto at Kingbridge is "Place Matters" and the facility's unusual design, welcoming light, superior acoustics and layout create a relaxing environment. First built as a health and wellness center, and later a leadership-training institute, Kingbridge is a Petri dish for Abele's efforts to understand corporate and individual behavior, shining a light on ways to shift that behavior toward collaborative outcomes.

At a recent gathering of York region representatives at an afternoon planning session, consultants, academics, corporate executives and meeting facilitators sat around a conference table to prepare for a late-September meeting about helping Ontario communities work together to foster innovation. Abele steered the conversation.

Karen Dubeau, vice president of the Newmarket Chamber of Commerce, set the agenda.

"How do you build collaboration ecosystems?" Dubeau asked. "We talk about collaboration, but how do you actually make that work between organizations especially that are not like each other? A hospital, a local utility, towns in the region, the chamber and the library, these are very different organizations culturally in their governance, in their budgeting, in their project priorities. How do you pull that together in a new model, a new leadership framework to advance initiatives that actually benefit all of the parties?"

Abele responded. "My experience with collaboration is that breakthroughs came, not from within the system, but by having non-establishment parties run the show. So they didn't have the bias of whatever establishment they came from. Their focus was to create the environment where all views were presented. They chose a panel of experts who were all contrary to each other. Their job was to critique, but because they were together with experts in other fields, they were not incented to sink the boat. They were incented to demonstrate that they had reasonableness, insight and creativity. And that was a spirit that lasted."

"John seems to appreciate the human alchemy of getting the right mix of questioners and wise men and troublemakers and jokers in a room to answer and frame a question in a non-obvious way," said Kenneth Zolot, who teaches entrepreneurship at M.I.T.'s School of Engineering. "He knows that sometimes you need to look at just one side of a star to see it properly rather than stare right at it."

LIGHT THE WORLD

While Abele was in college, his older brother landed him a summer job at Simonds Saw and Steel, a maker of cutting tools in Fitchburg, Mass., where Abele got his first taste of the way organizations worked. Low on the totem pole, he worked as an assistant to some of the company's engineers.

"Being a college student, I knew this wasn't a life, it was an experiment," Abele said. "I was always interested in quantita-

dynamics. My direct boss figured if he gave me the credit, it would reflect well on him."

Eschewing graduate school—one of only about 10 in his Amherst graduating class to do so—Abele went into sales, selling light bulbs. ("I took the Amherst motto 'Terras Ir-radiant'—Light the World, literally," he said smiling.) Among his customers was a small medical technology firm, Advanced Instruments. The company made analytical equipment used in hospitals, which presented a problem for Abele. After his nightmarish experience as a child, he never wanted to go near a hospital or medical equipment again.



KINGBRIDGE IS A PETRI DISH FOR ABELE'S EFFORTS TO UNDERSTAND CORPORATE AND INDIVIDUAL BEHAVIOR, SHINING A LIGHT ON WAYS TO SHIFT THAT BEHAVIOR TOWARD COLLABORATIVE OUTCOMES.

tive things, including trying to quantitatively explain human behavior. And I was constantly rebuffed."

But at Simonds, he made friends with some of the line workers, and one of them had devised a technique for grinding a saw blade on both sides of the blade at the same time. Though the idea made sense and produced a more efficient and cost-effective way to make the blade, nobody would listen to this man's proposal. Abele offered to write up the idea and give it to his boss on behalf of the worker.

The process worked and saved the company hundreds of thousands of dollars, "and they gave me the credit," Abele said. "I was embarrassed because I was just passing the idea along. But it was a wonderful exercise in organizational

"I had so much ether for the many operations I had that if I heard the sounds I heard when I was going under, I would literally collapse, just fall unconscious," he said.

Nonetheless, in 1960, Abele joined Advanced Instruments, which made an osmometer that measured particle concentration in solutions and a flame photometer that measured ions in a solution. Both instruments were new to the market, and they sparked a fascination with innovative medical devices.

While selling for Advanced Instruments he met Jack Whitehead, who would later found the Whitehead Institute for Biomedical Research in Cambridge, Mass. In the early 1960's, Whitehead was running a small medical firm called Technicon. Abele met Whitehead at a booth at a conference

and learned about Whitehead's skill at selling and his unique ideas about collaboration.

Whitehead, in an attempt to grow his company, bought an innovative device that automated the process of analyzing chemicals for lab tests. Though it was breakthrough technology, the inventor couldn't get any of the big laboratory supply companies to buy it. In those days, physicians seldom ordered lab tests. (Today, laboratory testing is a multibillion-dollar industry.) Whitehead bought the patents and set out to persuade the world to buy this machine.

In his *Harvard Business Review* article "Bringing Minds



Together" (July-August 2011), Abele described Whitehead's sales technique.

Whitehead, he said, told interested buyers "they'd have to spend a week at his factory learning about (the machine)—and that payment was required in advance. The training would cover how the instrument worked, what might go wrong, how to fix it, how to use it for different applications and how to develop new applications. Customers even had to put their own machines together."

This approach was like catnip to the early adopters. At the factory, an air of collaboration emerged, the participants feeling less like customers and more like partners. The group worked hard during the day and partied hard together in the evening. "They got to know one another very well," Abele wrote. "They became a kind of family. When the week ended, those relationships endured, and a vibrant community began to emerge around the innovation."

The impact on Abele was profound.

"Most of my colleagues saw what Jack was doing as creative marketing and aggressive business strategy," Abele said.

"But I saw it differently, and by now I know that something much bigger was actually going on. He was launching a new field that could be created only by collaboration—and collaboration among people who had previously seen no need to work together. Thanks to Jack's efforts, a group of scientist-customers self-organized to do something he never could have done on his own: advance the responsible development of automated chemical analysis."

Abele eventually rose through the ranks to run Advanced Instruments, but it was a family-owned business—the owner had three sons— and Abele realized that he didn't just want to run a company, he wanted to own a piece of the rock. When Abele left Advanced Instruments in 1965, he set out to find a company to buy. During the two years of searching, Abele stayed busy exploring the dynamics of the medical devices industry and the ways in which collaboration and communication across professions and industries would have a profound impact. He went so far as to found the Association for the Advancement of Medical Instrumentation (AAMI), a society "that challenged doctors, engineers and manufacturers to develop standards, improve communication and organize education."

In 1969, when Abele bought a tiny medical device company called Medi-Tech (which eventually became Boston Scientific), he had a new appreciation for collaborative methods and the type of personality required to spawn such teamwork.

Medi-Tech was founded by a Czech inventor named Itzak Bentov, an iconoclast who spoke 11 languages. Bentov's innovative steerable catheter intrigued Abele. He envisioned an array of potential uses for the device and believed he could build a company upon its promise.

In his new situation, Abele constantly reached out to the leading lights in their respective fields, men like Ken Olsen at Digital Equipment Corporation, Alex d'Arbeloff at Teradyne, and prominent physicians like Dwight Harken, father of cardiac surgery, at the Brigham and Women's Hospital in Boston.

"I always wanted to understand where character comes from," Abele said. "How do you get a Yoda?" Abele is fond of identifying types within organizations who fill key roles. There is the court jester, the fool who can speak truth to power without losing his head; the flamethrower, who can make creative trouble within an organization; and the Yoda, a corporate guru who is not in the chain of command but whose wisdom is invaluable.

In the early 1970's, Abele and the medical world met a charismatic Yoda named Andreas Gruentzig, a German physician working in Switzerland. Gruentzig was intrigued by the steerable catheter concept and foresaw a way to use a balloon catheter to clear arterial blockages, specifically in the case of heart disease. Balloon catheters had been used as far back as the 1800's for urological cases, and practitioners had improved the devices over the years. But Gruentzig felt

it was crude and nowhere near as effective as it might be. So he invented his own device with a sausage-shaped inflatable segment that would not get misshapen and fail to open a blockage. A careful and thorough researcher, he experimented first on dogs and human cadavers and eventually on the legs of human patients.

Seeking help in the design, Gruentzig reached out to Med-Tech and struck up a relationship with Abele. In 1975, Abele visited Gruentzig in Zurich and watched, intrigued, as the inventor made his devices by hand at his kitchen table.

But what made Gruentzig so effective was his innate understanding of human nature and the power of collaboration. A confident physician, Gruentzig “was a phenomenal presenter and he knew how to present to a hostile audience,” Abele said.

“He was very understated, which was unusual for someone who is passionate about a cause.” Mostly, Gruentzig, instead of proclaiming that he knew all the answers, presented his findings in a way that attracted other great thinkers and innovators to him.

It helped that early on, a number of the doctors who were interested in the technique were “non-establishment.” The idea of putting a balloon in an artery and expanding it strained credibility. How would it not damage the artery or loosen debris that would move downstream in the circulatory system and cause havoc?

With careful experimentation and help from a chemist who showed him how to develop strong, efficient polymers, Gruentzig found answers before the questions were even asked. Abele became an adviser on strategy for introducing new

THE SEARCH FOR THE GRUNION

While collaboration has been the underpinning of John Abele’s professional career, perhaps the most stirring example of intellectual teamwork for Abele came not in a laboratory or boardroom but in the roiling, frigid waters off Kiska, an island in the Western Aleutian islands 1,500 miles from mainland Alaska. There, in August 2007, Abele stood on the deck of the Aquila, a 165-foot crab boat, which he had hired as the search vessel to fulfill a life-long quest. The excitement at the prospect of discovery warded off the damp and cold. If this effort paid off, aided greatly by collaboration’s essential ally, serendipity, Abele would finally find out what happened to his father, whom he had last seen 65 years earlier.

In May 1942, a 5-year-old John Abele and his two older brothers bid goodbye to their father, Mannert L. Abele, an Annapolis graduate and commander of

the U.S.S. Grunion, a 311-foot submarine that was departing its Groton, Conn., base for a long and dangerous mission in the North Pacific. The mission was secret, so the Abeles had no idea where “Jim” Abele, as he was called, was heading. They would never see him again.

Four months passed and a telegram arrived from the Navy stating that the senior Abele was missing, along with the Grunion’s 69-man crew. The Grunion’s fate remained unknown, a mystery that settled into Abele’s psyche like a wound that would never heal. As decades passed, the Navy’s official designation did not change: “Overdue, presumed lost.”

But Abele and his brothers Brad and Bruce were not the types to give up. As cofounder of Boston Scientific, Abele was a billionaire with the resources to initiate a search. But even his riches wouldn’t have

medical devices. In 1976, Abele invited Gruentzig to present at the annual American Heart Association conference. The meeting was full of leading cardiologists and surgeons. Most ignored the balloon catheter, but a small cadre paid attention. Abele introduced them to Gruentzig, who turned the tables and asked questions of his questioners. “He was setting the stage,” Abele said. “He was an absolute master.”

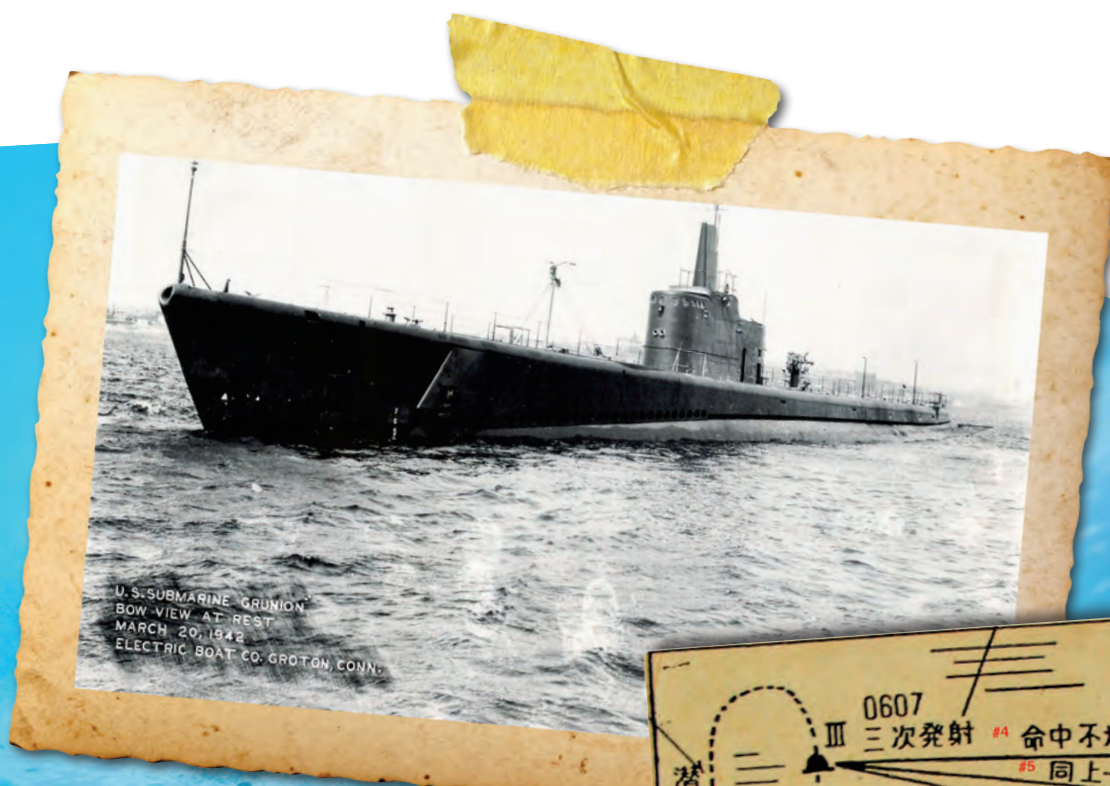
By listening to his audience, as much to get in their good graces as to tap their knowledge, Gruentzig gained credibility. Over time, he hosted surgeons, radiologists, cardiologists and others. “He was an outsider,” Abele said. “And one of my conclusions is that if you really want to change a culture, you can’t change it from the inside. You need somebody who is very talented but also a non-establishment type, someone

who is politically incorrect, to guide and lead. They can then become truly objective in the process.”

Using Gruentzig as his muse, Abele established an inviting culture at Boston Scientific. Slowly but surely, he created a community around the nascent company’s products. The company became known for its collaborative methods and for being trustworthy innovators. “We wanted those physicians to be partners with us, but we also wanted a larger group to make sure that whatever we were going to come up with would work for a variety of different backgrounds and mindsets,” Abele said.

To fuel growth, Abele had to understand the many aspects

CONTINUED ON PAGE 48 →



Above, the U.S.S. Grunion afloat; at right, a torpedo analysis depicting the attack.



Yutaka Iwasaki noticed the diagram and posted a response. The ship, he said, was the Kano Maru, a supply vessel stationed in the Aleutian islands, and according to Iwasaki's research, the Kano Maru's captain wrote an article in 1963 that mentioned the sinking of an American submarine in the Aleutians.

A family acquaintance, also a World War II history buff, tipped off Bruce Abele about the Web site and its intriguing data. The Abeles, believing this was the first tangible link to the Grunion, began an Internet search and found an e-mail address for Iwasaki, contacted him and received a translation of the Kano Maru captain's article.

According to a 2009 article in the Amherst College alumni magazine, the Kano Maru's captain "described a dramatic battle off the island of Kiska, one of two Alaskan islands occupied by the Japanese during the war. At 5:47 a.m. on July 31, 1942, the Kano Maru was torpedoed by the Grunion. The hit disabled the Kano Maru's engine; as the freighter floated in the water, a sitting duck, the Grunion fired four more torpedoes—two that missed and two that hit but failed to detonate. The sub then surfaced, whereupon, as Iwasaki's translation read, 'Kano Maru's forecandle gun fired; fourth shot hit the conning tower of the sub. It is thought the last of Grunion.'"

Believing they had solved the mystery of

been adequate to solve the mystery of the Grunion if not for the advent of the Internet, the power of crowd-sourcing and several serendipitous events.

In 1998, for example, an Air Force officer and World War II history buff named Richard Lane found a wiring diagram for the deck winch of a Japanese freighter in a Denver antique shop. He bought the diagram for a dollar and promptly forgot about it. But a few years later, he found the diagram in a drawer, and this time, he scanned it and posted it on a Web site devoted to World War II naval history. Soon after, a Japanese military historian named



Lieutenant Commander
Mannert L. Abele



the Grunion's fate, the Abeles wanted more. They wanted to locate the Grunion's final resting place. Finding a sunken submarine at the bottom of the ocean, however, was going to be a daunting task. By chance, John Abele met oceanographer Robert Ballard at a conference, and Ballard, the technical genius who discovered the wreck of the Titanic, connected Abele to a company in Seattle that did side-scan sonar with a camera that was towed across the ocean floor. The Abeles hired an Alaska fishing boat, the Aquila, knowing that its captain, Kale Garcia, was familiar with the Western Aleutian waters.

In the meantime, relying on crowd-sourcing, Abele set up a Web site devoted to the project, blogged about the progress and posted a mailing list that grew exponentially as time went on. Iwasaki continued to help the Abeles from Japan

and collected information from families of the crewmen of the Kano Maru.

"This project represents a model for collaboration in today's world," Abele told the Amherst alumni magazine. "Aim a diverse set of minds at solving a problem, and it's amazing what you can do."

In 2006, Iwasaki had a breakthrough in Japan. He found the Kano Maru's logbook, which contained coordinates of its battle with the Grunion. Without that, a search would be like trying to find a sunken needle in a vast nautical haystack. But now the search area was narrowed to about 200 square miles.

In August 2007, Abele boarded the Aquila for what he desperately hoped would be the culmination of his search. It was still a long shot. As the Amherst magazine reported:

At 7 p.m., the Aquila set out to search the deep waters off Kiska. Weather reports indicated a massive low-pressure system headed their way, so speed was essential. Arriving at the target area at 9 p.m., the crew lowered the ROV and turned on the cameras. Almost immediately they saw a strange object. 'It looked like kelp,' Abele says. 'But then we got closer.' It was the bow of a submarine—right away, on their first try. As the ROV moved around the stern, one image eerily duplicated a photo of the Grunion under construction at the Electric Boat shipyard in Connecticut. 'There she is,' John said quietly.



Today, Abele is still amazed at the outcome of the search. Having closure about his father was a priceless gift—well worth the \$1 million he spent on the effort. But it also triggered a clear epiphany about the art and power of collaboration.

"I remember one evening in the bridge of the Aquila," he said. "We were having a few beers with the crew and I blurted out my thanks that they had chosen us as much as we had chosen them. I've always had the view that the culture of an organization is everything. Our group definitely had differences of opinion, but the culture of the mission dominated. I wasn't the leader so much as I was a curator, focused on harnessing the collective intelligence of the group." —G.R.

“I ALWAYS WANTED TO UNDERSTAND WHERE CHARACTER COMES FROM. HOW DO YOU GET A YODA?”

of collaboration. “Growth might be sales,” he said. “Or growth might be due to the impact of a certain activity that doesn’t require enlargement of the organization. You can have different types of collaboration in any environment. You can have adversarial collaboration, or hierarchical collaboration. And then you can have more, an egalitarian collaboration where you bring a group of independent professionals together to work for the purpose of enlarging the pie.”

The company created criteria to screen potential collaborators, no small amount of hubris for a small player in a big field. Physicians were asked to rate themselves on those criteria by answering survey questions: Do you do a lot of research writing? Do you write articles? Do you give talks? How are you viewed by your colleagues? Are you respected? Are you collaborative?

“It was fascinating,” Abele said. “There were so many politically incorrect questions, but we were sending a message saying, ‘There are rules for participating in this, that in order to advance the technology we have to prevent any single individual from running away with it.’”

To his surprise, doctors loved the aggressive tactics. They were trendsetters who wanted to be challenged. “That was the purpose of those questions,” Abele said. “To say, ‘Hey, we can come out of left field here and change the world.’”

Bigger competitors tried to lure the industry’s opinion makers to their doors, but as Abele said, “The opinion makers took us out to dinner.”

Eventually, Gruentzig came to the United States to visit Medi-Tech’s offices in Watertown, Mass., and the two men formed a strong bond. Abele even taught Gruentzig how to windsurf on Cape Cod during his visit. By 1978, the first balloon angioplasties were performed in the U.S. and the momentum for less invasive surgery grew stronger. Though it has struggled in recent years to regain its past glory, Boston Scientific embodied Abele’s notions about collaboration.

INNOVATION WITHOUT BOUNDARIES

The art on the walls at Kingbridge is designed to provoke thoughtful dialogue or quiet contemplation. Escher prints, a favorite of Abele’s, are prevalent. In a quiet library, the world’s largest Klein bottle is housed in a glass case. The Klein bottle is a four-dimensional mathematical construct of a continuous glass surface with only one side. What looks like a bottle folded in on itself represents essentially no inside or outside but rather one boundless structure. For Abele, it represents not only the Kingbridge philosophy but a metaphor for perfect collaboration. Collaboration requires the elimination of boundaries, artificial and real.

“To me, the purpose of achieving a good collaborative environment is to harness collective intelligence,” Abele said, sitting in his spacious Kingbridge office. “We are taught to be cautious and a bit paranoid from a young age. When your teacher in grade school asked if anyone did not understand a concept, if you raised your hand, you were dead in the water. That passes on to adulthood, and the academic system makes it worse. The business world doesn’t do collaboration all that well, but it continues to pursue collaborative success.”

Having retired from active leadership at Boston Scientific, Abele has devoted his time to the endless search for creative collaboration opportunities. He has been an active board member and supporter of the FIRST Robotics competition, an international high school science and engineering contest that emphasizes collaboration. He is at work on a book about his collaboration theories and is a devoted student of behavioral economics. Being a big fan of Malcolm Gladwell (author of “The Tipping Point” and “Outliers”), Abele is a believer in the impact of indirect learning.

“John gets past the myth of collaboration where we are all sitting around a campfire holding hands,” Zolot said. “Collaboration to him is really understanding how to align the interests of various stakeholders, some of whom may be bitter enemies and competitors.”

If his vision emerges, Kingbridge will continue to grow as a destination for like-minded thinkers intent on embracing the promise of collaborative innovation.

“Collaboration is about relationships. It is about trust and always looking for the boundary and recognizing that the boundaries are going to change for a variety of reasons,” Abele said. “They will certainly change technologically and culturally in terms of what is politically acceptable. The key is trying to understand to what extent you can influence those boundaries.” K/F



MAKING SENSE OF

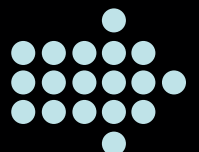
BIG

DATA

NEEDLES OF INSIGHT, HAYSTACKS OF NUMBERS

I am shy and reserved, the analyst tells me. Social events are all right, but I often enjoy a quiet night at home. Not that I am prone to stress. Quite the opposite: “You come across to others as someone who is rarely bothered by things.” More insights are coming: This analyst can tell whether I am gay or straight, whether I smoke, use drugs or drink alcohol, and how happy I am with my life. It can discern my approximate IQ score, my politics, religious views, ethnicity, age, gender and even whether my parents divorced during my childhood. Impressive, considering that the analyst is a computer algorithm working with limited information: All it has to go on is a list of my “likes” on Facebook.

BY DAVID BERREBY

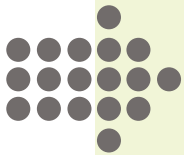




Web site called *youarewhatyoulike.com* generated the personality profile in less than a second, by comparing my Facebook information with a vast trove of data on other users. And in a paper published this year in the *Proceedings of the National Academy of Sciences*, the site’s proprietors—researchers at Cambridge University and Microsoft—demonstrated how Facebook “likes” can predict, with an 80 percent to 95 percent chance of being right, all those other private (and marketable) details. You may feel your life has its distinct and separate parts (Facebook likes, vacation preferences, credit history, kind of childhood you had) but analytic algorithms are getting better at interpreting each data point as part of a whole—and using that single clue to extrapolate the entire person. Indeed, with people leaving so many digital traces—some 2.5 quintillion new bytes of data daily, according to the consultant Marcia Conner—this kind of inference is getting easier and cheaper every day.

“Big Data” is our buzzword for machines combing huge stockpiles of information to find connections that human beings can’t see, but that phrase is something of a misnomer. It isn’t quantity that makes the new tidal wave of data so disruptive—businesses and governments have been dealing with oceans of facts and figures for decades. What matters, rather, is that this data is different. As Conner reports, some 80 percent of the data that consumers now reveal about themselves is unstructured, in those Facebook “likes,” tweets, blogs, YouTube clicks and other forms of self-expression. These can’t be captured by old-school information tools that require structure (like, for instance, the boxes of a census form or the one-through-nine “agree-disagree” scales of a survey).

Today’s data tools don’t need information to be packed into predesigned boxes. Instead, analysts can treat almost any activity, human or machine, as an opportunity to harvest useful information. Meanwhile, data of all kinds has become easier to collect, thanks to improved technology. Sensors can monitor the position, speed and mechanical function of a delivery truck; radio frequency identification tags can log what happens to every item in a supply chain; and the passing thoughts and feelings of consumers, once inaccessible, are being recorded online.



ANALYSTS CAN TREAT ALMOST ANY ACTIVITY, HUMAN OR MACHINE, AS AN OPPORTUNITY TO HARVEST USEFUL INFORMATION.



same techniques. So far, many of these uses are purely for fun—on the site *weddingcrunchers.com*, for example, users can track changes in the language and content of wedding announcements in *The New York Times*, mapping social change over the decades. (In the 1990's, for instance, newlyweds in their 30's began to outnumber newlyweds in their 20's, a trend that has not reversed.) But other applications may affect consumers' relationships to brands and their buying behavior. Consider Buycott, a new app for smartphones that scans a product code and tells its user in an instant about the company that made the item, and its parent company as well. Geared to social-change campaigns, the app relates basic corporate facts to social-responsibility and political reports. With the app, a shopper who scans a box at the supermarket can immediately know if the maker (or its parent company, or parent company's parent company) is one of 36 firms that regularly give money to defeat laws that would require food derived from genetically modified organisms to be identified on labels.

This convergence of three factors—tools that can treat almost any digital signal as useful data, more and more means to gather such information, and ever-cheaper analytics—powers the Big Data revolution, with all its well-publicized successes in cost control, quality assurance and productivity. Davenport and Dyché, for example, cite a health insurance company that now has a better gauge of customer dissatisfaction because it analyzes speech-to-text data from its call center recordings. And United Parcel Service now has sensors on its more than 46,000 vehicles, monitoring and reporting speed, direction, braking and drivetrain performance. Analyses of this information have improved route planning: In 2011, the company saved more than 8.4 million gallons of fuel by shaving 85 million miles off its pickup and delivery routes.

Some companies have avoided the risk of heartbreak by stepping back and leaving the early adoption of Big Data to others. Some retailers, for example, are backing away from



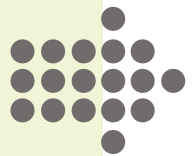
MORE BIG DATA FOR YOUR DOLLAR

The lower cost of a Hadoop cluster, compared to conventional database systems, or \$5,000 for a dedicated database appliance, means a lower barrier to entry and expanded utilization of data.

loyalty card marketing, happily giving up the chance to gather the heaps of data that those cards provide about customer behavior. Last summer, for example, *Supermarket News* noted that AB Acquisitions, the parent company of firms that run Albertsons, Acme, Jewel-Osco and other grocery chains, was abandoning the cards (spinning the move as “discounts for everybody” egalitarianism). “We found that tracking individual shopping habits isn’t as critical to our overall strategy as knowing what our customers in our neighborhoods are shopping for,” an Albertsons spokeswoman told *Supermarket News* editor David Orgel. “Tracking individual purchases can be one way to do it, but it’s not the only way.”

Meanwhile, consumer wariness about giving away data may be causing some to throw away their loyalty cards. A 2012 study by the research firm Colloquy found that less than half of Americans’ loyalty-card memberships were in use, for example, and between 2010 and 2012 the number of American supermarket loyalty accounts declined. Journalist Brian Palmer thinks that’s great. Big Data, he wrote recently, can make retailers unimaginative and lazy. “Would you prefer to shop at a store that increases profits by figuring out what you already do, then tricking you into doing it a little more often?” he asks. “Or a store that thinks creatively, brings you new products and showcases its wares in a novel way?”

It would be bad enough if over-reliance on Big Data caused a business to neglect other crucial skills. But there’s another potential pitfall: Big and diverse data sets can be devilishly hard to analyze



MAKING SENSE OF BIG DATA

It shouldn't be a surprise that these developments have spawned a lot of Big Data hype. Long-term, that hoopla will no doubt turn out to be correct—the automatic acquisition and analysis of data is bound to transform how humans live, work and consume in 2050. But what about 2014? Deciding whether to jump on the Big Data bandwagon in the nearer future requires an ability to separate the sky's-the-limit potential of these technologies from their applications in today's real world. Perhaps someday Big Data tools will become a magical black box that swallows information and emits executable plans that add value. That day, though, has not arrived. As James Kobielus, a "Big Data evangelist" at IBM's Big Data Hub, recently wrote, "This utopian vision can break your heart if you let it stray too far from practical reality."

"WOULD YOU PREFER TO SHOP AT A STORE THAT INCREASES PROFITS BY FIGURING OUT WHAT YOU ALREADY DO, THEN TRICKING YOU INTO DOING IT A LITTLE MORE OFTEN?"

—Brian Palmer

in a way that generates useful insights. Such data tend to present many "false positives" (apparent causal relationships that are really just coincidences) and blind alleys ("obvious" connections that are, in fact, statistical dead ends).

Here's an example: Since the turn of the millennium the median wage for all Americans has risen by 1 percent. At the same time, as the statistician David Smith recently noted, it is also true that the median wage has fallen since 2000 for high school dropouts, high school graduates, high school graduates with some college, college graduates and employees with advanced degrees. This phenomenon, in which aggregate data show one trend but data on every subgroup show the opposite, is known as Simpson's paradox. It usually indicates that an important factor was overlooked when the data were collected. In this case, as Smith pointed out, the explanation is that more students in 2013 are graduating from college than did in 2000, and college grads have suffered less wage attrition than those without a bachelor's degree. Because college grads do better than non-graduates, the higher college graduation rate raises the aggregate wage, even though wages within the college-grad cohort haven't gone up.





BIG DATA... CAN HELP YOU FIND RELATIONSHIPS AMONG VARIABLES THAT YOU CAN SEE. IT IS NO HELP, HOWEVER, AT GETTING YOU TO NOTICE WHAT YOU CAN'T SEE.

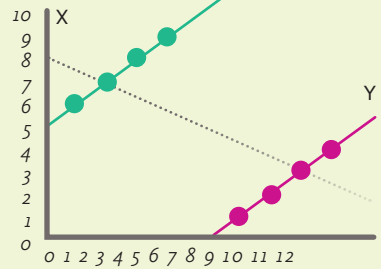
IN THE 1970s,

failure to appreciate Simpson's paradox led to a lawsuit against the University of California at Berkeley for gender discrimination. The statistics showed that 44 percent of men who applied, but only 35 percent of women, had been admitted to graduate school. Yet a look at individual departments found none favoring men. From Astronomy to Zoology, they admitted both sexes at about the same rate (except for a few, which slightly favored women).

The reason for the perceived disparity in the Berkeley admission statistics turned out to be that women applied for programs with tougher standards. There were more female applicants to the English department, where even highly qualified candidates were rejected, and fewer women seeking admission to the graduate chemistry program, where most qualified applicants were admitted. To resolve the problem of contradictory analyses required a step outside the data; it required referring to cultural knowledge about the society and students the data represented. Only then could analysts return to the data with this knowledge, adding it as a previously "hidden variable."

Big Data, therefore, can help you find relationships among variables that you can see. It is no help, however, at getting you to notice what you can't see. Among the "likes" that were most important in creating the *youarewhatyoulike.com* profile of me, for example, were Felix Mendelssohn, Modest Mussorgsky, kayaking and Doctors Without Borders. Why would a fondness for paddling and "Boris Godunov" predict that I am not a Type-A personality? If you don't need to know

THE SIMPSON'S PARADOX AT A GLANCE



Simpson's paradox occurs when an association between two variables is reversed upon observing a third variable.



the answer, you might reply, "Who cares?" But sometimes, to market effectively or find an underlying cause of trouble, you do need to know.

For all its promise, in other words, Big Data isn't yet a magic wand. "There is a disconnect between the ability to collect data and the ability to base decisions on them," Eric Bradlow, a professor of marketing at the Wharton School

and co-director of the Wharton Customer Analytics Initiative, told Fast Company last year. "People need to take a deep breath. They need to be more thoughtful about it."

Historians have cautioned that we should not overestimate technologies in their infancies. If you've taken a survey course or two, you might think that the reason the Inca Empire fell

in 1532 to 168 Spanish adventurers was that the conquistadors had guns and the Inca had arrows and stone throwers. However, as author Charles C. Mann has noted, 16th-century guns were tetchy and hard to aim—after the surprise wore off, the Inca found their weapons were more than adequate against Europeans. (The real "killer app" in the European conquest of the Americas was infectious disease.) It's important to remember that new technologies are not nearly as powerful as their mature descendants. This is why, as the futurist Roy Amara famously observed, "We tend to overestimate the effect of a technology in the short run and underestimate the effect in the long run."

So it is with omnipresent, 24/7 Big Data. Its day, with its immense consequences for how we live, socialize and consume, is coming. But it is not here yet. **K/F**

Growth Path: JDA Acquires

AROUND THE TURN OF THE CENTURY, BIG SOFTWARE COMPANIES GOT BIGGER AND SMALL SOFTWARE COMPANIES GOT NERVOUS. WHEN BEHEMOTHS LIKE ORACLE AND SAP STARTED MUSCLING THEIR WAY INTO THE RETAIL SYSTEMS BUSINESS, TINY JDA SOFTWARE SAW AN EXISTENTIAL THREAT.

Those were the glory days of E.R.P.—for enterprise resource planning software—as companies spent the late 90’s girding up to face the Y2K bug and passed the early 2000’s scrambling to seize the Internet initiative. As the big E.R.P. vendors moved beyond functions like accounting, finance and human resources into supply chain and customer relationship management, JDA’s profitable niche in retail systems was vulnerable. JDA had to get bigger and broader quickly, or be swept away.

So JDA embarked on a series of acquisitions that would transform the Scottsdale, Ariz.,-based company from a \$50-million retail specialist to a leading player in supply chain management, with nearly \$700 million in revenues in 2011. But in 2006, when Oracle acquired Retek, a direct competitor to JDA in retail systems, that outcome was hardly obvious.

“I think the whole market assumed we were going to get flattened,” says Hamish Brewer, JDA’s chief executive officer. “We recognized that the business we had been in for the past 20 years—inventory management and retail systems—was becoming commoditized, and because SAP and Oracle could offer a complete suite of H.R., financials and other things we didn’t do, we didn’t have a competitive offering.”

JDA was a small company, so its initial acquisitions were correspondingly small, like Intactix International Inc., which JDA acquired in April 2000 from Pricer AB, a multinational based in Sweden. Since its founding in 1990, Intactix had grown from two to 250 employees in 12 countries in six years, offering space- and category-management software and consulting products. Next came the E3 Corporation, a privately held provider of inventory systems, in September 2001. As about half of E3’s customers were non-retail, the deal accelerated JDA’s move into collaborative planning, forecasting and replenishment, and helped the company gain presence in wholesale distribution.

“We started to make some acquisitions, and at first they were pretty darn small, but putting it in context, JDA was about a \$50 million company itself at the time,” says Peter Hathaway, JDA’s former executive vice president and chief financial officer. “We were buying technology, with a bit of capability,” he says. But by 2006, JDA leadership determined “that there was a lot of effort put into buying and integrating these little companies, but it wasn’t having a lot of impact on revenues. You just didn’t get the bang for your buck,” says Hathaway.

It was time to think bigger. JDA’s first transformative acquisition came in 2006 with the purchase of Manugistics, a provider of decision-support software for manufacturing, logistics, statistics and transportation. Though Manugistics had been an early entrant in that market, with products that were still considered innovative, its financial performance had suffered from increased competition and the bursting of the dot.com bubble. Manugistics had about \$175 million in revenues at the time; JDA, \$229 million.

“Manugistics was the No. 2 behind iz, but at that time the company was in trouble, and I think people regarded this as one desperate company buying another,” says Brewer. “But the product was still very good, and we were able to rebuild that brand in the marketplace.” The merger boosted earnings, but post-merger integration presented challenges, technical and managerial. JDA’s applications ran on Microsoft’s .NET architecture. Manugistics had written all of its code for Java, a software development system created by Sun Microsystems that allows programs to run on multiple hardware and software platforms. Despite resistance from JDA’s engineers, the company’s leadership decided Java offered more flexibility for their target market, so JDA’s programs were gradually rewritten for the Sun code. (Sun was acquired by Oracle in January 2010.)

Mergers of tech companies often founder on such concerns, but analysts say JDA managed it well. “To JDA’s credit they have often improved the situation for one of their acquired companies, improving things like customer satisfaction and product investment,” says Dwight Klappich, a supply chain specialist with Gartner Inc. “When JDA acquired Manugistics, there was client dis-

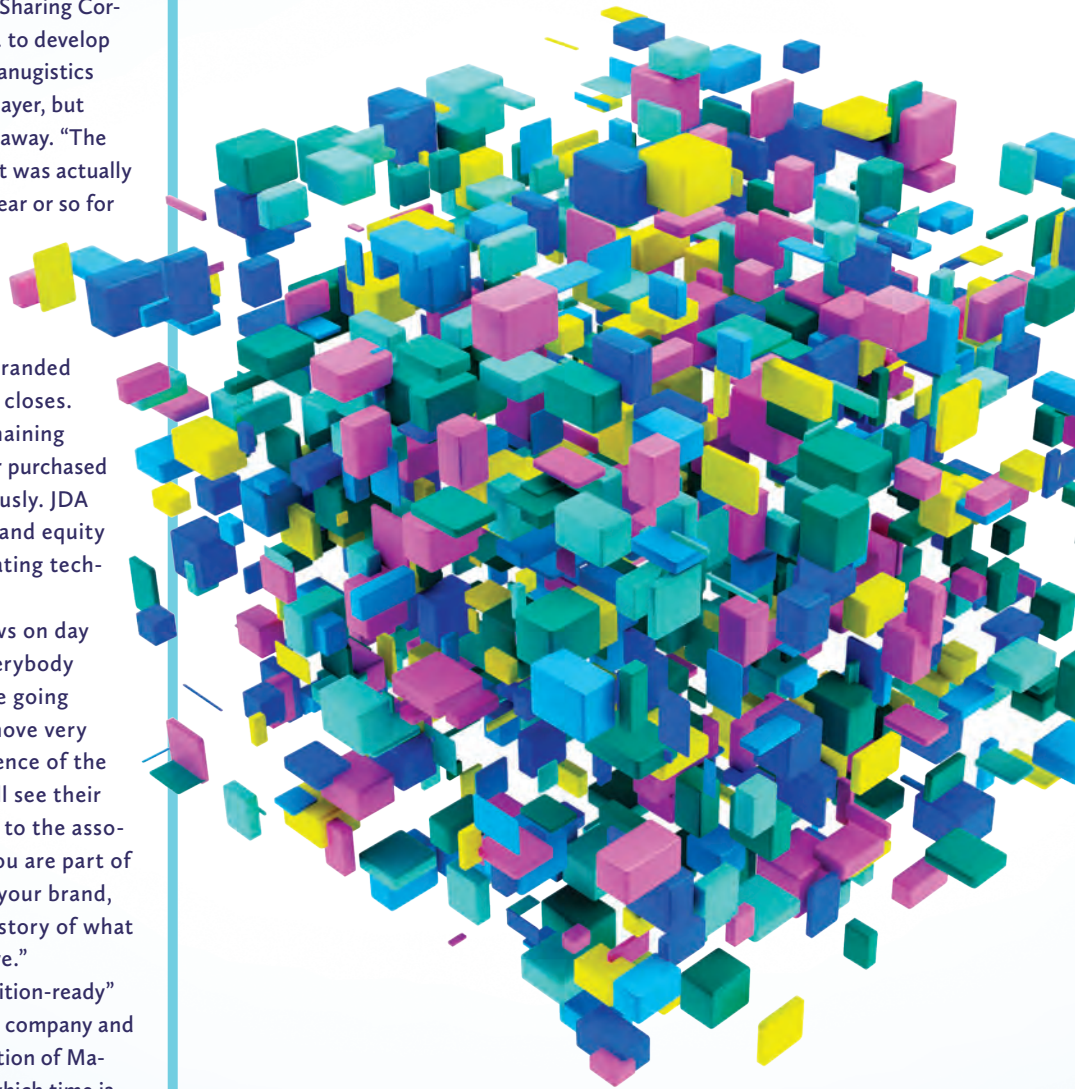
satisfaction with Manugistics' Transportation Management System offering. JDA turned this around relatively quickly, and customer satisfaction improved." That was a non-trivial task, but so too was integrating two disparate cultures. JDA was a bit of a mom-and-pop operation, whose founder, James D. Armstrong, had moved the company from Canada to Arizona in 1987 to be close to one of his largest customers, a major Phoenix auto parts dealer. Manugistics had been founded in 1969 in Bethesda, Md., as the Scientific Time Sharing Corporation, by engineers who left I.B.M. to develop their own programming language. "Manugistics put us on the map as a supply chain player, but the merger was a struggle," says Hathaway. "The relative size was a big jolt. ...The result was actually extremely positive, though it took a year or so for the traction to really take hold."

Some companies make a point of erasing an acquired business's brand and cultural identity as soon as possible. Cisco is famous for replacing branded coffee mugs on desks the day a deal closes. Others seek to capitalize on the remaining brand equity and culture, and let their purchased companies function semi-autonomously. JDA takes a middle course, preserving brand equity but renaming products while integrating technologies and management.

"We try to deliver all the bad news on day one," says Brewer. "We try to let everybody know within 24 to 48 hours if they're going to lose their job. In that sense, we move very quickly. We don't eradicate all existence of the brand that we've just acquired. You'll see their logos on our Web site. Our message to the associates is ... 'If you are still with us, you are part of JDA. We respect your company and your brand, and we won't try to eradicate the history of what you've done.' We respect their tenure."

JDA leaders speak of being "acquisition-ready" when they've integrated one acquired company and are shopping for another. The integration of Manugistics took about three years, by which time i2 Technologies, the other major competitor in supply chain software, had also become available. The two were complementary, in that Manugistics' strength was in process manufacturing of consumer goods, like cans of soft drinks or tubes of toothpaste,

Some big technology companies that have grown through acquisitions make a point of erasing cultural identity. JDA takes a middle course, preserving brand equity, but renaming product, while integrating technologies and management.





while i2 specialized in discrete manufacturing, the assembling of parts into complex products, like cars and computers.

“The opportunity came up to buy i2, which had also run into hard times,” says Brewer. “The company had had a sale process for at least a year or two, and nobody apparently wanted to buy them. We completed the deal in January 2010. We took on the moniker from i2: The Supply Chain Company. It’s working out pretty well for us.” In early 2012, JDA began exploring the acquisition of the RedPrairie Corporation, whose heritage was in warehousing, workforce management, store operations and e-commerce. But then the market intervened, in the form of shareholder activists who prodded JDA’s board to sell the company, believing

it could command a significant increase in share price.

“We started a quiet process, talking to a few companies and a few private equity firms,” says Brewer. One of them was New Mountain Capital, which owned RedPrairie. “We had had a conversation with them about acquiring RedPrairie, and they saw that this was a spectacular opportunity for JDA to create a lot of value for the shareholder, so they

were holding out for a higher price. So now, the tables were turned, and in the end, they bought us. We sold JDA to New Mountain on Dec. 21, 2012, for just under \$2 billion.”

After this merger, JDA emerged as the big, broad supply chain leader it had set out to be. The now privately held company retains the JDA brand, and Brewer continues as chief executive. The combined company has revenues of \$1.1 billion. Through all the changes, JDA sustained robust revenue and earnings growth after the market crisis of 2008. But the rapid expansion has caused some growing pains. “This is one of the toughest parts of the transition,” says Brian Boylan, executive vice president and chief human resources officer. “We used to be a small company with a small-company mentality ... and we have had to change pretty dramatically.”

Adds Brewer, “We found people ... who understood how a multibillion [dollar] software company ran and what you have to do to compete with the big boys. We hired a lot of talent. The truth is there’s some

risk in that. Some of them work and some of them don’t. In the process, you really try to re-establish in your company what the definition of ‘good’ is.” JDA must also play the part of a much bigger company, because in today’s market \$1 billion in sales is small relative to the competition.

“This is a huge change-management process for the entire leadership team: to get out of that cottage industry mindset and into world class,” says Brewer. “SAP is 20 times bigger than us, Oracle 40 times, and that’s who we compete with every day. Most of my direct reports are from much bigger companies than JDA, and they know how a large company runs. The toughest thing for us to figure out when we’re interviewing someone from a bigger company is can they rescale to a company of our size? You don’t have armies of people to do things for you. It’s a lot more hands-on.” As JDA begins to depend more on organic growth and less on acquisitions, the company intends to place more emphasis on internal talent and less on aggressive recruiting. JDA’s Leadership Supply Chain program includes the Emerging Leader Program, which aims to spot high-potential employees at a lower level to groom for future vice presidents, and the Fearless Leader Program, aimed at building up future senior vice presidents and executive vice presidents.

“When we started in 2005, we didn’t have the leadership in place to execute on our strategy,” says Boylan. “We had a number of people who had been on board since the company was very small, but who didn’t have the capacity to scale with the organization. We were forced to go to the outside, but you don’t want to be in that position all the time.” Competing with the likes of Oracle and SAP also required a geographic expansion. Of JDA’s 4,500 employees, nearly 1,600 are based in Bangalore and Hyderabad, India, engaged in software development and support, as well as providing consulting and cloud services to customers globally. The company also has employees in Europe and the Asian-Pacific countries, including China and Japan.

“The offering we have is fairly complex. You can’t just find people off the street to explain it,” says Brewer. “We really need to have our own presence in each of our major markets. We have to run like a multibillion company even though we aren’t one yet.” Indeed, JDA’s low profile is almost striking in itself for a company that has grown so fast; there have been no big spreads in Forbes, Inc. or any of

As JDA begins to depend more on organic growth, and less on acquisitions, the company intends to place more emphasis on internal candidates and less on aggressive recruiting.



the high-tech glossies, and mention in the business pages is rare. Brewer says the company's quiet approach to self-promotion is at least partly strategic.

"If you asked our marketing department, they would say, yes, we have chosen not to invest enough in marketing," Brewer says. "The truth is we're no secret among the people who need to know. Our target market is probably the top 2,000 to 3,000 retailers, top 5,000 to 10,000 manufacturers in the world. In most cases, we know the individuals we need to market to, and we do that one-on-one."

JDA's forte is supply chain expertise that big general-purpose software companies do not match. "We go head-to-head with Oracle and SAP every day, and we win about 70 percent of those competitions," Hathaway says. "Our features and functionality are better. When it comes to supply chain, we're able to run those planning and optimization algorithms faster and produce a far more accurate

result. That translates into better supply chain plans, which dramatically increase efficiency, reducing working capital and improving service levels and margin." Tim Payne, an analyst at Gartner, says JDA has assembled a large number of programs and technologies for the coming phase of supply chain management, which is using algorithms to project and plan for material needs, known as supply chain planning (SCP). "JDA could pull together a very strong story to out-compete SAP and Oracle in the SCP market." But JDA also has to contend with SAP and Oracle in "the cloud." In cloud computing, popularized by Salesforce.com's customer relationship management programs, companies rent their core applications from software vendors rather than buying, installing and maintaining the large programs themselves. The programs reside on giant servers spread across the Internet in the so-called cloud, where they are backed up, maintained and updated by the software vendor, not the customer. Although the big enterprise software companies initially dismissed cloud computing as toy-like and inadequate, they have recently moved into the field aggressively.

Indeed, Ernst & Young's compilation of merger and acquisition activity for 2012 concluded that cloud computing and software-as-a-service (SaaS) deals are dominating the landscape. In EY's words, the "cloud/SaaS megatrend ran away from the rest of the pack of deal-driving trends in 2012,

JDA's forte is supply chain expertise that big general-purpose software companies do not match.



growing to more than 15 percent of global technology M&A deal volume." That pace has accelerated in 2013, with non-tech companies like Wal-Mart joining the likes of I.B.M. and Oracle in bidding up cloud deals. Often, EY reported, "established software companies were surprised by faster-than-expected customer adoption of SaaS."

For Hamish Brewer, the cloud presents a huge opportunity for JDA's customers and a challenge to his company. He sees the cloud giving bricks-and-mortar retailers a better way to compete with pure Web players. "Today every retailer has a Web presence. But try walking into a retail shop and saying, 'I want to do something with my online shopping cart.' Our job is to help the world's leading retailers become competitive with Amazon," he says.

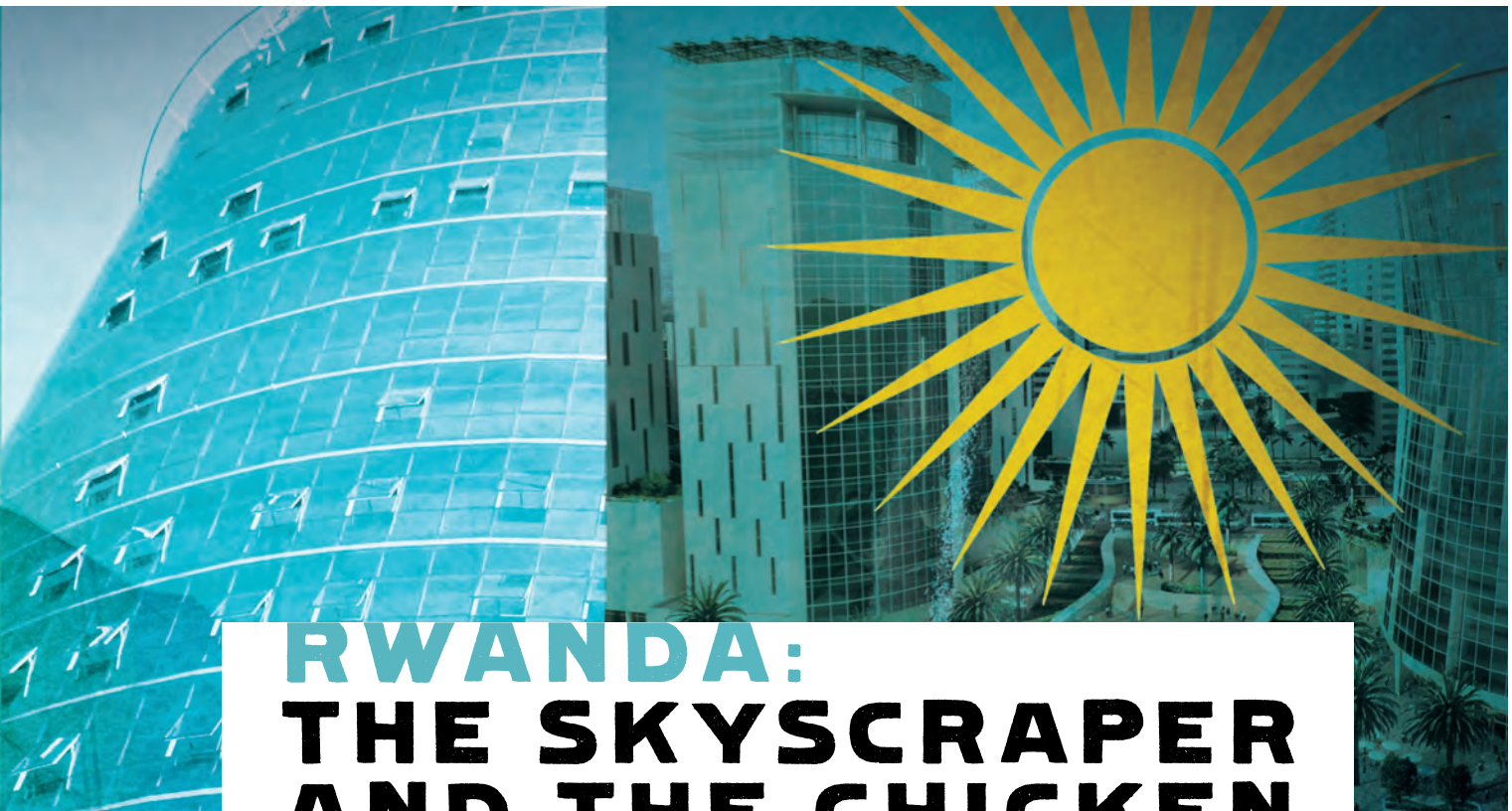
For JDA, "the big challenge now is moving to providing all our products in the cloud," Brewer says. "Where it used to take months and months to install a program, now we can literally do it in an hour. It's still not the majority of our business, but I bet you in five years it will be."

And the company will again augment internal development with acquisitions. "We have a strategy: to build out the biggest suite of supply chain products for retailers and manufacturers," Brewer says. "For the near term we are completely consumed integrating JDA and RedPrairie into one company, but once that is complete and we are once again 'acquisition ready,' then I am sure we will start looking again." K/F



THE SEARCH
FOR GROWTH





RWANDA: THE SKYSCRAPER AND THE CHICKEN

TWO DECADES AFTER Rwanda's horrific genocide, the country is in the midst of an impressive transformation. Evidence of its recent achievement is everywhere, in its bricks-and-mortar, paved roads and even fiber optics, as the country strives to evolve from an economy grounded in subsistence agriculture to one based in information and communication technology.

During our time in Rwanda and its capital city of Kigali to research and write our book, "Rwanda, Inc.," we absorbed many other images. Two in particular became indelible, a mix of past and present reminders; leaning forward toward the future with the knowledge that slipping backward is simply not an option. One is a skyscraper, a symbol of Rwanda's aspirations as a hub of business and technology. The other is a chicken, a reminder of the continued importance of raising the standard of living where 80 percent of the population still exists as subsistence farmers on tiny plots of land.

First, the skyscraper. The 20-story Kigali City Tower, built by Rwandan businessman and investor Hatari Sekoko, dominates the skyline.

On one of our trips to Rwanda in early 2011, the tower was under construction without an anchor tenant, a venture that would be unheard of in the United States, where a project of that scale could not be undertaken without at least one firm commitment. By early 2012, though, the tower was open for business and fully leased after the last space was taken by Visa Inc., which has a partnership with the government of Rwanda to "electronify" Rwanda's economy, connecting its nearly 11 million residents to the formal financial sector.

As much as Rwanda strives toward the future, however, it cannot abandon its agrarian roots. This is where the chicken comes in. Fresh from the butcher in its brown and black



BY **PATRICIA CRISAFULLI AND ANDREA REDMOND**



**AFRICA'S ARCHITECT OF
CHANGE**

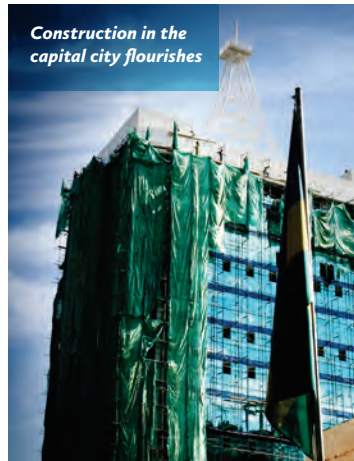
PRES. PAUL KAGAME

President Paul Kagame, a Tutsi, commanded a rebel force that ended the Rwandan genocide. When the war ended, he was appointed vice president and minister of defense and elected president in 2000 by the Parliament and ministers. When a new constitution went into effect, he was again elected president in 2003 and re-elected in 2010, with the aim of transforming Rwanda into a middle-income country by 2020.



feathers, the chicken was held by the feet by a woman in a bright print blouse, a slim blue pencil skirt and red high-heeled shoes. Watching the woman pick her way along an unpaved back street in Kigali, where the red earth had been scarred deeply by rains earlier in the season, we could only wonder where she was going with the bird. Wherever the chicken was headed, it reminded us of the basics; while Rwanda steams ahead toward its vision of becoming a middle-income country, it must also ensure that the basic needs of its people are met.

Yet, Rwanda's drive to establish a more secure and prosperous future is not at the expense of ignoring its past. The nation has memorialized the genocide that occurred from April to July 1994, when militias sanctioned by the previous government murdered a million Rwandans. In the midst of the terror, 2 million citizens fled the country. The objective of the *genocidaires* was clear: to eradicate the

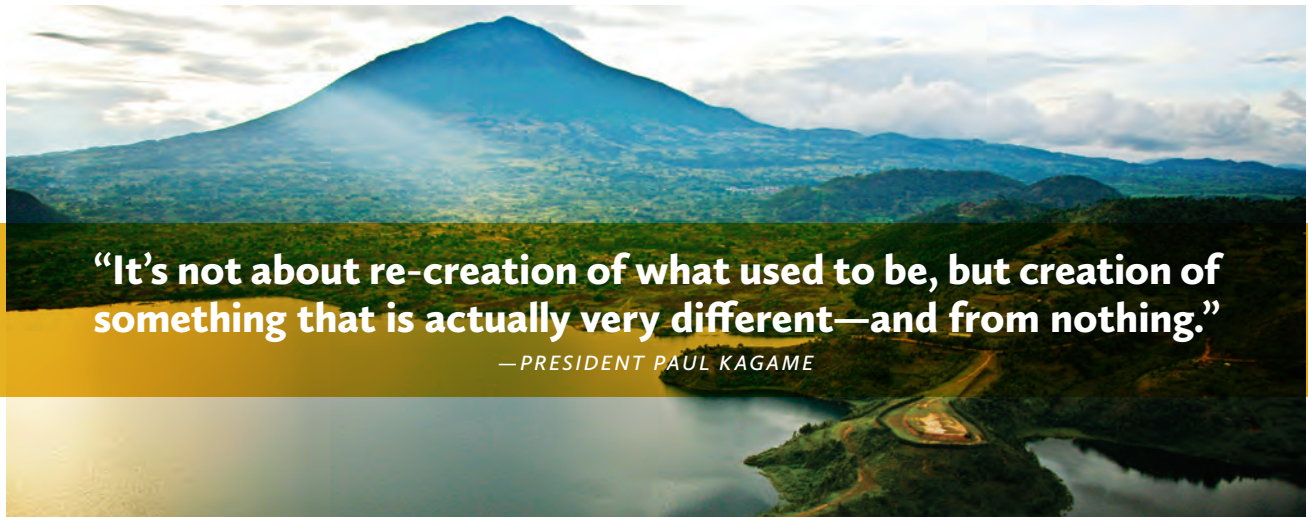


Construction in the capital city flourishes

used to be, but creation of something that is actually very different—and from nothing,” Kagame told us during an interview at the presidential offices. “It is a story that continues to this day.”

To understand Rwanda today, one must comprehend three periods or “chapters” of its history, as Foreign Minister Louise Mushikiwabo told us. Chapter 1 begins with “the struggle,” the civil war that broke out in 1990 and extended through the genocide and subsequent years of fighting to put down insurgencies and stabilize the country. Chapter 2 began in 2000, with reconstruction and rebirth

that lasted roughly a decade. Now, Rwanda is in the early stages of Chapter 3, building upon a new foundation of governance and economic development. “It is our national ambition now, and part of the policy of this ministry, to have a presence in the world. We want to define ourselves and to interact and open up as much as we can; to bring to Rwanda



“It’s not about re-creation of what used to be, but creation of something that is actually very different—and from nothing.”

— PRESIDENT PAUL KAGAME

minority Tutsi at the hands of the majority Hutu.

Today, such ethnic distinctions are no longer made; Rwanda embraces all Rwandans. Reconciliation and unification are preached everywhere, politically and spiritually. Indeed, reconciliation has become the key underpinning of virtually every initiative in Rwanda, as laid out in its Vision 2020 development program. Vision 2020 calls for compulsory education, universal health care and steps toward a knowledge-based economy.

In our conversations with Rwandan President Paul Kagame, the theme of creating “something out of nothing” was raised repeatedly. “It’s not about re-creation of what

opportunities from the world, whether in trade or know-how or good practices—those things that allow Rwandans to have a better life and that will raise the standard of life for Rwanda,” Mushikiwabo said.

Rwanda’s Chapter 3 also carries a sobering message: What has been accomplished thus far must be surpassed. The current GDP growth rate of 7 to 8 percent must expand even faster if Rwanda is to continue to reduce poverty. Of all the measures of progress thus far, the most impressive is in poverty reduction. Rwanda has reduced the percentage of its population living in poverty to 44.9 percent in 2011, from 56.9 percent in 2006. This translates into 1 million people

RWANDA OTC MARKET

BID (Buyers)	OFFER (Sellers)	SALES
25	101,200	130
35	323,800	1000
127	55,700	2-1
	1,200	
	10,700	
		320
		325
		3-3
		100 3-7

The Rwanda Stock Exchange has plans to adopt an electronic trading platform; guided tours into the Virunga Mountains to see gorillas and basket weaving provide entrepreneurial opportunities.



A hand up, not a hand out: Ikiraro Investments teaches best practices in raising poultry for egg production.

emerging from poverty in just five years. In addition, the number of Rwandans living in extreme poverty fell to 24 percent from 37 percent over the same period. Perhaps even better news, and reflective of Rwanda's drive to raise the bottom of the socioeconomic pyramid, is that the so-called Gini coefficient showed decreases in income inequality.

But make no mistake,

Rwanda is not perfect. This is not the Garden of Eden for business where an investment today multiplies tenfold by tomorrow. The wheels turn slowly at times, to the frustration of some foreign investors, because of unnecessary bureaucracy and a lack of experience and confidence within the public sector. Patience, one foreign investor told us, is the name of the game in doing business in Rwanda. The development of human capital is a significant challenge, particularly at the middle tier. Rwanda is a landlocked country and transportation costs are considerable, according to some estimates amounting to 40 percent of the cost of imported retail goods. And Rwanda's heavy dependence on imported energy and lack of electrical distribution are major concerns.

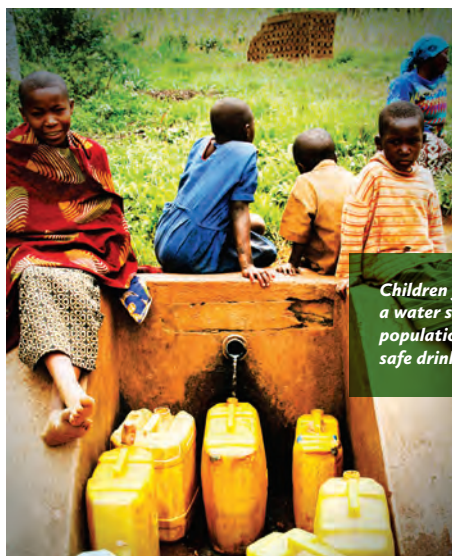
"Rwanda, like any nation, is not an impeccable place. It has many challenges and obstacles to overcome," said Donald Kaberuka, president of the African Development Bank, who

served as Rwanda's minister of finance and economic planning from 1997 through 2005 and is credited with helping stabilize the economy after the genocide. "But Rwanda's track record to date gives her and her friends conviction that a prosperous nation, at peace with herself, connected into global networks of trade and capital, is feasible."

Perhaps the most distinguishing characteristic in Rwanda, and a huge plus for attracting foreign investment, is the government's zero-tolerance policy for corruption. On a continent where wealth all too often ends up in the pockets of the elite, and where doing even basic business involves red tape and money to grease the wheels, Rwanda is a startling exception. "In Rwanda, you have a stable democracy and good governance," said Clifford Sacks, CEO for Africa and head of Pan-African Equities for Renaissance Capital, an emerging markets investment bank. Not everyone, however, sees Rwanda as a success story. Once the darling of the Western press, which wrote glowing reports post-genocide, Rwanda has seen the pendulum of opinion in some circles swing in the other direction where the country and its leaders are concerned. There are two portraits of Kagame, the former

general who led the Rwandan Patriotic Front (RPF) to end the genocide. (He is now completing his second, democratically elected term as president.) In one view, he is a savior, nearly messianic in his mission and vision, who single-handedly delivered his

nation out of hell on earth. In the other, he is a heavy-handed tyrant, a dictator who silences the opposition.



Children filling jerry cans at a water station. 75% of the population has access to safe drinking water.

What we saw was a leader who was neither of the extremes; Kagame and the situations he faces are far too complex for that. He believes Rwanda's problems can only be solved with Rwandan solutions and, after seeing his country abandoned by the West during the genocide, cares little about international opinion. Yet, at the same time, he reaches out to partner with those who will help his country progress toward a better future for all Rwandans. Looking at the country through the lens of economic development and governance, as we did in "Rwanda, Inc.," there is no doubt that the architect of what we call the "ultimate turnaround" is the country's "CEO"—Paul Kagame.

With such ambitious plans to advance and diversify its economy, Rwanda has had to add another type of capacity, the institutional variety, through the Rwanda Development Board. One of the RDB's top priorities is to solicit investors for development projects, particularly in infrastructure. For Rwanda to transform itself into a middle-income country, it needs continuous infrastructure expansion, encompassing a variety of projects and priorities.

One of Rwanda's development projects has a high international profile because of the technology involved: the KivuWatt project developed by ContourGlobal of New York, which will extract and process methane dissolved in the waters of Lake Kivu, a 1,500-foot-deep body of water in western Rwanda, to power 100 megawatts of electricity-generating capacity. The first phase, now under way, is for 25 megawatts of power generation. Safe extraction of methane, which can be volatile, would not only produce electricity but could also reduce health and safety hazards by lowering the risk of a catastrophic release of gases trapped in Lake Kivu, which is surrounded by more than 2 million inhabitants.

"The opportunity to take part in a project that provides so much benefit in a post-conflict environment, including providing electricity critical to Rwanda's continued economic growth—and at the same time reducing the risk of a catastrophic release of the lake gases—was very attractive to our lending group," William Barry, vice president of business development for ContourGlobal and the KivuWatt project manager, told us.

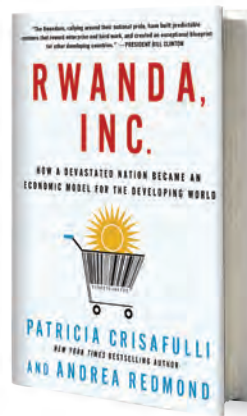
Rwanda's other projects include exploratory drilling and testing of geothermal sites; the building of a new airport to

allow greater use of regional air transport for goods as well as passengers; and a proposed rail link that would connect Rwanda and Burundi with the port of Dar es Salaam in Tanzania, which has been in the planning stage for several years. At 1,670 kilometers (roughly 1,037 miles), the rail line would be the longest in the region and has a reported price of about \$5 billion.

At the same time, the country continues to emphasize health and education and is on track to meet most of its United Nations Millennium Development Goals by 2015.

Access to universal health care is a laudable goal, with improvements in maternal and infant health and reduced mortality. Partners in Health, led by Dr. Paul Farmer, and the Clinton Foundation are among the nongovernment organizations (NGOs) working with the Rwandan government to further its programs targeting poor, rural Rwandans. In education, Bridge2Rwanda, a U.S.-based NGO that promotes entrepreneurship, servant leadership and foreign direct investment, seeks to prepare exceptional young Rwandans as

"Rwanda, like any nation, is not an impeccable place. It has many challenges and obstacles to overcome."



Adapted from "Rwanda, Inc." by Patricia Crisafulli and Andrea Redmond.

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scholarship students to universities and colleges in the U.S. and elsewhere. After four years of education, they return to their home country as the members of

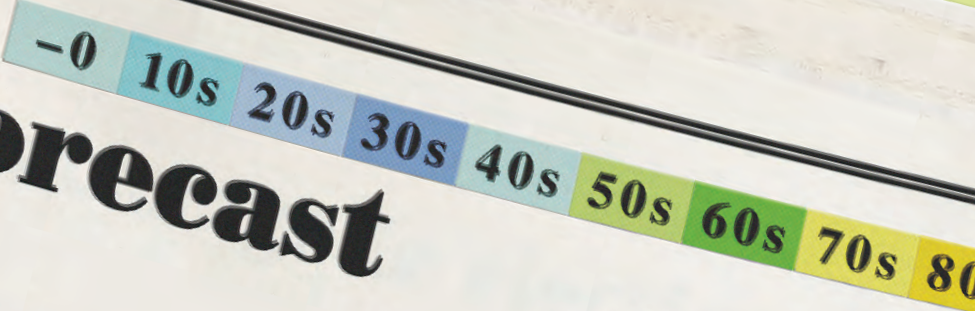
the next generation of leaders in business, entrepreneurship, education and public service.

To move forward, Rwanda must do all these tasks at the same time—memorializing the past, promoting reconciliation and advancing the country's economic development. It is an ambitious agenda, to say the least.

Despite gaps in expertise and bureaucratic delays at times, Rwanda has no shortage of can-do attitude. In a country that is both a work *in* progress and a work *of* progress, the wheels continue to turn. Given the magnitude of its needs, odds favor more progress. Moreover, given where the country has been—in the pit of despair and destruction—and how far it has come in less than two decades, there is no reason to doubt the country's resolve. **K/F**

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Today's Global Forecast



BRICs FORECAST COOLING DOWN
SOME SEVERE STORMS AHEAD



It's a Slow-Growth Kind of World

ENTREPRENEURS are an impressively optimistic bunch: They estimate their chances of surviving at about 60 percent, whereas the true figure is only a third of that. But even these glass-half-fullers must be getting a bit worried about the state of the global economy. Wherever you look, hope seems to be fleeting while gloom endures.

Pundits have repeatedly discovered powerful engines of growth—the BRICs or the “next 11” or oil-revitalized America. Some have even praised Europe’s hidden strengths (which brings to mind the joke that they are “very well hidden”). But these engines have proven to be disappointing. Several roared for a bit, then went hoarse. Others have failed to catch at all. The result is a disappointing global growth rate.

The most worrying slowdown has come from the BRICs—Brazil, Russia, India and China. The rise of the BRICs over the past couple decades has been one of the greatest revolutions in economic history. In the first decade of this century, China grew at more than 10 percent a year, and India by 6.5 percent. This BRIC-powered growth was obviously good for the emerging world, pulling billions out of poverty and creating new business empires. It was good for the rich world as well. Companies gained because they could contract out jobs to millions of willing workers in the emerging world. Consumers gained because they had access to a flood of cheap products. And govern-

ments gained because globalization put a downward pressure on inflation. Australia and Canada enjoyed a particular bonanza as commodity producers.

Alas, the BRIC age is coming to an end. Brazil’s growth rate slowed from 7.5 percent in 2010 to 2.7 percent in 2011 to 0.9 percent in 2012. The International Monetary Fund now reckons China will grow by just 7.8 percent in 2013, India by 5.6 percent, and Russia and Brazil by 2.5 percent. In 2008, the BRICs accounted for two-thirds of world GDP growth. In 2012, they accounted for less than half, and the IMF predicts that they will stay at that level for the next five years.

There are obvious reasons for this. After two decades of rapid growth, emerging-market countries have picked all the low-hanging fruit. They are learning that the next stage of growth demands high-quality infrastructure and inquiring minds. But democratic countries (particularly India) lack the right infrastructure, and authoritarian countries like China lack the inquiring minds.

Optimists are now looking for the next engines of growth in the emerging world. The ever-inventive Goldman Sachs touts “the Next 11” (which includes Bangladesh, Indonesia, Mexico, Nigeria and Turkey). But, even if they continue to grow at a significant clip—and that’s a big if—the “Next 11” will not have the same impact as the BRICs. They lack the scale—they are collectively only a bit more populous than India—and they are more developed than



the BRICs were when they embarked on their explosive growth. They are also grappling with many of the same problems as the BRICs: dysfunctional governments, discontented populations, cosseted national champions and underdeveloped domestic markets. There is no escaping the big problem confronting the global economy: The world has less catch-up potential than it used to. Its most populous countries are no longer all that poor, and its poor countries are no longer all that populous.

Many have shifted their hopes from the emerging world to the United States. America was the engine of the world economy in the 1950's and 1960's, when it grew at 3 percent a year despite being a mature economy, and in the 1990's, when it again grew at 3 percent a year in the Goldilocks era of Clintonism. The shale-gas revolution has ignited hopes that the U.S. will be able to pull off the miracle once again. America is, after all, an extraordinarily diverse economy, with many centers of excellence; and shale gas is revolutionizing the energy industry, transforming America from a net importer to a net exporter and reducing the cost of one of the major inputs into the economy.

The shale-gas development is one of the best things that have happened to the global economy in general and the U.S. economy in particular. But powerful forces are dragging America down. As Robert Litan and Carl Schramm point out forcefully in their book "Better Capitalism," three of the great growth engines of the U.S. economy are in trouble.

America regards itself as the original start-up nation. But venture capitalists have been slashing their spending and dumping more adventurous companies, not least because about 90 percent of them failed to produce a positive return. The number of initial public offerings is down from an average of 547 a year in the 1990's to 192 since then, reducing the supply of new high-growth companies, the biggest engines of job creation.

The start-up nation is also an immigrant nation. Fully 18 percent of the Fortune 500 list as of 2010 were founded by immigrants (among them AT&T, DuPont, eBay, Google, Kraft, Heinz and Procter & Gamble). Include the children of immi-

grants and the figure is 40 percent. Immigrants founded a quarter of successful high-tech and engineering companies between 1995 and 2005. They obtain patents at twice the rate of U.S. natives with the same educational credentials. But America's immigration policies have tightened dramatically over the past decade, and a vocal faction of the

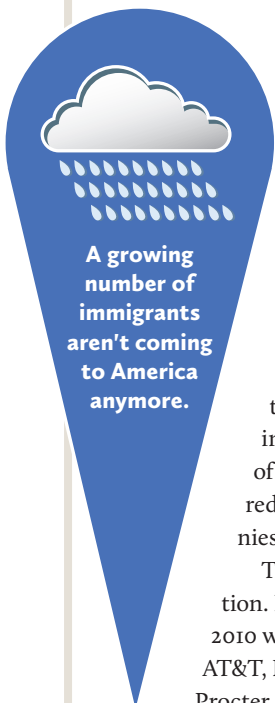
Republican Party is determined to tighten them further. (Meanwhile other rich countries, such as Canada, have continued to woo skilled immigrants.) Comprehensive immigration reform is unlikely to pass Congress. A growing number of highly skilled immigrants are returning home or not bothering to come to America in the first place. Why endure America's visa obstacle course when other countries are rolling out the red carpet?

Which leaves Europe. In the book "Europe's Hidden Potential," Burkhard Schwenker and Thomas Clark point to Europe's hidden strengths (such as its tradition of skilled craftsmanship and its culture of consensus) and argue that these could turn the old continent into an unexpected powerhouse. Europe certainly has islands of excellence, from Denmark's pharmaceutical industry to Germany's middle-sized manufacturers. But it is unlikely in the extreme that these islands can transform an otherwise sclerotic continent.

Europe has a dismal record of producing high-growth companies. Thirty of California's top 100 companies were founded since 1970. The comparable figure for Sweden—one of Europe's most pro-business countries—is just two. The European economy continues to be crushed by the logic of the euro. Peripheral countries such as Greece, Spain and Italy are locked in a near-depression. But Europe's strongest economy, Germany, worries about bailing out spongers, worries that translate into opposition to debt forgiveness and banking union. German Chancellor Angela Merkel's reelection in September will ensure more of the same.

THE LACK OF an obvious engine for global recovery is worrying enough. But even more troubling is the fact that structural problems can halt any surge of growth—or potentially push the global economy into the doldrums.

The two biggest problems are debt and demography. The financial crisis was partly precipitated by unprecedented levels of debt, particularly in the rich world. The Bank of International Settlements estimates that



debt has grown to \$33 trillion around the world since 2007. That is equal to half the world economy's annual output. Debt will continue to haunt the world economy for years, hindering growth and producing periodic crises. For example, the severe underfunding of America's pension systems (and the unrealistic assumptions about rate of return on investment) will lead to a succession of bankruptcies as cities and states find that they cannot honor their obligations to public-sector retirees. Detroit's bankruptcy in 2012 was not so much a freak occurrence as a harbinger of things to come.

THE RAPID AGING OF THE RICH WORLD will turn an entitlement problem into a crisis. The dependency ratio is rising fast as the number of people paying into the system goes down and the number of people taking money out goes up. The relatively speedy growth of the post-war years was made possible by the addition of young women to the labor force. We have now reaped all the benefits of new workers and are beginning to subtract people from the work force. The challenge of dealing with an aging population is compounded by poor returns on financial assets: returns that are much lower than those needed to keep pension funds solvent—let alone provide retirees with the rising living standards that they see as their birthright.

The demographic problem reaches beyond the rich world. China's working-age population began to shrink for the first time in 2012. Thanks in part to its own policies, China will soon have to tackle the problems of an aging populace without the advantage of generations of wealth. And as China and the developed world deal with aging populations, some of the poor world will have to grapple with a surge in youth unemployment. India failed to add any net new jobs between 2004/2005 and 2009/2010 when it was growing rapidly. As many as half of the young people in North Africa and the Middle East are unemployed. The only solution to this vast misallocation of human resources is an equally vast migration. But resistance to further immigration is mounting.

The third problem is innovation-stagnation. Tyler Cowen, an economist at George Mason University, talks of a "great stagnation." Peter Thiel, a cofounder of PayPal, the Internet payment company, and the first outside investor in Facebook, complains that we wanted flying cars and all

China's working-age population has begun to shrink for the first time in 2012.

we got was 140 characters. Lots of statistics suggest that we are getting ever smaller returns on investments. Federal spending on health-related research increased from \$20 billion in 1993 to \$30 billion in 2008, for example, but the number of new drugs approved by the Food and Drug Administration fell from a peak of 50 in 1996 to 15 in 2008.

This position is controversial. Commentators argue that the Internet is a powerful technology, one that is reorganizing everything from corporate supply chains (which are becoming more global) to education (which is becoming more virtual).

But even if you discount talk of a technological stagnation, two things seem to be going on. The first is that inequality is reaching levels not seen since the Gilded Age: a tiny minority of people are reaping a disproportionate share of the gains of technological innovation. The second is that many of us are confronting huge changes without getting any richer. This raises a terrifying prospect: that we may be living through a combination of a great disruption and a great stagnation. Rapid change is tolerable if it makes us all feel richer. But rapid change that leaves most of us staying where we are while enriching a fortunate few threatens to create another big problem: surging political discontent.

Besides these structural problems, we need to keep in mind the possibility of explosions: low-risk events that could plunge the world into an extreme depression. The euro could still collapse, though that is looking less likely than it did a year ago. Terrorists could blow up the information superhighway. The more interconnected the economy becomes, the more it is dependent on the smooth workings of the Internet. China could suffer from a political meltdown as the politburo is pulled apart by internal wrangling or as revolts in the provinces gather momentum. Recent events in Egypt have reminded us that authoritarian regimes are always vulnerable to sudden collapse. The fact that a growing portion of the world economy is under authoritarian control adds a new set of perils to an already risky environment.

There will be plenty of rich pickings for the fortunate few. Entire sectors of the global economy are being rapidly reorganized: Education will change more in the next decade than it has for the past century. High-growth companies can become global forces easier than ever before. But the prospect for the vast majority looks grim. Most of us will be struggling to maintain our current living standards even as the world is upended around us. **K/F**

ART OF THE Kayak



NICK SCHADE grew up around canoes and other boats, so after he graduated from college in 1986, he thought he'd get a sea kayak. But the dealers' offerings were too expensive for someone just starting out. So he did what kayakers have done for thousands of years: He pulled some materials together and built his own.

"I sat down on my parents' living-room floor and planned out a kayak from looking at tiny pictures in a magazine," he recalls. He made the boat out of thin cedar strips, bending them around a form and gluing the ends together, then coating the finished boat in fiberglass and epoxy. Impressed, Schade's older brother asked for the plans and made a kayak for himself. Then Schade made another, and another. In a few years, while he was working as an engineer for the United States Navy in Connecticut, he had created Guillemot Kayaks, a sideline business selling plans to boaters and woodworkers.

In 1995, Guillemot became his full-time job. Ever since, that business—designing kayaks, building prototypes, selling plans, occasionally building a complete boat and always thinking up more designs—has thrived. As kayaking has increased in popularity, so has the mix of modernity and tradition that is involved in making, or even designing, one's own boat: the great pleasure, as Schade puts it, of "converting a pile of nondescript strips of wood into a fine, fun, functional craft."

For thousands of years, Arctic peoples made kayaks with frames of driftwood or whalebone, with hulls made from the skins of seals, sewn together and waterproofed with blubber. The boats were 16 or 17 feet long, less than 2 feet across at their widest, and after thousands of years of life-or-death testing and design evolution, they were perfect for their purpose: to carry hunters across often-rough seas in water so cold

there was no point in learning to swim. Then, some 150 years ago, the kayak was adopted by other peoples, and went through several cycles of product evolution.

First, there was a phase in which traditional skills were diverted to new purposes. In the 19th century, for example, the Aleuts of the Pacific Northwest made their version of the kayak, the baidarka, in new forms that suited the purposes of their Russian colonial overlords (which were, above all, to hunt down every last sea otter they could). Then new workshops and craftspeople took up the "native" design: By the late 1800's in Europe, canvas-and-wood versions of the kayak were being made by scores of new companies and sold to a growing middle class as a new kind of recreation. This phase led to the evolution of new shapes and sizes—stubby whitewater kayaks for shooting over rapids, broad "touring" boats for a quiet day on a lake, surfboard-like contraptions with indentations for seats that also include fish-finders and paddles for anglers, "folding boats" with frames like tent poles and hulls of thick polyurethane, and racing boats so knife-like they can't stay upright unless they're speeding forward.

Later, new materials and technology led to disruptive change; in the 1950's, for instance, the availability of fiberglass permitted mass manufacture that more closely resembled the original Arctic designs. And in the 80's, a new manufacturing technique—filling a mold with plastic pellets, then heating them until they melt together into the shape of the mold—allowed companies to make plastic kayaks, which were cheaper and less delicate, but they attracted many more people to the sport.

Yet this era of lower prices and mass marketing coincided with a resurgence of interest in the spirit and techniques with which kayaking began. For the past few decades, more and more paddlers have taken an interest in kayaks made by the hands that will paddle them, with material that has been neither synthesized nor extruded, but grown. Some have used wood ("nature's own composite material," Schade calls it) and fiberglass; others, wood and modern materials that

STORY BY DAVID BERREBY
PHOTOGRAPHY BY IAN MERRIT

mimic animal parts (for example, one kayak maker, Brian Schulz, uses artificial sinew for his thread and the type of nylon in bulletproof vests for his skin). The 1980's, that decade of the "rotomolded" kayak, was also when writer George Dyson delved into the lore and physics of the Aleut baidarka, recreating those skin and wood boats with nylon and aluminum, and paddling his experiments for thousands of miles. (His book, "Baidarka," is the best account of the culture, history and physics of these craft.) As the definition of "kayak" has been stretched across new purposes and materials, many paddlers have returned to its roots, with appreciation for the kayak makers' ability to deal with unforgiving physics.

The problems that have to be solved to design one of these boats successfully might sound familiar to anyone who has tried to run an organization. A successful kayak design emerges from the tension between competing imperatives: Be sturdy but agile, fast but stable, simple to keep on course but easy to maneuver in quick-changing conditions, true to an ancient tradition but informed by the latest engineering, obedient to the laws of physics

and the demands of a fickle market. "No aspect of a kayak functions in isolation," Dyson has written. "It's a series of compromises," says Schade. "If you want maneuverability, you want the boat to be short; if you want fast, you want the boat to be long. If you want a fast, maneuverable boat, you've got to decide where you want to come out in between." It is not a job for the impatient, or for anyone who doesn't want to get their hands (literally) dirty and their feet (literally) wet. When Schade has a design idea that he believes will make a workable boat, he paddles the prototype for at least 1,000 miles before he's convinced the design will work. Testing can easily take a year.

A well-designed boat stays upright in one of two ways. It can resist any shift in the alignment of the center of gravity and the center of buoyancy, "wanting" to stay level on the water (which calls for a broader hull with a flatter bottom). Or it can compensate well for tipping, by being shaped so that whenever the center of gravity moves, the center of buoyancy slides under it in time (which requires a narrower hull and a curved or even V-shaped bottom).

Keeping the paddler up is, of course, only the first of many design challenges. Slight variations



in conditions— even in water temperature—will affect how quickly and easily the kayak does what the paddler needs it to do.

As a kayak moves forward, propelled by the paddle pushing rhythmically on one side and then the other, over and over, the water around it pushes back. In accordance with Isaac Newton's Third Law of Motion (for every action, there is an equal and opposite reaction), the water displaced by the boat will come back. The act of displacing water creates waves at the bow and the stern, which also bump up against the boat and slow its progress. In other words, some of the resistance to a kayak's motion is created by that motion itself.

Meanwhile, the natural waves of the sea also create resistance (the amount of which is a function of wave height and length), because as they well up, they increase the volume of water that the kayak has to push out of the way to advance. Moreover, unlike longer boats, kayaks must also reckon with the effects of wave frequency. All vessels in water experience a natural oscillation as they push water aside and the water then pushes back up. If this oscillation happens to match the frequency of waves hitting the boat, the effect of the waves can be amplified by mechanical resonance, bouncing the kayak around and slowing it further.

Water molecules are tightly bound and resist being pulled apart (which is why rain beads up into drops, and why you can fill a glass of water above the rim). This means every unit of water in the sea is subject to friction as it is tugged by other units of water that are moving faster or slower than it is. This friction gives every liquid, be it water or honey or mercury, its characteristic viscosity. Viscosity in paddling is the kayaker's friend—it fosters an orderly relationship between a moving kayak and the water it passes through, in which (as Dyson quotes the 19th-century Scottish naval architect John Scott Russell to explain) "the whole skin of the ship is covered with a thin layer of water, which adheres to it firmly and travels with it; to this first film a second is attached,

which moves with it but which has to drag along with itself a third resisting film, which sticks to it; a fourth, fifth and sixth film, all in the same manner hang on to one another, until at last we reach a film which stands still." This "laminar flow" minimizes the water's resistance to the boat's forward motion.

Modern naval designers have a variety of conceptual tools to cope with these hydrodynamic challenges. There is, for example, the "prismatic coefficient" used by naval architects. The prismatic coefficient is found by dividing the size of the immersed section of a boat by the size of an imagined rectangle whose length is the length of the boat and whose width is the boat's width at its widest point. (It is as if they were comparing the actual boat's shape with that of a board from which that shape was sawed.) A kayak whose waterline tapers to delicate points has a prismatic coefficient around 0.45, Schade writes. A more canoe-like kayak with a blunter bow and stern might have one closer to 0.6. That boat will be capable of higher speeds, but if those higher speeds create turbulence, the resulting drag will make that higher speed impossible to maintain for long. As Schade puts it, "You don't want a design that sacrifices efficiency at cruising speed for a maximum hull speed that will be used only in a sprint."

In our 21st century of high-tech materials, computer-aided design, a globalized supply chain and precision manufacturing, there are many



more possible solutions to challenges like these. Kayaks are made these days out of Kevlar and carbon fiber, and designed with the same tools used for yachts and battleships. Schade says he got an idea for one of his designs from a 1923 powerboat. "I saw a picture of it and thought to myself, 'There's a kayak in this,'" he says. Yet the fundamental insights into these challenges emerged in the Arctic thousands of years ago.

Each kayak must be fitted to the individual who will paddle it. After all, for thousands of years, each kayak was made by a particular man and his particular family, for his own particular body and requirements. (Dyson, for example, recounts how in 1933 an Aleut man named Black Stepan Britskalov explained his rules for building a baidarka: "diameter of the first man-hole, one lower arm plus the hand; width of the lower prow, three to four fingers, width of the upper prow, three to four fingers," and so on.)

One of the biggest mistakes potential paddlers make is to assume that there is such a thing as the right kayak that works for everyone. "This one friend of mine," Schade says, "he buys two or three boats a year, looking for the perfect boat. He's switching so much he's never improving himself. I like to say, 'There's no such thing as a fast boat, only a fast paddler.'"

You might say, then, that the kayak has come full circle: It is now, as it was thousands of years ago, the ultimate personalized product—a form of self-reliance and self-expression that weds the universal physics of motion and fluids with the needs and taste of the one adventurer who will take it out onto the waves. K/F





You Can Never Know Less

J O E L K U R T Z M A N

THE OTHER NIGHT I was reading about the race to the moon in a book written by one of the scientists who managed the project. The book, which was self-published and could have used one more edit, was filled with interesting facts about an intensely heroic time in history.

Scientists and technologists faced daunting challenges. Not only did they have to design, construct, launch and control a rocket that weighed 6.2 million pounds, stood 363 feet tall (the height of a 33-story building) and had three human explorers on board, they had to do it in only 10 years. And you think winning at “Jeopardy!” is hard.

Outside of war, challenges like that are rare. The space race, between the United States and what was then the Soviet Union, was not about conquest, but about influence. The idea was that people around the world would want to identify with the country that

had the best claim on the future. Which country would that be? The country with the smartest scientists, the best engineers and the finest technicians. To demonstrate their prowess, the Americans and Soviets gave themselves an impossible challenge.

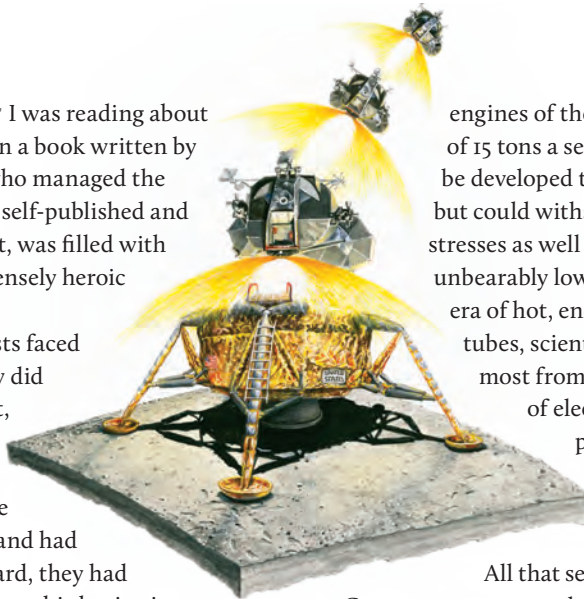
The difference between what they did and what we do is that so much of the space program had to be invented, not adapted from older technology. Pumps had to be designed that could push liquid fuel and oxygen, cooled to minus 356 degrees, into the main

engines of the Saturn rocket at a rate of 15 tons a second. Materials had to be developed that were lightweight but could withstand tremendous stresses as well as extremely high and unbearably low temperatures. In the era of hot, energy-hungry vacuum tubes, scientists had to invent, almost from scratch, a different kind of electronics to make computers, communication systems, navigational instruments and control devices.

All that seems like ancient history now. Computers are everywhere. We have mobile devices, self-parking and self-driving cars, Google glasses, phones and tablets that can tell you where you mislaid them, and social media. We live in a world where things talk to things. But the rough draft of much of today’s technology was sketched out for the launching pad that would take astronauts to the moon.

R. Buckminster Fuller, the mathematician and designer, said that knowledge always (and only) expands. He argued that we can never know less than we know today. Someone develops a new gizmo that can pump fluids into rocket engines at insanely high rates, and someone else adapts that gizmo for use on passenger planes. Someone invents sensors to monitor an astronaut’s heart rate, and soon they are in every doctor’s office. Knowledge increases, and when it does, it spreads.

So, the question is, are we producing new knowledge fast enough? Forty-plus years ago, to demonstrate their grasp on the future, two countries competed to send explorers to the moon and to return them safely to Earth. Isn’t it time to do something equally bold? K/F



IN MEMORIAM

This issue of *Briefings* is dedicated to the memory of **Robert McNabb**. A loving friend, colleague and Korn/Ferry partner.



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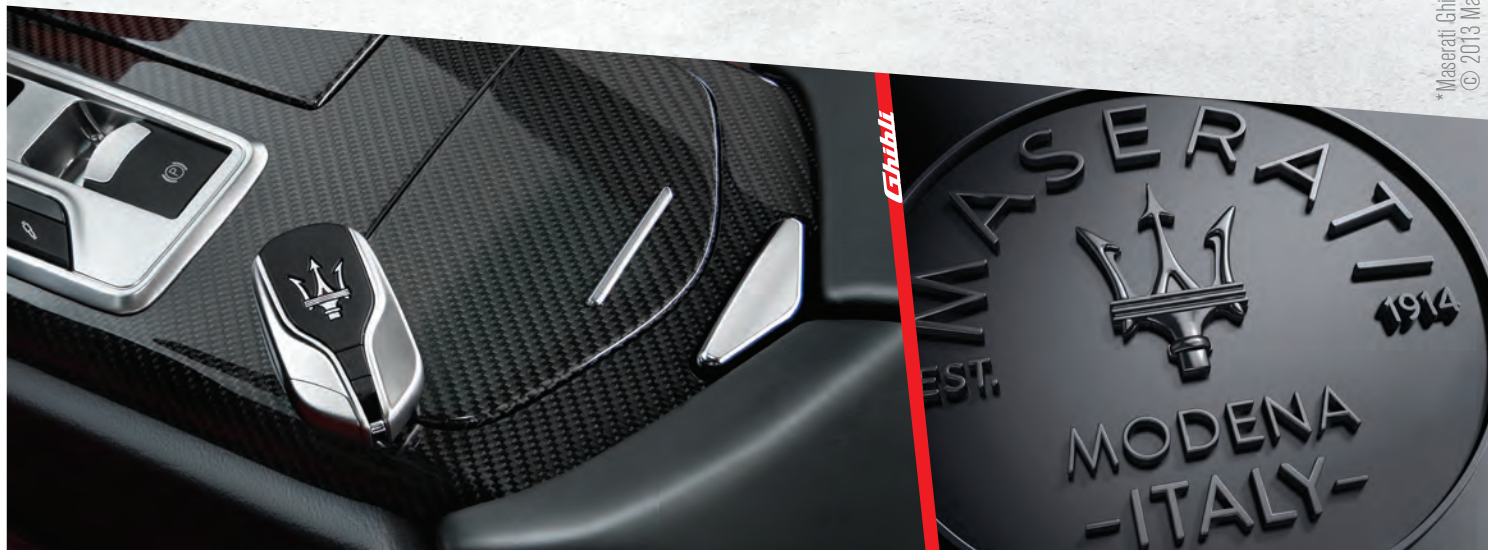
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