THE NEW NEW

BEYOND DETROIT

by CHARLES C. MANN

THE SECRET OF GOOGLENOMICS

by STEVEN LEVY

THE NEW SOCIALISM

by KEVIN KELLY

conomy

by **CHRIS ANDERSON**

THE ERA OF THE HUGE CONGLOMERATE IS OVER. THE FUTURE OF BUSINESS WILL BE MORE STARTUPS, FEWER GIANTS, AND INFINITE OPPORTUNITY.

As the Internet was taking shape in the late 1980s, an MIT professor named Tom Malone started thinking about how it could change the structure of industries. In a series of papers, he predicted that the big top-down companies of the 20th century would soon "decentralize and externalize" into industry ecosystems.

"Imagine an AT&T that breaks up into not two or three different companies but two or three hundred thousand different companies," Malone told WIRED in a July 1998 interview. "This sort of voluntary, radical disaggregation is an attractive alternative for some large organizations."

It simply stood to reason: Huge vertically integrated conglomerates were created to minimize what economist Ronald Coase called transaction costs between teams and up and down the supply chain. Now distributed-information networks would do the same outside the walls of a single company. The Web would be globalization taken to the extreme. Projects would be open to the best of breed anywhere, creating virtual flash firms of suppliers and workers that would come together for one product and then re-form for another. "Small pieces, loosely joined" was the mantra.

But out in the reality of the world's great industries, the opposite seemed to happen. Corporations just kept getting bigger. On Wall Street, Goldman Sachs was pulling in almost $90 billion a year, tripling annual revenue in less than a decade. The pharmaceutical industry consolidated through hundreds of mergers and acquisitions. The Fortune 10, which today includes Wal-Mart and General Electric, more than tripled in size since 1990. And AT&T, far from breaking up into 300,000 different companies, became even bigger than before and, once again—at least for iPhone users—a monopoly.

And then last September it all came toppling down. Those big financial firms turned out to have been inflated by debt at levels never before seen (and hopefully never repeated). The big car companies crashed head-on into skyrocketing oil prices and plummeting consumer demand. Big Pharma ran out of blockbusters. Wal-Mart kept closing stores, while GE tried to sell off divisions. (OK, AT&T is still an iPhone monopoly, but give it time!)

So now, in the graveyard of giants, it's worth asking: Was Malone right? Was his age of nimble mammals simply delayed by the final march of corporate dinosaurs into the tar pits?

This crisis is not just the trough of a cycle but the end of an era. We will come out not just wiser but different.

What we have discovered over the past nine months are growing diseconomies of scale. Bigger firms are harder to run on cash flow alone, so they need more debt (oops!). Bigger companies have to place bigger bets but have less and less control over distribution and competition in an increasingly diverse marketplace. Those bets get riskier

illustration by **ANDY GILMORE**

and the payoffs lower. And as Wall Street firms are learning, bigger companies are going to get more regulated, limiting their flexibility. The stars of finance are fleeing for smaller firms; it's the only place they can imagine getting anything interesting done.

As venture capitalist Paul Graham put it, "It turns out the rule 'large and disciplined organizations win' needs to have a qualification appended: 'at games that change slowly.' No one knew till change reached a sufficient speed."

The result is that the next new economy, the one rising from the ashes of this latest meltdown, will favor the small.

Take Detroit. The only way for the Big Three to survive, Charles C. Mann writes in the following story, is to harness the innovation of the myriad startups working on automotive technology.

Or take Google. As Steven Levy explores on page 108, the company deploys a bottom-up model for ad sales, dictated not by firm handshakes but by hard math.

Or even society at large. A century ago, mass collective action could be organized only by the state. Now we have the Web. Kevin Kelly resurrects socialism—without the state—on page 116.

To all the usual reasons why small companies have an advantage, from nimbleness to risk-taking, add these new ones: The rise of cloud computing means that young firms no longer have to buy their own IT equipment, which helps them avoid having to raise money or take on debt. Likewise, the webification of the supply chain in many industries, from electronics to apparel, means that even the tiniest companies can now order globally, just like the giants. In the same way a musician with just a laptop and some gumption can accomplish most of what a record label does, an ambitious engineer can invent and produce a gadget with little more than that same laptop.

"Involuntary entrepreneurship" is now creating tens of thousands of small businesses and a huge market of contract and freelance labor. Many will take full-time jobs again once they become available, but many others will choose not to. The crisis may have turned our economy into small pieces, loosely joined, but it will be the collective action of millions of workers hungry for change that keeps it that way.

CHRIS ANDERSON (canderson@wired.com) *is* WIRED*'s editor in chief.*

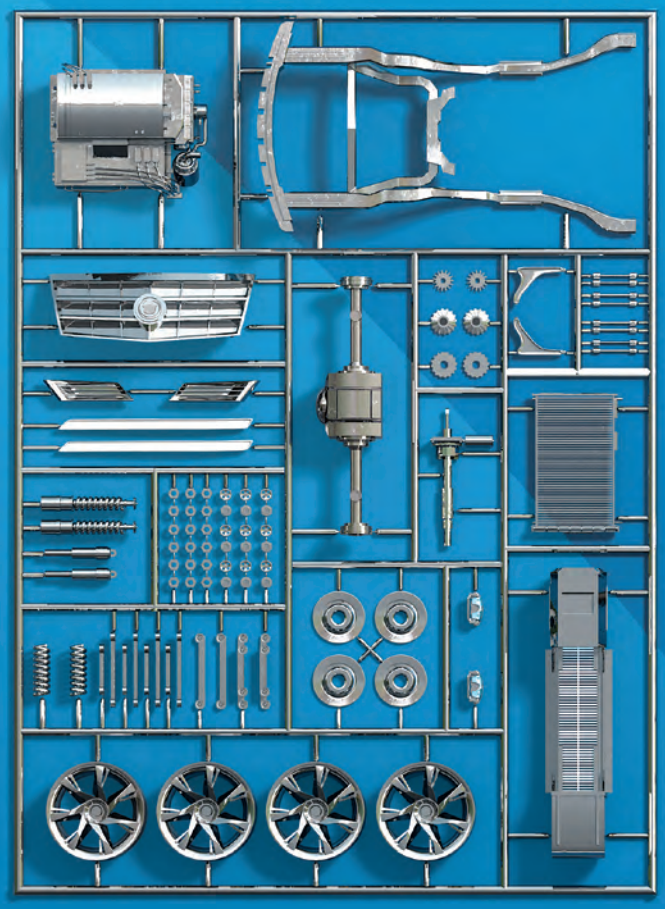
Nimble competitors, broken business models, crazy gas prices—and those are just a few of the problems facing US car companies. There's only one road to recovery: Let the little guys drive.

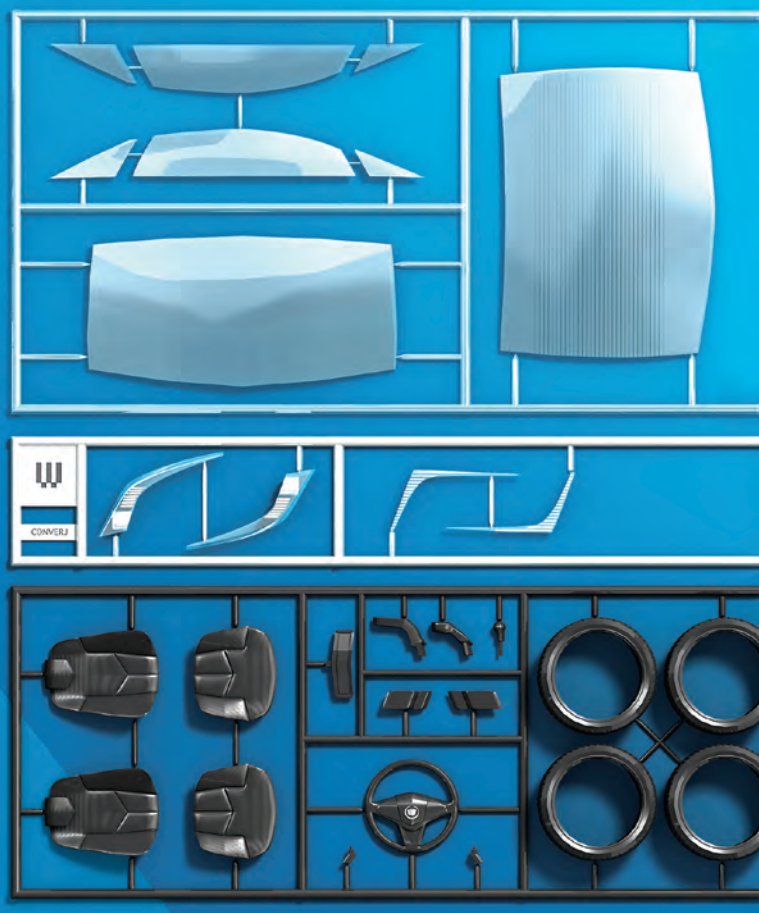
by **CHARLES C. MANN**

100

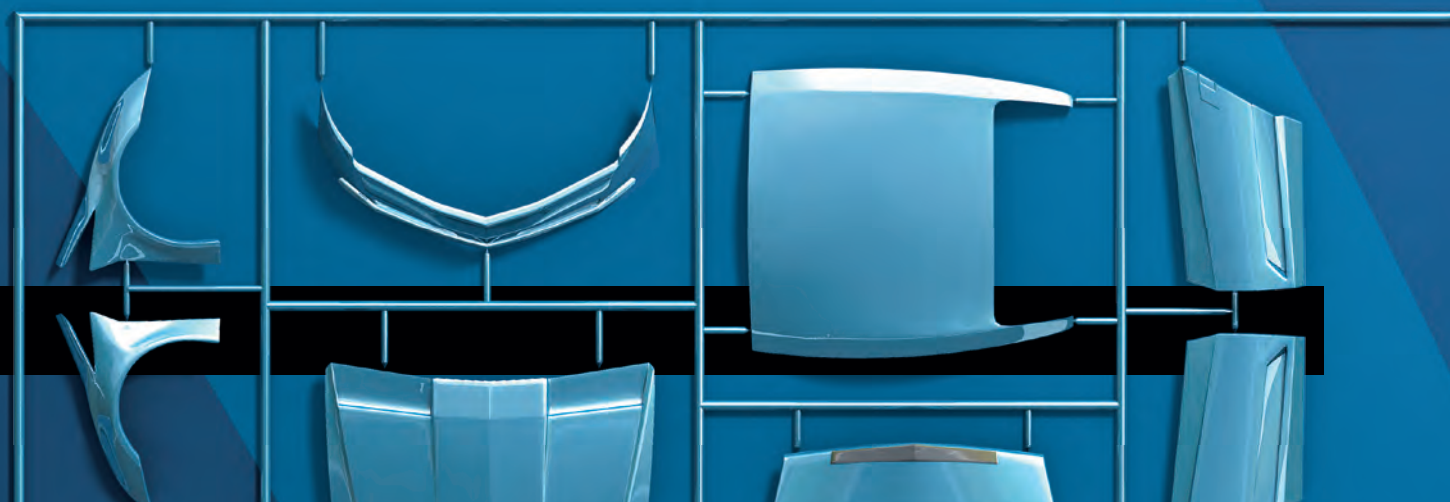
BEYOND

illustrations by **BRYAN CHRISTIE DESIGN**





Detroit



The offices of Transonic Combustion are not going to win any design prizes. Located in Camarillo, California, the company occupies a line of anonymous rooms and padlocked garage workshops at the edge of town, where land is cheap and prying eyes are scarce. Alloy-frame bicycles lean against the walls of the computer-stuffed workspaces; wastebaskets overflow with empty Mountain Dew cans. So many nondisclosure agreements have spewed from the printers on the tables that they must be capable of producing them without human intervention.

It looks, in other words, like any other high tech startup trying to make its mark in software, electronics, biotech, or energy. But Transonic isn't working in any of those fields. Instead, it is part of a surprising wavelet of innovation in an industry largely dismissed by venture capital: automobiles. The company makes a special breed of fuel injectors, which use advanced technology to force precisely timed, high-pressure bursts of gas-air mixture into engines to increase their power and efficiency. Tests are not complete yet, but Transonic believes that its products could help drivers get as much as 100 miles per gallon out of otherwise standard internal combustion engines. "If you double gas mileage, that ultimately cuts consumption by about half," Transonic president Brian Ahlborn says. "We're in business to make money, but we're aware of what that kind of dramatic drop could imply." He hopes that in the next few years Transonic fuel injectors will be in millions of vehicles, saving millions of gallons of gas a year.

Not long ago, Ahlborn's dream would have seemed quixotic. Detroit's Big Three automakers have for decades been notoriously hostile to outside innovation; *Flash of Genius* and *Tucker*, films that decry the industry's insularity, are both based on true stories. No small US company has grown into a big carmaker in the past 50 years—one of the reasons that the automobile itself hasn't changed more fundamentally during that time. "It's as if the computer industry were still dominated by Wang and Data General and DEC, and they were still selling minicomputers," says Henry Chesbrough, executive director at UC Berkeley's Center for Open Innovation.

Nonetheless, the automotive startup world is sputtering to life. Venture capitalists invested roughly $300 million in young car-related companies last year, up from $8 million in 2003. Dozens of startups are dipping a toe in the water, many in the high tech corridors near Boston and in Southern California (see "Next Year's Module," page 106). Some, like Transonic, focus on nitty-gritty hacks of machines that exist today. Others are assembling fanciful all-electric sports cars that may cost as much as a small house. But all of them are trying to jump-start the industry with new ideas, vigor, and technology.

Detroit desperately needs them. US automakers' share of the domestic market has plummeted nearly 30 percentage points since the early 1980s. The federal government has unceremoniously ousted the head of General Motors. By the time you read this, two of the Big Three may be in bankruptcy, a bleak capstone to years of collapsing stock prices, shrinking margins, and cascading layoffs. Some analysts believe not one of the major US carmakers will exist a decade from now. And while there are plenty of historical explanations for Detroit's sorry state—vicious labor relations, uncontrolled health care costs, neglected quality control—the most fundamental problem is also the hardest to overcome: The most innovative cars are no longer made in America.

If a domestic auto industry is to survive, it will have to incorporate and encourage breakthroughs from outsiders like Transonic. Automakers will need to transition from a vertical, proprietary, hierarchical model to an open, modular, collaborative one, becoming central nodes in an entrepreneurial ecosystem. In other words, the industry will need to undergo much the same wrenching transformation that the US computer business did some three decades ago, when the minicomputer gave way to the personal computer. Whereas minicomputers were restricted to using mainly software and hardware from their makers, PCs used interchangeable elements that could be designed, manufactured, and installed by third parties. Opening the gates to outsiders unleashed a flood of innovation that gave rise to firms like Microsoft, Dell, and Oracle. It destroyed many of the old computer giants—but guaranteed a generation of American leadership in a critical sector of the world economy. It is late in the day, but the same could still happen in the car industry; it just has to harness our national entrepreneurial spirit to develop the next wave of auto breakthroughs.

THE AUTO INDUSTRY MUST LEARN TO INCORPORATE IDEAS FROM OUTSIDERS—AS THE PC INDUSTRY DID 30 YEARS AGO.

Transforming US auto manufacturing would be an enormous task. It would require the cooperation of the federal government to help create the conditions under which innovators can thrive—primarily by removing the energy and health care obstacles that now stand in their way. But now is the time to do it. The specter of global economic collapse has forced politicians, labor, and industry to abandon some of their most entrenched and dysfunctional ideas. Eventually, a reconfigured car industry could leapfrog Europe and Japan the way Toyota began to outpace Detroit 30 years ago. Indeed, such a radical reconfiguration may be the only way this vital industry can survive on these shores. "They're going to have to swing for the fences," says Steven Klepper, an economist at Carnegie Mellon University who studies industry innovation. "The only way I can see for them to win the game is to change it entirely."

I should declare a personal interest here. My father worked as a Big Three executive for much of my childhood, most of that time at Ford. He left to run his own marina, but he always remained loyal to Detroit. He never bought a foreign car. I didn't buy one until after his death, and even then I felt like I was thumbing my nose at his memory. I would like to return to a US product. More than that, I would like millions of Americans—people who don't share my sentimental ties—to come back to vehicles from US companies.

My father spent his days at the "Rouge," in Dearborn, outside Detroit. Once the biggest factory complex in the world, it had its own electricity plant, its own steel mill, even its own docks on the River Rouge that were big enough to handle deep-water vessels. Raw materials were unloaded on those docks, shuttled around the plant on 100 miles of internal railroad, and turned into finished vehicles, entirely inside the high factory walls. The Rouge made every major component for every model it produced except the tires—the company even tried to make the tires for a while, buying an Amazonian rubber plantation twice the size of Delaware in the 1920s.

The Rouge was an embodiment of the vertical integration that has defined the US car industry since the days of Henry Ford. Initially, the complex was Ford's attempt to solve a manufacturing problem; in the days before networked communication, coordinating precisely with small suppliers was impossible, which meant he couldn't ensure that all the parts for his cars would be ready at the right time and in the proper condition. Ford's answer: total control. By trusting as little as possible to outside entities, he was able to guarantee that his factories got what they needed when they needed it.

But by the 1970s, this system's deficiencies—bureaucracy, groupthink, and inflexibility—were obvious. Toyota-style production, with its dramatically smaller parts inventories and workers who functioned in teams, was much more efficient. Japanese companies also enjoyed better relationships with labor, more-dedicated employees, and centralized purchasing that allowed them to take advantage of economies of scale. It took a long time—far too long—for the Big Three to adapt, but they finally did. Detroit began adopting lean production methods in the late 1980s, and by 2007 it had repaired its labor relations enough to win important benefit concessions. General Motors also centralized its fragmented organization to benefit from massive economies of scale. (The rest of Detroit is still several years behind GM in this regard, according to David Cole, chair of the Center for Automotive Research in Ann Arbor.)

The costs of these shifts were huge and painful—the once-proud Rouge was nearly shut down altogether—but almost everyone inside and outside of Detroit believes they were worth the hurt. When the transition is complete, lean production, labor concessions, and globalization will have shaved nearly $5,000 off the cost of every new vehicle from Detroit. Many consumers may still regard US carmakers as high-cost, low-quality manufacturers, but in truth they have largely caught up with—and in some cases surpassed—their Japanese competitors.

But even this extraordinary effort may well not be enough. Consider the 2010 Fusion hybrid, Ford's next-generation gas-electric, launched in March. Driven by a nickel-metal hydride battery that is smaller, lighter, and more powerful than the one in the previous model, the car has a novel electronic dashboard that uses visual cues to train drivers to maximize mileage. The Environmental Protection Agency rates the car at 41 mpg for city driving, though many reviewers report getting 50 mpg or more. Ford did focus far too long on its highly profitable pickup trucks

Traditionally, the Big Three design most of their car components in-house. These Jeep doors are ready for the assembly line in Chrysler's Jefferson North Assembly Plant in Detroit.

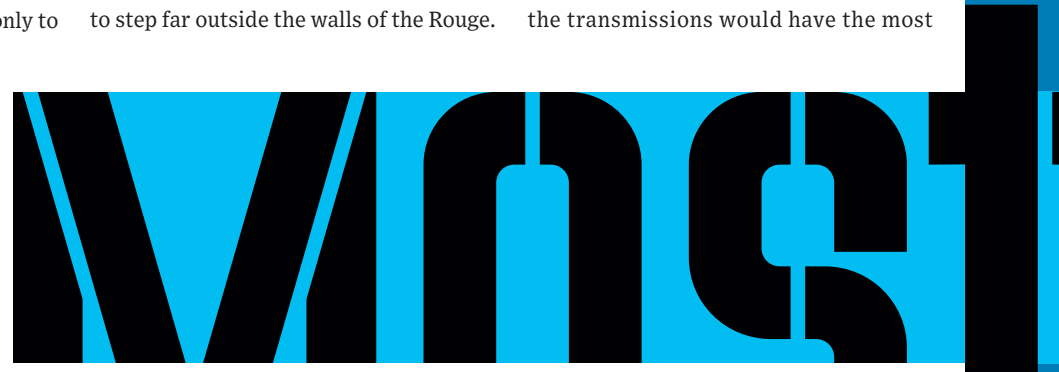
FLOTO + WARNER

and SUVs, and it was blindsided by the public interest in hybrids, which soared with the US arrival of the Toyota Prius in 2000. But now it has crashed through a top-of-the-line, technologically advanced product in record time. Sleekly styled and innovative, the Fusion "proves what I've been writing and saying for years," proclaimed *Washington Post* auto writer Warren Brown. "Detroit makes good cars."

Alas, so does the competition. One month after the Fusion came on the market, Honda launched a new version of the Insight, a five-passenger hybrid with almost the same fuel efficiency as a Fusion—and a base price of $19,800, about a quarter less than the Ford's $27,270 price tag. One month after that, Toyota introduced its third-generation Prius, rated by the EPA at 50 mpg—now the most fuel-efficient vehicle in the US market. A similar fate may well await GM's forthcoming plug-in electric car, the truly innovative Chevrolet Volt, which unlike typical hybrids uses its gas engine only to charge and extend the range of its heavy-duty battery, drastically cutting fuel consumption. The problem is that "the rest of the Volt is just an ordinary family sedan, for which they are charging more than $40,000," says Michael Cusumano, a professor at MIT's Sloan School of Management. "If they sell more than a few thousand, I'll be surprised." Meanwhile, according to current timetables, by the time the Volt goes on sale in late 2010, Toyota will have already released its own plug-in version of the fashionable Prius.

By seeking to match the likes of Toyota, Detroit has been trying to come from behind in a game where its adversaries set the rules. To Klepper, the Carnegie Mellon economist, the Big Three today resemble the American television-receiver industry in the 1970s and 1980s, pioneered by US corporations that, after decades of domination, were suddenly confronted by foreign innovation. Companies like RCA and Zenith were slow to incorporate new technologies until it was too late; all exited or sold out to foreign firms. "Every time American companies catch up to the competition," Klepper says, "the competition already has moved on and instituted new things. In that situation, it's extremely difficult to get ahead."

The only escape from this conundrum is to pursue what Harvard Business School professor Clayton Christensen has called disruptive innovation—the kind of change that alters the trajectory of an industry. As Christensen argued in his 1997 book, *The Innovator's Dilemma*, successful companies in mature industries rarely embrace disruptive innovation because, by definition, it threatens their business models. Loath to revamp factories at high cost to make products that will compete with their own goods, companies drag their feet; perversely, financial markets often reward them for their shortsightedness. Good as they are, the European and Japanese automakers are established companies. At this point, they are as unlikely to pursue disruptive innovation as Detroit has been. That gives the US auto industry an opening. To take that opportunity, it will have to behave differently—it will have to step far outside the walls of the Rouge.



■ **Most modern automobiles** have a long, serpentine belt that winds intricately through the engine compartment. Driven by the engine, it powers the accessory system: the alternator, water pump, AC compressor, and a handful of other components. During city driving, the engine turns slowly, which spins the belt slowly, which in turn pumps the compressor slowly. Running at low efficiency, the air conditioner must be enormously powerful to keep the car cool—so powerful that car and truck air conditioners account for about 5 percent of annual US motor fuel consumption. Similar problems plague alternators, which provide little charge to the battery during the start and stop of most driving.

Fallbrook Technologies, a San Diego startup, has raised $50 million to solve this problem. It hopes to squeeze more power from the serpentine belt by building simple, cheap transmission components that will power the accessory system more efficiently. Unlike standard transmissions, which move from gear to gear in distinct steps, transmissions using Fallbrook's technology move along a smooth continuum, allowing it to function more effectively at low speeds and to drive accessories at a constant velocity, no matter how fast the engine is turning. Typically, automobile transmission systems have hundreds of parts, many of which must be manufactured to high precision. Fallbrook's has fewer than 50, of which the most critical is a set of stainless-steel ball bearings—"the cheapest precision-machined product in the world," says Fallbrook CEO William Klehm, a former Ford executive. Preliminary tests on military vehicles show that Fallbrook's tech can make alternators produce 75 percent more power at idling speed. Although the transmissions would have the most impact on tomorrow's electric cars, Klehm says they can be used almost immediately to benefit gas engines, too.

When Klehm was working for Ford, a small outfit like Fallbrook would have had little chance of engaging the industry. "There was a big NIH problem," he says. "If something was 'not invented here,' we didn't want it." Detroit has long worked with outside suppliers, but the relationship has typically been one-way and often hostile; car companies specify exactly what services they need and how much they'll pay for them. Since the 1990s, the Big Three have forced suppliers' prices down so much that many are edging toward bankruptcy. At the same time, the industry has tried to loosen up, outsourcing production to independent firms. However, these efforts have done little to change the

underlying dynamic, in which the automakers exert an enormous amount of control over a handful of giant suppliers. None of the big manufacturers have regularly allowed Silicon Valley–style innovators like Transonic and Fallbrook into the core of their products.

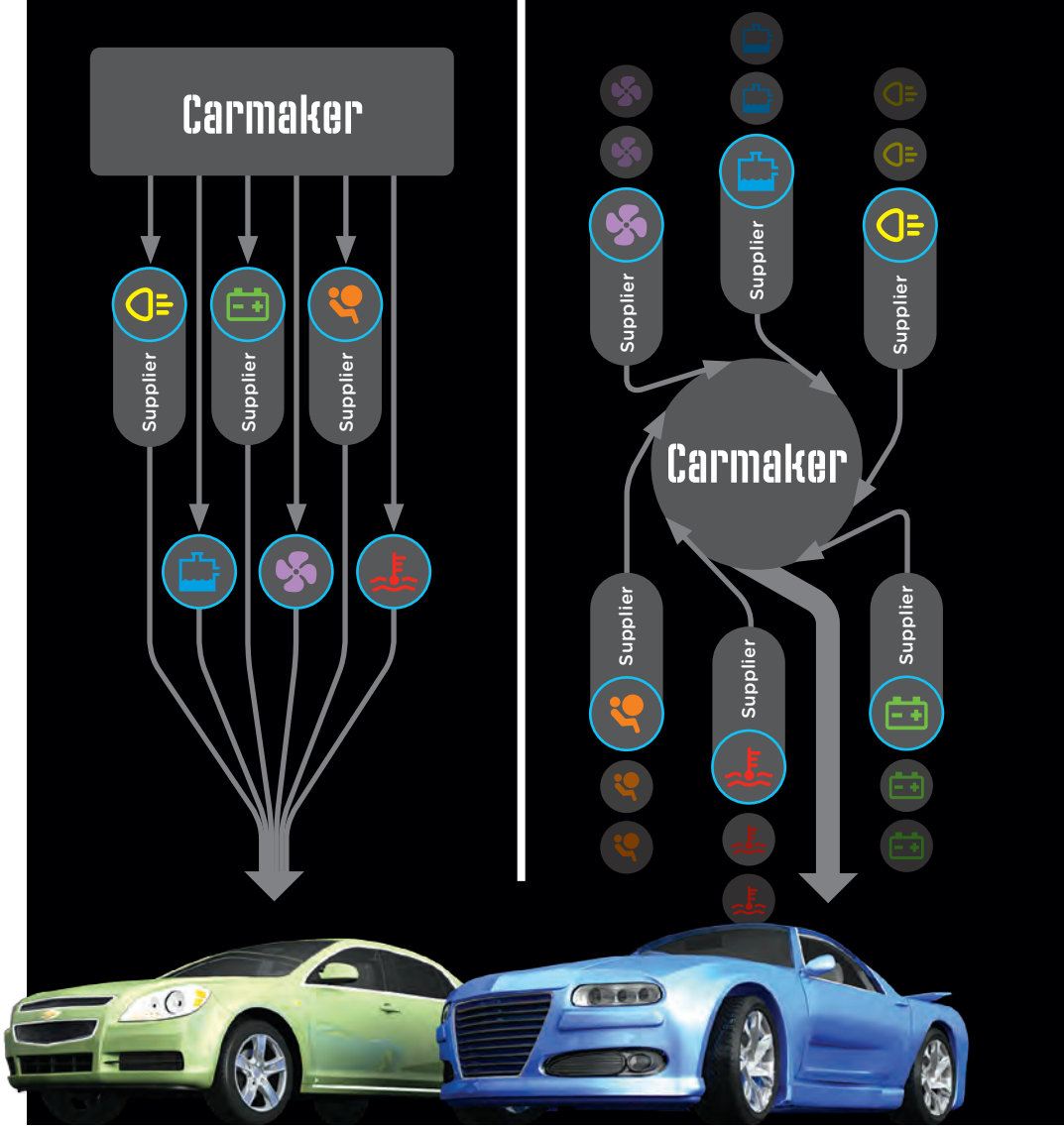
Even inside the companies themselves, the industry draws on a narrow well of innovation. Detroit does work with the University of Michigan, an excellent school. But the Big Three pull in few employees from other top colleges. "Our students have basically not been joining GM, Ford, or Chrysler for 20 years," MIT's Cusumano says. "They go to companies like Intel, Cisco, and Hewlett-Packard." One consequence, he says, is that when young engineers and designers launch their own firms, the last sector they think of is the auto industry. "It's seen as a place that isn't interested in new ways of doing things."

In its insularity, the auto industry is increasingly an outlier. A growing number of firms have adopted what UC Berkeley's Chesbrough dubbed "open innovation"—accelerating change by letting ideas flow much more freely in and out of companies. Rather than depending primarily on their own engineers, he says, auto companies should leverage the insights of others, outsourcing much or most R&D to an ecosystem of small, agile entities outside the factory walls. Unsurprisingly, open innovation is seen most clearly in firms like IBM, Alcatel-Lucent, and Millennium Pharmaceuticals, but Chesbrough argues that it has been picked up with success by companies in fields ranging from chemicals and packaged goods to lubricants and home-improvement gadgets. "The auto industry is different," he says. "It hasn't learned that no one company or industry has a monopoly on useful ideas."

Nobody can say which companies will come up with the inventions that revive the auto industry—Transonic, Fallbrook, any of the other startups, or some company yet to be created. A few years ago, a 1978 photo of Microsoft's founders—a disheveled bunch of geeks—made the email rounds under the subject line "Would you have invested?" No single company could have foreseen or designed the modern computer industry, just as the Big Three cannot predict the eventual shape of

Manufacturing, Retooled

The Detroit-knows-best model for automaking has broken down. A better way: Build an ecosystem of innovation that harnesses the best ideas and technologies, wherever they originate.



the US auto industry. But they can build the ecosystem that allows it to develop.

How does a traditionally top-down manufacturer become an open-ended promoter of innovation? Clues can be found in "Managing in an Age of Modularity," a classic 1997 *Harvard Business Review* paper by economists Carliss Baldwin and Kim Clark. They studied how personal-computer manufacturers divided their products into subsystems, establishing standards that allow parts to be readily swapped out and replaced. By giving outside innovators the freedom to tinker with individual modules—hardware, operating systems, software, peripherals—PC makers spurred the development of far more sophisticated devices and allowed customers to individualize and customize their purchases. In other words, modularity encouraged multiple innovations from multiple sources and made them easy to incorporate.

The analogy between cars and computers can't be taken too far. Because automobile design and manufacturing flaws can kill people, the industry is properly governed by strict regulations—and subject to continual product-liability litigation. As a result, automakers will never be able to release a set of standards, then snap together a working automobile out of whatever components entrepreneurs happen to come up with. But they can use this model to rethink how they approach innovation and manufacturing.

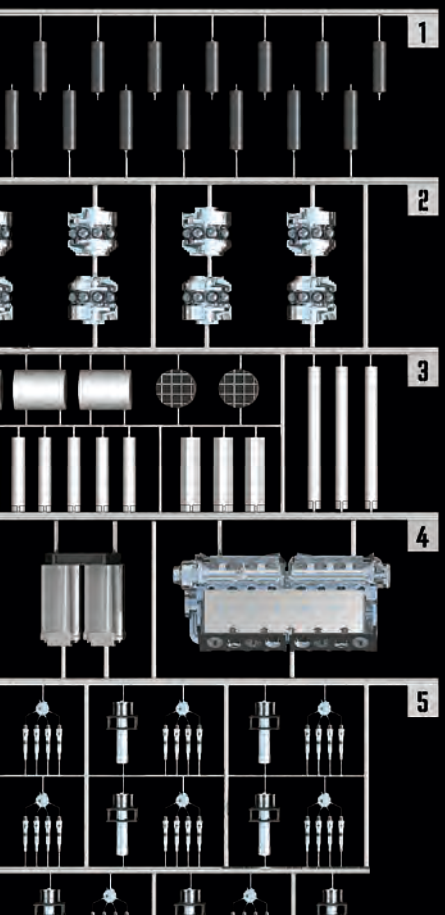
Indeed, a precursor already exists. In 2000, GM inaugurated a new complex in southern Brazil. Rather than following the still-dominant Rouge model, the Gravataí factory consisted of 17 separate plants, 16 of which were occupied by suppliers, including Delphi, Goodyear, and Lear. Unlike elsewhere in the auto world, the Gravataí suppliers didn't just carry out GM's blueprints but took an active role in designing their subunits: fuel lines, rear axle, exhaust and cooling systems. Suppliers delivered preassembled modules to GM workers, who plugged in the pieces to make cars much more quickly than plants in the rest of the world.

Despite its achievements, the Gravataí model has largely been ignored. It should have been extended. Instead of limiting the number of suppliers, companies could encourage startups to join the supplier network, working to meet industry specifications while bringing their own ideas and innovations to the table. As in Gravataí, the car company would act largely as a coordinator and assembler, piecing together interchangeable units to create a complete vehicle.

The growing dependence of cars on computers will accelerate this process. The typical 2009 car includes about 200 electronic sensors and some 40 networks, monitoring everything from temperature to tire pressure. Outside firms are already largely responsible for the electronic equipment that reduces emissions by controlling the mixture of fuel and air combusted by the engine; they also largely developed electronic stability control, the network of actuators and controllers in the suspension that helps prevent skids. One can readily imagine

Next Year's Module

In a new, modular car industry, the Big Three could plug into the legion of nimble component companies that are eager to develop and manufacture the next wave of automative breakthroughs. Here are five promising firms and the products that might help US carmakers regain the mantle of innovation. —C.C.M.



A123Systems
WATERTOWN, MASSACHUSETTS
Nanophosphate lithium-ion batteries that are optimized for electric vehicles. Chrysler and Norwegian electric-car maker Think both plan to use A123's products in future models.

Fallbrook Technologies
SAN DIEGO, CALIFORNIA
Continuously variable transmission components, which could let cars accelerate without shifting gears. Currently being developed to help alternators and AC units run more efficiently.

GEO_2 Technologies
WOBURN, MASSACHUSETTS
Spongelike, rigid ceramic for diesel vehicle filters. Increased airflow reduces back pressure, boosting fuel efficiency and power. Could be used to give smaller gas engines more pep.

ISE
POWAY, CALIFORNIA
Heavy-duty gas/diesel-electric hybrid drive systems for buses, trucks, tractors, even trams—a market almost completely ignored by major automakers.

Transonic Combustion
CAMARILLO, CALIFORNIA
Advanced fuel-injection system that brings fuel and air to a "supercritical" state increasing its explosive power and decreasing pollutants. Can be used on gas, diesel, and ethanol engines.

garage entrepreneurs in Silicon Valley—or platoons of data-crunchers at Google—building software-driven devices that make cars run more cleanly, efficiently, and safely. Scott McCormick, president of the Connected Vehicle Trade Association, foresees a future in which networked cars constantly communicate with one another and the road, helping drivers avoid traffic jams and accidents. Plenty of tech companies would be happy to take part in accomplishing that vision.

By outsourcing most R&D, car companies would be able to reap the rewards of innovation for a fraction of the cost and risk. The growing sophistication of design and simulation software makes it easier for startups to create prototypes and test new products virtually, before undergoing those expensive processes in the real world. Not every idea will succeed, but the costs of failure will be reduced and borne by smaller firms that can collapse with less impact on the larger economy. Ultimately, modular construction will lead to cars that can be custom-built to the specifications of their future owners, somewhat as Dell allows purchasers to click on hyperlinks to add or subtract computer features. Custom-rebuilt, too—it will be easy to install upgraded modules, in much the way that computer owners replace old video cards.

Of course, there are dangers for the automakers. When US computer giants adopted more-open, modular designs in the 1980s, they set off an explosion of technological advances. But they also reduced their own relevance. Famously, IBM was overwhelmed by the entrepreneurs and developers it had enabled; to save itself from bankruptcy, the company successfully shifted its focus from physical products to software and services. Wang and DEC no longer exist as stand-alone companies. More globally, the balance of power in the industry has moved away from manufacturers and toward the module designers—the chipmakers and software jockeys whose innovations move the industry forward.

American carmakers could follow a similar course. By shifting away from vertical integration, they will inherently play a smaller role in the overall industry. As system architects, they would lay down the framework in which independent developers work, communicating and enforcing those standards with would-be suppliers. They would also be the marketers and sales force—nobody knows how to advertise like Detroit.

This will not come easy. But in seeking a model for outsourcing in a heavily regulated industry, automakers might look to pharmaceutical companies, which also operate under severe regulatory, legal, and safety constraints. Manufacturing is simpler for drug companies, but the process of testing new products with clinical trials is nightmarishly complex and costly. Yet this has not prevented drug firms from relying on outsiders; they routinely buy startups and test out their technology. Many or most of the acquisitions prove unusable, but the successes pay for failures. Managing and using outside innovation is difficult, but it has helped keep the US drug industry alive in a climate of unforgiving competition.

It is an open question whether the Big Three will be able to participate in the new auto industry. But they can't expect to maintain their positions as gatekeepers. They are too weak, and there is simply too much activity, too much interest, and too much money in play. Although that may be bad news for the companies, it may not be bad for their customers and—in the long run—their employees and the nation itself, which will eventually benefit from a revitalized industry. What is good for the country may no longer be good for General Motors.

THE BIG THREE MAY NOT SURVIVE. BUT WHAT IS GOOD FOR THE COUNTRY MAY NO LONGER BE GOOD FOR GENERAL MOTORS.

The biggest obstacle faced by Transonic Combustion is just down the street from its offices: a gas station. When I pulled in for a fill-up, the average price per gallon was about $1.90—so low that Americans were again buying gas-guzzling SUVs and pickup trucks. It is difficult to imagine the typical US driver paying more for Transonic's hyperefficient fuel injectors when a fill-up costs less than a pizza. Nor will there be much enthusiasm for cleaner, safer vehicles in a nation that has few penalties for carbon emissions and where performance standards have remained effectively unchanged for decades.

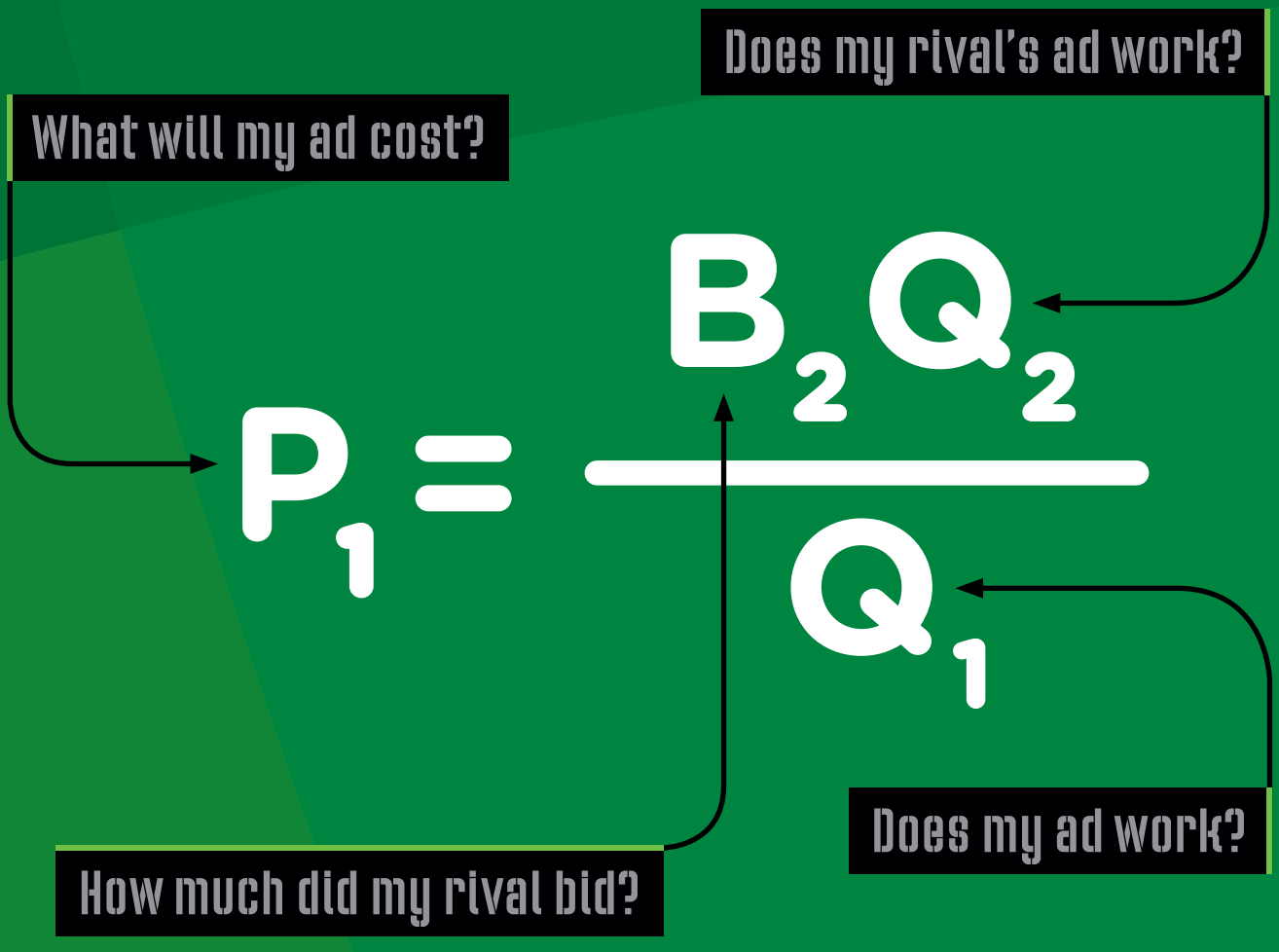
In other words, the US automotive industry will not introduce innovative cars unless there is a market to support them. And sustaining that market is next to impossible when oil prices can double or drop by half within six months, argues Bernard Swiecki, an analyst at the Center for Automotive Research. That's why he and other economists argue that higher gas taxes are necessary. As the events of last summer prove, the best way to get Americans to buy more-efficient vehicles is to sell gas at $4 a gallon. A tax that sets a floor for fuel prices would be politically unpopular, but its bitter taste could be offset by cuts in the payroll tax—and by making it part of the broader energy package.

Even with all of these initiatives, a good outcome for the US auto industry is far from guaranteed. Detroit is in an extraordinarily difficult position. But a long shot is better than none at all. Asked if he could think of any industry that had recovered from the position in which Detroit now finds itself, David Cole, chair of the Center for Automotive Research, answered—unhappily, to my ear—with a simple "no." Then he said, "That doesn't mean it can't happen, though. There's room for bold action. I just hope they're allowed to take it."

Contributing editor **CHARLES C. MANN** (charlesmann.org) *wrote about spam blogs in issue 14.09.*

THE SECRETS OF

Googler



nomics

Sure, it rules the world of search, but the real engine of Google's enormous success lies in its secret sauce: a data-fueled, auction-driven recipe for profitability that the rest of us need to start learning from fast.

by STEVEN LEVY

In the midst of financial apocalypse, the gadflies and gurus of the global marketplace are gathered at the San Francisco Hilton for the annual meeting of the American Economics Association. The mood is similar to a seismologist convention in the wake of the Big One. Yet surprisingly, one of the most popular sessions has nothing to do with toxic assets, derivatives, or unemployment curves.

"I'm going to talk about online auctions," says Hal Varian, the session's first speaker. Varian is a lanky 62-year-old professor at UC Berkeley's Haas School of Business and School of Information, but these days he's best known as Google's chief economist. This morning's crowd hasn't come for predictions about the credit market; they want to hear about Google's secret sauce.

Varian is an expert on what may be the most successful business idea in history: AdWords, Google's unique method for selling online advertising. AdWords analyzes every Google search to determine which advertisers get each of up to 11 "sponsored links" on every results page. It's the world's biggest, fastest auction, a never-ending, automated, self-service version of Tokyo's boisterous Tsukiji fish market, and it takes place, Varian says, "every time you search." He never mentions how much revenue advertising brings in. But Google is a public company, so anyone can find the number: It was $21 billion last year.

His talk quickly becomes technical. There's the difference between the Generalized Second Price auction model and the Vickrey-Clark-Groves alternative. Game theory takes a turn; so does the Nash Equilibrium. Terms involving the c-word—as in *clicks*—get tossed around like beach balls at a summer rock festival. Clickthrough rate. Cost per click. Supply curve of clicks. The audience is enthralled.

During the question-and-answer period, a man wearing a camel-colored corduroy blazer raises his hand. "Let me understand this," he begins, half skeptical, half unsure. "You say that an auction happens every time a search takes place? That would mean millions of times a day!"

Varian smiles. "Millions," he says, "is actually quite an understatement."

Why does Google even *need* a chief economist? The simplest reason is that the company is an economy unto itself. The ad auction, marinated in that special sauce, is a seething laboratory of fiduciary forensics, with customers ranging from giant multinationals to dorm-room entrepreneurs, all billed by the world's largest micropayment system.

Google depends on economic principles to hone what has become the search engine of choice for more than 60 percent of all Internet surfers, and the company uses auction theory to grease the skids of its own operations. All these calculations require an army of math geeks, algorithms of Ramanujanian complexity, and a sales force more comfortable with whiteboard markers than fairway irons.

Varian, an upbeat, avuncular presence at the Googleplex in Mountain View, California, serves as the Adam Smith of the new discipline of Googlenomics. His job is to provide a theoretical framework for Google's business practices while leading a team of quants to enforce bottom-line discipline, reining in the more propellerhead propensities of the company's dominant engineering culture.

Googlenomics actually comes in two flavors: macro and micro. The macroeconomic side involves some of the company's seemingly altruistic behavior, which often baffles observers. Why does Google give away products like its browser, its apps, and the Android operating system for mobile phones? Anything that increases Internet use ultimately enriches Google, Varian says. And since using the Web without using Google is like dining at In-N-Out without ordering a hamburger, more eyeballs on the Web lead inexorably to more ad sales for Google.

The microeconomics of Google is more complicated. Selling ads doesn't generate only profits; it also generates torrents of data about users' tastes and habits, data that Google then sifts and processes in order to predict future consumer behavior, find ways to improve its products, and sell more ads. This is the heart and soul of Googlenomics. It's a system of constant self-analysis: a data-fueled feedback loop that defines not only Google's future but the future of anyone who does business online.

When the American Economics Association meets next year, the financial crisis may still be topic A. But one of the keynote speakers has already been chosen: Googlenomist Hal Varian.

Ironically, economics was a distant focus in the first days of Google. After Larry Page and Sergey Brin founded the company in 1998, they channeled their energy into its free search product and left much of the business planning to a 22-year-old Stanford graduate named Salar Kamangar, Google's ninth employee. The early assumption was that although ads would be an important source of revenue, licensing search technology and selling servers would be just as lucrative. Page and Brin also believed that ads should be useful and welcome—not annoying intrusions. Kamangar and another early Googler, Eric Veach, set out to implement that ideal. Neither had a background in business or economics. Kamangar had been a biology major, and Veach's field of study was computer science.

Google's ads were always plain blocks of text relevant to the search query. But at first, there were two kinds. Ads at the top of the page were sold the old-fashioned way, by a crew of human beings headquartered

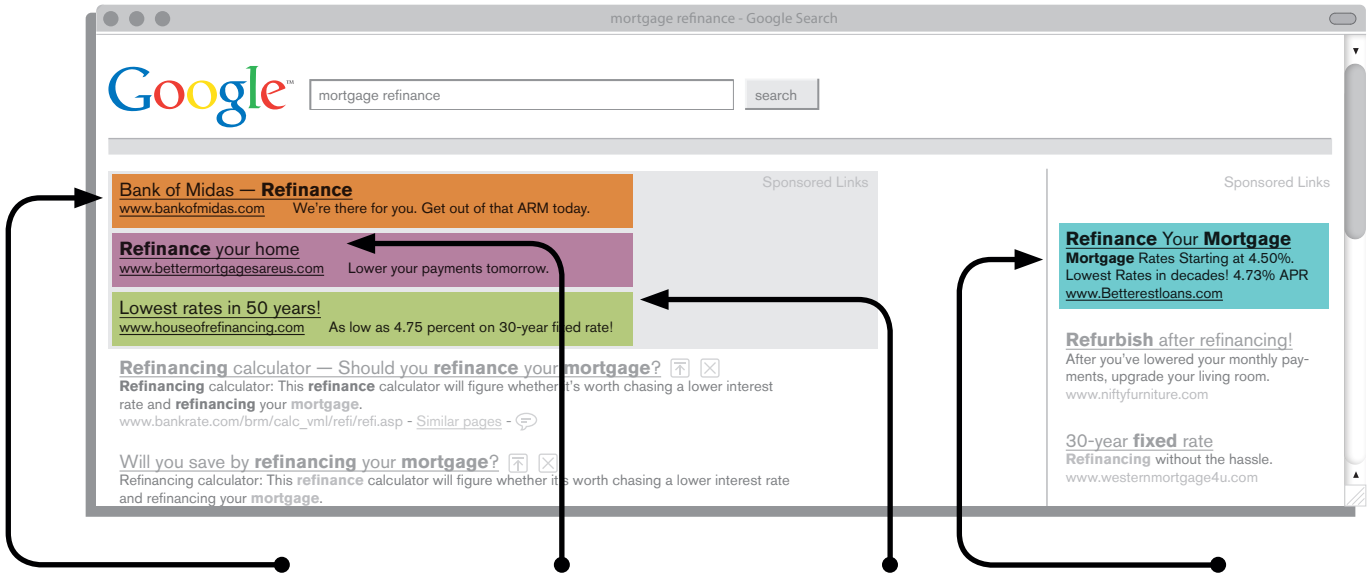
GOOGLE IS AN ECONOMY UNTO ITSELF, A SEETHING LABORATORY OF FIDUCIARY FORENSICS.

Google recruited its own chief economist, UC Berkeley professor Hal Varian, to serve as in-house high priest of Googlenomics.

PHOTOGRAPH BY Joe Pugliese

Anatomy of an Auction

Every time you do a Google search, up to 11 ad spots are auctioned off simultaneously, just in time to show up on the results page. Here's how it works. – JOANNA PEARLSTEIN



AD POSITION	1. Receive Bid	2. Assess Quality	3. Calculate Rank	4. Set Price
1	$8.80	7	61.6	$8.29
2	$7.25	8	58	$6.56
3	$7.50	7	52.5	$6.86
4	$8.00	6	48	$7.08
5	$8.50	5	42.5	$8.50

Bank of Midas selects keywords like *mortgage refinance* and places bids on them. To help advertisers set smart bids, Google provides an estimated minimum bid needed to get on the first page of search results. Besides keywords, advertisers can connect their ads to specific dates, times, and geographic locations. But the highest bid doesn't guarantee an ad will appear at the top of page.

Google also scores ads—like this one for Better Mortgages Are Us—on a quality scale of 1 to 10. The score is based on relevance (how well the ad matches a user's query), the quality of the landing page that the ad links to (the value of its content and how quickly it loads), and the ad's past clickthrough rate (or, if it's new, the rate of a similar ad), along with other criteria Google won't reveal.

The order in which the ads will be displayed is determined by a simple formula: Rank = bid x quality score. An above-average quality score, like the 7 earned by House of Refinancing, can compensate for a lower bid.

In a twist on a classic second-price auction, the cost of each ad is tied to the bid of the advertiser ranked one notch down, using the formula below. (Here, BetterestLoans' price hinges on NiftyFurniture's bid and quality.)

$$P_1 = \frac{B_2 Q_2}{Q_1}$$

P_1 — Price paid by the advertiser
B_2 — Next-highest-placing ad's bid
Q_2 — Quality score of next-highest-placing ad
Q_1 — Advertiser's quality score

largely in New York City. Salespeople wooed big customers over dinner, explaining what keywords meant and what the prices were. Advertisers were then billed by the number of user views, or impressions, regardless of whether anyone clicked on the ad. Down the right side were other ads that smaller businesses could buy directly online. The first of these, for live mail-order lobsters, was sold in 2000, just minutes after Google deployed a link reading SEE YOUR AD HERE.

But as the business grew, Kamangar and Veach decided to price the slots on the side of the page by means of an auction. Not an eBay-style auction that unfolds over days or minutes as bids are raised or abandoned, but a huge marketplace of virtual auctions in which sealed bids are submitted in advance

and winners are determined algorithmically in fractions of a second. Google hoped that millions of small and medium companies would take part in the market, so it was essential that the process be self-service. Advertisers bid on search terms, or keywords, but instead of bidding on the price per impression, they were bidding on a price they were willing to pay each time a user *clicked* on the ad. (The bid would be accompanied by a budget of how many clicks the advertiser was willing to pay for.) The new system was called AdWords Select, while the ads at the top of the page, with prices still set by humans, was renamed AdWords Premium.

One key innovation was that all the sidebar slots on the results page were sold off in a single auction. (Compare that to an early pioneer of auction-driven search ads, Overture, which held a separate auction for each slot.) The problem with an all-at-once auction, however, was that advertisers might be inclined to lowball their bids to avoid the sucker's trap of paying a huge amount more than the guy just below them on the page. So the Googlers decided that the winner of each auction would pay the amount (plus a penny) of the bid from the advertiser with the next-highest offer. (If Joe bids $10, Alice bids $9, and Sue bids $6, Joe gets the top slot and pays $9.01. Alice gets the next slot for $6.01, and so on.) Since competitors didn't have to worry about costly overbidding errors, the paradoxical result was that it encouraged higher bids.

"Eric Veach did the math independently," Kamangar says. "We found out along the way that second-price auctions had existed in other forms in the past and were used at one time in Treasury auctions." (Another crucial innovation had to do with ad quality, but more on that later.)

Google's homemade solution to its ad problem impressed even Paul Milgrom, the Stanford economist who is to auction theory what Letitia Baldridge is to etiquette. "I've begun to realize that Google somehow stumbled on a level of simplification in ad auctions that was not included before," he says. And applying a variation on second-price auctions wasn't just a theoretical advance. "Google immediately started getting higher prices for advertising than Overture was getting."

■ **Google hired Varian** in May 2002, a few months after implementing the auction-based version of AdWords. The offer came about when Google's then-new CEO, Eric Schmidt, ran into Varian at the Aspen Institute and they struck up a conversation about Internet issues. Schmidt was with Larry Page, who was pushing his own notions about how some of the big problems in business and science could be solved by using computation and analysis on an unprecedented scale. Varian remembers thinking, "Why did Eric bring his high-school nephew?"

Schmidt, whose father was an economist, invited Varian to spend a day or two a week at Google. On his first visit, Varian asked Schmidt what he should do. "Why don't you take a look at the ad auction?" Schmidt said.

Google had already developed the basics of AdWords, but there was still plenty of tweaking to do, and Varian was uniquely qualified to "take a look." As head of the information school at UC Berkeley and coauthor (with Carl Shapiro) of a popular book called *Information Rules: A Strategic Guide to the Network Economy*, he was already the go-to economist on ecommerce.

At the time, most online companies were still selling advertising the way it was done in the days of *Mad Men*. But Varian saw immediately that Google's ad business was less like buying traditional spots and more like computer dating. "The theory was Google as yenta—matchmaker," he says. He also realized there was another old idea underlying the new approach: A 1983 paper by Harvard economist Herman Leonard described using marketplace mechanisms to assign job candidates to slots in a corporation, or students to dorm rooms. It was called a two-sided matching market. "The mathematical structure of the Google auction," Varian says, "is the same as those two-sided matching markets."

Varian tried to understand the process better by applying game theory. "I think I was the first person to do that," he says. After just a few weeks at Google, he went back to Schmidt. "It's amazing!" Varian said. "You've managed to design an auction perfectly."

To Schmidt, who had been at Google barely a year, this was an incredible relief. "Remember, this was when the company had 200 employees and no cash," he says. "All of a sudden we realized we were in the auction business."

It wasn't long before the success of AdWords Select began to dwarf that of its sister system, the more traditional AdWords Premium. Inevitably, Veach and Kamangar argued that *all* the ad slots should be auctioned off. In search, Google had already used scale, power, and clever algorithms to change the way people accessed information. By turning over its sales process entirely to an auction-based system, the company could similarly upend the world of advertising, removing human guesswork from the equation.

The move was risky. Going ahead with the phaseout—nicknamed Premium Sunset—meant giving up campaigns that were selling for hundreds of thousands of dollars, for the unproven possibility that the auction process would generate even bigger sums. "We were going to erase a huge part of the company's revenue," says Tim Armstrong, then head of direct sales in the US. (This March, Armstrong left Google to become AOL's new chair and CEO.) "Ninety-nine percent of companies would have said, 'Hold on, don't make that change.' But we had Larry, Sergey, and Eric saying, 'Let's go for it.'"

News of the switch jacked up the Maalox consumption among Google's salespeople. Instead of selling to corporate giants, their job would now be to get them to *place bids in an auction*? "We thought it was a little half-cocked," says Jeff Levick, an early leader of

"ALL OF A SUDDEN," CEO ERIC SCHMIDT SAYS, "WE REALIZED WE WERE IN THE AUCTION BUSINESS."

the Google sales team. The young company wasn't getting rid of its sales force (though the system certainly helped Google run with far fewer salespeople than a traditional media company) but was asking them to get geekier, helping big customers shape online strategies as opposed to simply selling ad space.

Levick tells a story of visiting three big customers to inform them of the new system: "The guy in California almost threw us out of his office and told us to fuck ourselves. The guy in Chicago said, 'This is going to be the worst business move you ever made.' But the guy in Massachusetts said, 'I trust you.'"

That client knew math, says Levick, whose secret weapon was the numbers. When the data was crunched—and Google worked hard to give clients the tools needed to run the numbers themselves—advertisers saw that the new system paid off for them, too.

AdWords was such a hit that Google went auction-crazy. The company used auctions to place ads on other Web sites (that program was dubbed AdSense). "But the really gutsy move," Varian says, "was using it in the IPO." In 2004, Google used a variation of a Dutch auction for its IPO; Brin and Page loved that the process leveled the playing field between small investors and powerful brokerage houses. And in 2008, the company couldn't resist participating in the FCC's auction to reallocate portions of the radio spectrum.

Google even uses auctions for internal operations, like allocating servers among its various business units. Since moving a product's storage and computation to a new data center is disruptive, engineers often put it off. "I suggested we run an auction similar to what the airlines do when they oversell a flight. They keep offering bigger vouchers until enough customers give up their seats," Varian says. "In our case, we offer more machines in exchange for moving to new servers. One group might do it for 50 new ones, another for 100, and another won't move unless we give them 300. So we give them to the lowest bidder—they get their extra capacity, and we get computation shifted to the new data center."

The transition to an all-auction sales model was a milestone for Google, ensuring that its entire revenue engine would run with the same computer-science fervor as its search operation. Now, when Google recruits alpha geeks, it is just as likely to have them focus on AdWords as on search or apps.

■ **The across-the-board** emphasis on engineering, mathematical formulas, and data-mining has made Google a new kind of company. But to fully understand why, you have to go back and look under AdWords' hood.

Most people think of the Google ad auction as a straightforward affair. In fact, there's a key component that few users know about and even sophisticated advertisers don't fully understand. The bids themselves are only a part of what ultimately determines the auction winners. The other major determinant is something called the quality score. This metric strives to ensure that the ads Google shows on its results page are true, high-caliber matches for what users are querying. If they aren't, the whole system suffers and Google makes less money.

Google determines quality scores by calculating multiple factors, including the relevance of the ad to the specific keyword or keywords, the quality of the landing page the ad is linked to, and, above all, the percentage of times users actually click on a given ad when it appears on a results page. (Other factors, Google won't even discuss.) There's also a penalty invoked when the ad quality is too low—in such cases, the company slaps a minimum bid on the advertiser. Google explains that this practice—reviled by many companies affected by it—protects users from being exposed to irrelevant or annoying ads that would sour people on sponsored links in general. Several lawsuits have been filed by would-be advertisers who claim that they are victims of an arbitrary process by a quasi monopoly.

You can argue about fairness, but arbitrary it ain't. To figure out the quality score, Google needs to estimate in advance how many users will click on an ad. That's very tricky, especially since we're talking about billions of auctions. But since the ad model depends on predicting clickthroughs as perfectly as possible, the company must quantify and analyze every twist and turn of the data. Susan Wojcicki, who oversees Google's advertising, refers to it as "the physics of clicks."

During Varian's second summer in Mountain View, when he was still coming in only a day or two a week, he asked a recently hired computer scientist from Stanford named Diane Tang to create the Google equivalent of the Consumer Price Index, called the Keyword Pricing Index. "Instead of a basket of goods like diapers and beer and doughnuts, we have keywords," says Tang, who is known internally as the Queen of Clicks.

The Keyword Pricing Index is a reality check. It alerts Google to any anomalous price bubbles, a sure sign that an auction isn't working properly. Categories are ranked by the cost per click that advertisers generally have to pay, weighted by distribution, and then separated into three bundles: high cap, mid cap, and low cap. "The high caps are very competitive keywords, like 'flowers' and 'hotels,'" Tang says. In the mid-cap realm you have keywords that may vary seasonally—the price to place ads alongside results for "snowboarding" skyrockets during the winter. Low caps like "Massachusetts buggy whips" are the stuff of long tails.

Tang's index is just one example of a much broader effort. As the amount of data at the company's disposal grows, the opportunities to exploit it multiply, which ends up further extending the range and scope of the Google economy. So it's utterly essential to calculate correctly the quality scores that prop up AdWords.

"The people working for me are generally econometricians—sort of a cross between statisticians and economists," says Varian, who moved to Google full-time in 2007 (he's on leave from Berkeley) and leads two teams, one of them focused on analysis.

"Google needs mathematical types that have a rich tool set for looking for signals in noise," says statistician Daryl Pregibon, who joined Google in 2003 after 23 years as a top scientist at Bell Labs and AT&T Labs. "The rough rule of thumb is one statistician for every 100 computer scientists."

Keywords and click rates are their bread and butter. "We are trying to understand the mechanisms behind the metrics," says Qing Wu, one of Varian's minions. His specialty is forecasting, so now he predicts patterns of queries based on the season, the climate, international holidays, even the time of day. "We have temperature data, weather data, and queries data, so we can do correlation and statistical modeling," Wu says. The results all feed into Google's backend system, helping advertisers devise more-efficient campaigns.

To track and test their predictions, Wu and his colleagues use dozens of onscreen dashboards that continuously stream information, a sort of Bloomberg terminal for the Googlesphere. Wu checks obsessively to see whether reality is matching the forecasts: "With a dashboard, you can monitor the queries, the amount of money you make, how many advertisers you have, how many keywords they're bidding on, what the rate of return is for each advertiser."

Wu calls Google "the barometer of the world." Indeed, studying the clicks is like looking through a window with a panoramic view of everything. You can see the change of seasons—clicks gravitating toward skiing and heavy clothes in winter, bikinis and sunscreen in summer—and you can track who's up and down in pop culture. Most of us remember news events from television or newspapers; Googlers recall them as spikes in their graphs. "One of the big things a few years ago was the SARS epidemic," Tang says. Wu didn't even have to read the papers to know about the financial meltdown—he saw the jump in people Googling for *gold*. And since prediction and analysis are so crucial to AdWords, every bit of data, no matter how seemingly trivial, has potential value.

Since Google hired Varian, other companies, like Yahoo, have decided that they, too, must have a chief economist heading a division that scrutinizes auctions, dashboards, and econometric models to fine-tune their business plan. In 2007, Harvard economist Susan Athey was surprised to get a summons to Redmond to meet with Steve Ballmer. "That's a call you take," she says. Athey spent last year working in Microsoft's Cambridge, Massachusetts, office.

Can the rest of the world be far behind? Although Eric Schmidt doesn't think it will happen as quickly as some believe, he does think that Google-style auctions are applicable to all sorts of transactions. The solution to the glut in auto inventory? Put the entire supply of unsold cars up for bid. That'll clear out the lot. Housing, too: "People use auctions now in cases of distress, like auctioning a house when there are no buyers," Schmidt says. "But you can imagine a situation in which it was a normal and routine way of doing things."

AS THE AMOUNT OF DATA AT THE COMPANY'S DISPOSAL GROWS, THE OPPORTUNITIES TO EXPLOIT IT MULTIPLY.

Varian believes that a new era is dawning for what you might call the datarati—and it's all about harnessing supply and demand. "What's ubiquitous and cheap?" Varian asks. "Data." And what is scarce? The analytic ability to utilize that data. As a result, he believes that the kind of technical person who once would have wound up working for a hedge fund on Wall Street will now work at a firm whose business hinges on making smart, daring choices—decisions based on surprising results gleaned from algorithmic spelunking and executed with the confidence that comes from really doing the math.

It's a satisfying development for Varian, a guy whose career as an economist was inspired by a sci-fi novel he read in junior high. "In Isaac Asimov's first *Foundation Trilogy*, there was a character who basically constructed mathematical models of society, and I thought this was a really exciting idea. When I went to college, I looked around for that subject. It turned out to be economics." Varian is telling this story from his pied-à-Plex, where he sometimes stays during the week to avoid driving the 40-some miles from Google headquarters to his home in the East Bay. It happens to be the ranch-style house, which Google now owns, where Brin and Page started the company.

There's a wild contrast between this sparsely furnished residence and what it has spawned—dozens of millionaire geeks, billions of auctions, and new ground rules for businesses in a data-driven society that is far weirder than the one Asimov envisioned nearly 60 years ago. What could be more baffling than a capitalist corporation that gives away its best services, doesn't set the prices for the ads that support it, and turns away customers because their ads don't measure up to its complex formulas? Varian, of course, knows that his employer's success is not the result of inspired craziness but of an early recognition that the Internet rewards fanatical focus on scale, speed, data analysis, and customer satisfaction. (A bit of auction theory doesn't hurt, either.) Today we have a name for those rules: Googlenomics. Learn them, or pay the price.

Senior writer **STEVEN LEVY** (steven_levy@wired.com) *wrote about the* Kryptos *sculpture at CIA headquarters in issue 17.05.*

Wikipedia, Flickr, and Twitter aren't just revolutions in online social media. They're the vanguard of a cultural movement. Forget about state ownership and five-year plans. A global collectivist society is coming—and this time you're going to like it.

by KEVIN KELLY

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THE NEW SOC

cialism

illustration by CHRISTOPH NIEMANN

Bill Gates once derided open source advocates with the worst epithet a capitalist can muster. These folks, he said, were a "new modern-day sort of communists," a malevolent force bent on destroying the monopolistic incentive that helps support the American dream. Gates was wrong: Open source zealots are more likely to be libertarians than commie pinkos. Yet there is some truth to his allegation. The frantic global rush to connect everyone to everyone, all the time, is quietly giving rise to a revised version of socialism.

Communal aspects of digital culture run deep and wide. Wikipedia is just one remarkable example of an emerging collectivism—and not just Wikipedia but wikiness at large. Ward Cunningham, who invented the first collaborative Web page in 1994, tracks nearly 150 wiki engines today, each powering myriad sites. Wetpaint, launched just three years ago, hosts more than 1 million communal efforts. Widespread adoption of the share-friendly Creative Commons alternative copyright license and the rise of ubiquitous file-sharing are two more steps in this shift. Mushrooming collaborative sites like Digg, StumbleUpon, the Hype Machine, and Twine have added weight to this great upheaval. Nearly every day another startup proudly heralds a new way to harness community action. These developments suggest a steady move toward a sort of socialism uniquely tuned for a networked world.

We're not talking about your grandfather's socialism. In fact, there is a long list of past movements this new socialism is not. It is not class warfare. It is not anti-American; indeed, digital socialism may be the newest American innovation. While old-school socialism was an arm of the state, digital socialism is socialism without the state. This new brand of socialism currently operates in the realm of culture and economics, rather than government—for now.

The type of communism with which Gates hoped to tar the creators of Linux was born in an era of enforced borders, centralized communications, and top-heavy industrial processes. Those constraints gave rise to a type of collective ownership that replaced the brilliant chaos of a free market with scientific five-year plans devised by an all-powerful politburo. This political operating system failed, to put it mildly. However, unlike those older strains of red-flag socialism, the new socialism runs over a borderless Internet, through a tightly integrated global economy. It is designed to heighten individual autonomy and thwart centralization. It is decentralization extreme.

Instead of gathering on collective farms, we gather in collective worlds. Instead of state factories, we have desktop factories connected to virtual co-ops. Instead of sharing drill bits, picks, and shovels, we share apps, scripts, and APIs. Instead of faceless politburos, we have faceless meritocracies, where the only thing that matters is getting things done. Instead of national production, we have peer production. Instead of government rations and subsidies, we have a bounty of free goods.

I recognize that the word *socialism* is bound to make many readers twitch. It carries tremendous cultural baggage, as do the related terms *communal*, *communitarian*, and *collective*. I use *socialism* because technically it is the best word to indicate a range of technologies that rely for their power on social interactions. Broadly, collective action is what Web sites and Net-connected apps generate when they harness input from the global audience. Of course, there's rhetorical danger in lumping so many types of organization under such an inflammatory heading. But there are no unsoiled terms available, so we might as well redeem this one.

When masses of people who own the means of production work toward a common goal and share their products in common, when they contribute labor without wages and enjoy the fruits free of charge, it's not unreasonable to call that socialism.

In the late '90s, activist, provocateur, and aging hippy John Barlow began calling this drift, somewhat tongue in cheek, "dot-communism." He defined it as a "workforce composed entirely of free agents," a decentralized gift or barter economy where there is no property and where technological architecture defines the political space. He was right on the virtual money. But there is one way in which *socialism* is the wrong word for what is happening: It is not an ideology. It demands no rigid creed. Rather, it is a spectrum of attitudes, techniques, and tools that promote collaboration, sharing, aggregation, coordination, ad hocracy, and a host of other newly enabled types of social cooperation. It is a design frontier and a particularly fertile space for innovation.

In his 2008 book, *Here Comes Everybody*, media theorist Clay Shirky suggests a useful hierarchy for sorting through these new social arrangements. Groups of people start off simply sharing and then progress to cooperation, collaboration, and finally collectivism. At each step, the amount of coordination increases. A survey of the online landscape reveals ample evidence of this phenomenon.

I. SHARING

The online masses have an incredible willingness to share. The number of personal photos posted on Facebook and MySpace is astronomical, but it's a safe bet that the overwhelming majority of photos taken with a digital camera are shared in some fashion. Then there are status updates, map locations, half-thoughts posted online. Add to this the 6 billion videos served by YouTube each month in the US alone and the millions of fan-created stories deposited on fanfic sites. The list of sharing organizations is almost endless: Yelp for reviews, Loopt for locations, Delicious for bookmarks.

Sharing is the mildest form of socialism, but it serves as the foundation for higher levels of communal engagement.

II. COOPERATION

When individuals work together toward a large-scale goal, it produces results that emerge at the group level. Not only have amateurs shared more than 3 billion photos on Flickr, but they have tagged them with categories, labels, and keywords. Others in the community cull the pictures into sets. The popularity of Creative Commons licensing means that communally, if not outright communistically, your picture is my picture.

Anyone can use a photo, just as a communard might use the community wheelbarrow. I don't have to shoot yet another photo of the Eiffel Tower, since the community can provide a better one than I can take myself.

Thousands of aggregator sites employ the same social dynamic for threefold benefit. First, the technology aids users directly, letting them tag, bookmark, rank, and archive for their own use. Second, other users benefit from an individual's tags, bookmarks, and so on. And this, in turn, often creates additional value that can come only from the group as a whole. For instance, tagged snapshots of the same scene from different angles can be assembled into a stunning 3-D rendering of the location. (Check out Microsoft's Photosynth.) In a curious way, this proposition exceeds the socialist promise of "from each according to his ability, to each according to his needs" because it betters what you contribute and delivers more than you need.

Community aggregators can unleash astonishing power. Sites like Digg and Reddit, which let users vote on the Web links they display most prominently, can steer public conversation as much as newspapers or TV networks. (Full disclosure: Reddit is owned by *Wired*'s parent company, Condé Nast.) Serious contributors to these sites put in far more energy than they could ever get in return, but they keep contributing in part because of the cultural power these instruments wield. A contributor's influence extends way beyond a lone vote, and the community's collective influence can be far out of proportion to the number of contributors. That is the whole point of social institutions—the sum outperforms the parts. Traditional socialism aimed to ramp up this dynamic via the state. Now, decoupled from government and hooked into the global digital matrix, this elusive force operates at a larger scale than ever before.

III. COLLABORATION

Organized collaboration can produce results beyond the achievements of ad hoc cooperation. Just look at any of hundreds of open source software projects, such as the Apache Web server. In these endeavors, finely tuned communal tools generate high-quality products from the coordinated work of thousands or tens of thousands of members. In contrast to casual cooperation, collaboration on large, complex projects tends to bring the participants only indirect benefits, since each member of the group interacts with only a small part of the end product. An enthusiast may spend months writing code for a subroutine when the program's full utility is several years away. In fact, the work-reward ratio is so out of kilter from a free-market perspective—the workers do immense amounts of high-market-value work without being paid—that these collaborative efforts make no sense within capitalism.

Adding to the economic dissonance, we've become accustomed to enjoying the products of these collaborations free of charge. Instead of money, the peer producers who create the stuff gain credit, status, reputation, enjoyment, satisfaction, and experience. Not only is the product free, it can be copied freely and used as the basis for new products. Alternative schemes for managing intellectual property, including Creative Commons and the GNU licenses, were invented to ensure these "frees."

Of course, there's nothing particularly socialistic about collaboration per se. But the tools of online collaboration support a communal style of production that shuns capitalistic investors and keeps ownership in the hands of the workers, and to some extent those of the consuming masses.

Socialism: A History

1516	Thomas More's *Utopia*
1794	Thomas Paine's *The Age of Reason*
1825	First US commune
1848	Marx & Engels' *The Communist Manifesto*
1864	International Workingmen's Association
1903	Bolshevik Party elects Lenin
1917	Russian Revolution
1922	Stalin consolidates power
1946	State-run health care in Saskatchewan
1959	Cuban Revolution
1967	Che Guevara executed
1973	Salvador Allende deposed
1980	Usenet
1985	Mikhail Gorbachev's glasnost
1991	Soviet Union dissolves
1994	Linux 1.0
1998	Venezuela elects Hugo Chavez

IV. COLLECTIVISM

While cooperation can write an encyclopedia, no one is held responsible if the community fails to reach consensus, and lack of agreement doesn't endanger the enterprise as a whole. The aim of a collective, however, is to engineer a system where self-directed peers take responsibility for critical processes and where difficult decisions, such as sorting out priorities, are decided by all participants. Throughout history, hundreds of small-scale collectivist groups have tried this operating system. The results have not been encouraging, even setting aside Jim Jones and the Manson family.

Indeed, a close examination of the governing kernel of, say, Wikipedia, Linux, or OpenOffice shows that these efforts are further from the collectivist ideal than appears from the outside. While millions of writers contribute to Wikipedia, a smaller number of editors (around 1,500) are responsible for the majority of the editing. Ditto for collectives that write code. A vast army of contributions is managed by a much smaller group of coordinators. As Mitch Kapor, founding chair of the Mozilla open source code factory, observed, "Inside every working anarchy, there's an old-boy network."

This isn't necessarily a bad thing. Some types of collectives benefit from hierarchy while others are hurt by it. Platforms like the Internet and Facebook, or democracy—which are intended to serve as a substrate for producing goods and delivering services—benefit from being as nonhierarchical as

1999	Blogger.com
2000	Google: 1 billion indexed pages
2001	Wikipedia
2002	Brazil elects Lula da Silva
2003	Public Library of Science
2004	Digg
2005	Amazon's Mechanical Turk
2006	Twitter
2008	Facebook: 100 million users
2008	US allocates $700 billion for troubled mortgage assets
2009	YouTube: 100 million monthly US users

possible, minimizing barriers to entry and distributing rights and responsibilities equally. When powerful actors appear, the entire fabric suffers. On the other hand, organizations built to create products often need strong leaders and hierarchies arranged around time scales: One level focuses on hourly needs, another on the next five years.

In the past, constructing an organization that exploited hierarchy yet maximized collectivism was nearly impossible. Now digital networking provides the necessary infrastructure. The Net empowers product-focused organizations to function collectively while keeping the hierarchy from fully taking over. The organization behind MySQL, an open source database, is not romantically nonhierarchical, but it is far more collectivist than Oracle. Likewise, Wikipedia is not a bastion of equality, but it is vastly more collectivist than the *Encyclopædia Britannica*. The elite core we find at the heart of online collectives is actually a sign that stateless socialism can work on a grand scale.

■ **Most people in the West,** including myself, were indoctrinated with the notion that extending the power of individuals necessarily diminishes the power of the state, and vice versa. In practice, though, most polities socialize some resources and individualize others. Most free-market economies have socialized education, and even extremely socialized societies allow some private property.

Rather than viewing technological socialism as one side of a zero-sum trade-off between free-market individualism and centralized authority, it can be seen as a cultural OS that elevates both the individual and the group at once. The largely unarticulated but intuitively understood goal of communitarian technology is this: to maximize both individual autonomy and the power of people working together. Thus, digital socialism can be viewed as a third way that renders irrelevant the old debates.

The notion of a third way is echoed by Yochai Benkler, author of *The Wealth of Networks*, who has probably thought more than anyone else about the politics of networks. "I see the emergence of social production and peer production as an alternative to both state-based and market-based closed, proprietary systems," he says, noting that these activities "can enhance creativity, productivity, and freedom." The new OS is neither the classic communism of centralized planning without private property nor the undiluted chaos of a free market. Instead, it is an emerging design space in which decentralized public coordination can solve problems and create things that neither pure communism nor pure capitalism can.

Hybrid systems that blend market and nonmarket mechanisms are not new. For decades, researchers have studied the decentralized, socialized production methods of northern Italian and Basque industrial co-ops, in which employees are owners, selecting management and limiting profit distribution, independent of state control. But only since the arrival of low-cost, instantaneous, ubiquitous collaboration has it been possible to migrate the core of those ideas into diverse new realms, like writing enterprise software or reference books.

The dream is to scale up this third way beyond local experiments. How large? Ohloh, a company that tracks the open source industry, lists roughly 250,000 people working on an amazing 275,000 projects. That's almost the size of General Motors' workforce. That is an awful lot of people working for free, even if they're not full-time. Imagine if all the employees of GM weren't paid yet continued to produce automobiles!

So far, the biggest efforts are open source projects, and the largest of them, such as Apache, manage several hundred contributors—about the size of a village. One study estimates that 60,000 man-years of work have poured into last year's release of Fedora Linux 9, so we have proof that self-assembly and the dynamics of sharing can govern a project on the scale of a decentralized town or village.

Of course, the total census of participants in online collective work is far greater. YouTube claims some 350 million monthly visitors. Nearly 10 million registered users have contributed to Wikipedia, 160,000 of whom are designated active. More than 35 million folks have posted and tagged more than 3 billion photos and videos on Flickr. Yahoo hosts 7.8 million groups focused on every possible subject. Google has 3.9 million.

These numbers still fall short of a nation. They may not even cross the threshold of mainstream (although if YouTube isn't mainstream, what is?). But clearly the population that lives with socialized media is significant. The number of people who make things for free, share things for free, use things for free, belong to collective software farms, work on projects that require communal decisions, or experience the benefits of decentralized socialism has reached millions and counting. Revolutions have grown out of much smaller numbers.

On the face of it, one might expect a lot of political posturing from folks who are constructing an alternative to capitalism and corporatism. But the coders, hackers, and programmers who design sharing tools don't think of themselves as revolutionaries. No new political party is being organized in conference rooms—at least, not in the US. (In Sweden, the Pirate Party formed on a platform of file-sharing. It won a paltry 0.63 percent of votes in the 2006 national election.)

Indeed, the leaders of the new socialism are extremely pragmatic. A survey of 2,784 open source developers explored their motivations. The most common was "to learn and develop new skills." That's practical. One academic put it this way (paraphrasing): The major reason for working on free stuff is to improve my own damn software. Basically, overt politics is not practical enough.

But the rest of us may not be politically immune to the rising tide of sharing, cooperation, collaboration, and collectivism. For the first time in years, the s-word is being uttered by TV pundits and in national newsmagazines as a force in US politics. Obviously, the trend toward nationalizing hunks of industry, instituting national health care, and jump-starting job creation with tax money isn't wholly due to techno-socialism. But the last election demonstrated the power of a decentralized, webified base with digital collaboration at its core. The more we benefit from such collaboration, the more open we become to socialist institutions in government. The coercive, soul-smashing system of North Korea is dead; the future is a hybrid that takes cues from both Wikipedia and the moderate socialism of Sweden.

How close to a noncapitalistic, open source, peer-production society can this movement take us? Every time that question has been asked, the answer has been: closer than we thought. Consider craigslist. Just classified ads, right? But the site amplified the handy community swap board to reach a regional audience, enhanced it with pictures and real-time updates, and suddenly became a national treasure. Operating without state funding or control, connecting citizens directly to citizens, this mostly free marketplace achieves social good at an efficiency that would stagger any government or traditional corporation. Sure, it undermines the business model of newspapers, but at the same time it makes an indisputable case that the sharing model is a viable alternative to both profit-seeking corporations and tax-supported civic institutions.

Who would have believed that poor farmers could secure $100 loans from perfect strangers on the other side of the planet—and pay them back? That is what Kiva does with peer-to-peer lending. Every public health care expert declared confidently that sharing was fine for photos, but no one would share their medical records. But PatientsLikeMe, where patients pool results of treatments to better their own care, prove that collective action can trump both doctors and privacy scares. The increasingly common habit of sharing what you're thinking (Twitter), what you're reading (StumbleUpon), your finances (Wesabe), your everything (the Web) is becoming a foundation of our culture. Doing it while collaboratively building encyclopedias, news agencies, video archives, and software in groups that span continents, with people you don't know and whose class is irrelevant—that makes political socialism seem like the logical next step.

A similar thing happened with free markets over the past century. Every day, someone asked: What can't markets do? We took a long list of problems that seemed to require rational planning or paternal government and instead applied marketplace logic. In most cases, the market solution worked significantly better. Much of the prosperity in recent decades was gained by unleashing market forces on social problems.

Now we're trying the same trick with collaborative social technology, applying digital socialism to a growing list of wishes—and occasionally to problems that the free market couldn't solve—to see if it works. So far, the results have been startling. At nearly every turn, the power of sharing, cooperation, collaboration, openness, free pricing, and transparency has proven to be more practical than we capitalists thought possible. Each time we try it, we find that the power of the new socialism is bigger than we imagined.

We underestimate the power of our tools to reshape our minds. Did we really believe we could collaboratively build and inhabit virtual worlds all day, every day, and not have it affect our perspective? The force of online socialism is growing. Its dynamic is spreading beyond electrons—perhaps into elections. W

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