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by Thomas H. Davenport

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We all know the power of the killer app. Over the years, groundbreaking systems from companies such as American Airlines (electronic reservations), Otis Elevator (predictive maintenance), and American Hospital Supply (online ordering) have dramatically boosted their creators' revenues and reputations. These heralded—and coveted—applications amassed and applied data in ways that upended customer expectations and optimized operations to unprecedented degrees. They transformed technology from a supporting tool into a strategic weapon.

Companies questing for killer apps generally focus all their firepower on the one area that promises to create the greatest competitive advantage. But a new breed of company is upping the stakes. Organizations such as Amazon, Harrah's, Capital One, and the Boston Red Sox have dominated their fields by deploying industrial-strength analytics across a wide variety of activities. In essence, they are transforming their organizations into armies of killer apps and crunching their way to victory.

Organizations are competing on analytics not just because they can—business today is awash in data and data crunchers—but also because they should. At a time when firms in many industries offer similar products and use comparable technologies, business processes are among the last remaining points of differentiation. And analytics competitors wring every last drop of value from those processes. So, like other companies, they know what products their customers want, but they also know what prices those customers will pay, how many items each will buy in a lifetime, and what triggers will make people buy more. Like other companies, they know compensation costs and turnover rates, but they can also calculate how much personnel contribute to or detract from the bottom line and how salary levels relate to individuals' performance. Like other companies, they know when inventories are running low, but they can also predict problems with demand and supply chains, to achieve low rates of inventory and high rates of perfect orders.

And analytics competitors do all those things in a coordinated way, as part of an overarching strategy championed by top leadership and pushed down to decision makers at every level. Employees hired for their expertise with numbers or trained to recognize their importance are armed with the best evidence and the best quantitative tools. As a result, they make the best decisions: big and small, every day, over and over and over.

Although numerous organizations are embracing analytics, only a handful have achieved this level of proficiency. But analytics competitors are the leaders in their varied fields—consumer products, finance, retail, and travel and entertainment among them. Analytics has been instrumental to Capital One, which has exceeded 20% growth in earnings per share every year since it became a public company. It has allowed Amazon to dominate online retailing and turn a profit despite enormous investments in growth and infrastructure. In sports, the real secret weapon isn't steroids, but stats, as dramatic victories by the Boston Red Sox, the New England Patriots, and the Oakland A's attest.

At such organizations, virtuosity with data is often part of the brand. Progressive makes advertising hay from its detailed parsing of individual insurance rates. Amazon customers can watch the company learning about them as its service grows more targeted with frequent purchases. Thanks to Michael Lewis's best-selling book *Moneyball,* which demonstrated the power of statistics in professional baseball, the Oakland A's are almost as famous for their geeky number crunching as they are for their athletic prowess.

To identify characteristics shared by analytics competitors, I and two of my colleagues at Babson College's Working Knowledge Research Center studied 32 organizations that have made a commitment to quantitative, fact-based analysis. Eleven of those organizations we classified as full-bore analytics competitors, meaning top management had announced that analytics was key to their strategies; they had multiple initiatives under way involving complex data and statistical analysis, and they managed analytical activity at the enterprise (not departmental) level.

This article lays out the characteristics and practices of these statistical masters and describes some of the very substantial changes other companies must undergo in order to compete on quantitative turf. As one would expect, the transformation requires a significant investment in technology, the accumulation of massive stores of data, and the formulation of companywide strategies for managing the data. But at least as important, it requires executives' vocal, unswerving commitment and willingness to change the way employees think, work, and are treated. As Gary Loveman, CEO of analytics competitor Harrah's, frequently puts it, "Do we think this is true? Or do we know?"

Anatomy of an Analytics Competitor

One analytics competitor that's at the top of its game is Marriott International. Over the past 20 years, the corporation has honed to a science its system for establishing the optimal price for guest rooms (the key analytics process in hotels, known as revenue management). Today, its ambitions are far grander. Through its Total Hotel Optimization program, Marriott has expanded its quantitative expertise to areas such as conference facilities and catering, and made related tools available over the Internet to property revenue managers and hotel owners. It has developed systems to optimize offerings to frequent customers and assess the likelihood of those customers' defecting to competitors. It has given local revenue managers the power to override the system's recommendations when certain local factors can't be predicted (like the large number of Hurricane Katrina evacuees arriving in Houston). The company has even created a revenue opportunity model, which computes actual revenues as a percentage of the optimal rates that could have been charged. That figure has grown from 83% to 91% as Marriott's revenue-management analytics has taken root throughout the enterprise. The word is out among property owners and franchisees: If you want to squeeze the most revenue from your inventory, Marriott's approach is the ticket.

Clearly, organizations such as Marriott don't behave like traditional companies. Customers notice the difference in every interaction; employees and vendors live the difference every day. Our study found three key attributes among analytics competitors:

Widespread use of modeling and optimization. Any company can generate simple descriptive statistics about aspects of its busi-

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Employees hired for their expertise with numbers or trained to recognize their importance are armed with the best evidence and the best quantitative tools. As a result, they make the best decisions.

ness—average revenue per employee, for example, or average order size. But analytics competitors look well beyond basic statistics. These companies use predictive modeling to identify the most profitable customers—plus those with the greatest profit potential and the ones most likely to cancel their accounts. They pool data generated in-house and data acquired from outside sources (which they analyze more deeply than do their less statistically savvy competitors) for a comprehensive understanding of their customers. They optimize their supply chains and can thus determine the impact of an unexpected constraint, simulate alternatives, and route shipments around problems. They establish prices in real time to get the highest yield possible from each of their customer transactions. They create complex models of how their operational costs relate to their financial performance.

Leaders in analytics also use sophisticated experiments to measure the overall impact or "lift" of intervention strategies and then apply the results to continuously improve subsequent analyses. Capital One, for example, conducts more than 30,000 experiments a year, with different interest rates, incentives, direct-mail packaging, and other variables. Its goal is to maximize the likelihood both that potential customers will sign up for credit cards and that they will pay back Capital One.

Progressive employs similar experiments using widely available insurance industry data. The company defines narrow groups, or cells, of customers: for example, motorcycle riders ages 30 and above, with college educations, credit scores over a certain level, and no accidents. For each cell, the company performs a regression analysis to identify factors that most closely correlate with the losses that group engenders. It then sets prices for the cells, which should enable the company to earn a profit across a portfolio of customer groups, and uses simulation software to test the financial implications of those hypotheses. With this approach, Progressive can profitably insure customers in traditionally high-risk categories. Other insurers reject high-risk customers out of hand, without bothering to delve more deeply into the data (although even traditional competitors, such as Allstate, are starting to embrace analytics as a strategy).

An enterprise approach. Analytics competitors understand that most business functions—even those, like marketing, that have historically depended on art rather than science—can be improved with sophisticated quantitative techniques. These organizations don't gain advantage from one killer app, but rather from multiple applications supporting many parts of the business—and, in a few cases, being rolled out for use by customers and suppliers.

UPS embodies the evolution from targeted analytics user to comprehensive analytics competitor. Although the company is among the world's most rigorous practitioners of operations research and industrial engineering, its capabilities were, until fairly recently, narrowly focused. Today, UPS is wielding its statistical skill to track the movement of packages and to anticipate and influence the actions of people—assessing the likelihood of customer attrition and identifying sources of problems. The UPS Customer Intelligence Group, for example, is able to accurately predict customer defections by examining usage patterns and complaints. When the data point to a potential defector, a salesperson contacts that customer to review and resolve the problem, dramatically reducing the loss of accounts. UPS still lacks the breadth of initiatives of a full-bore analytics competitor, but it is heading in that direction.

Analytics competitors treat all such activities from all provenances as a single, coherent initiative, often massed under one rubric, such as "information-based strategy" at Capital One or "information-based customer management" at Barclays Bank. These programs operate not just under a common label but also under common leadership and with common technology and tools. In traditional companies, "business intelligence" (the term IT people use for analytics and reporting processes and software) is generally managed by departments; number-crunching functions select their own tools, control their own data warehouses, and train their own people. But that way, chaos lies. For one thing, the proliferation of user-developed spreadsheets and databases inevitably leads to multiple versions of key indicators within an organization. Furthermore, research has shown that between 20% and 40% of spreadsheets contain errors; the more spreadsheets floating around a company, therefore, the more fecund the breeding ground for mistakes. Analytics competitors, by contrast, field centralized groups to ensure that critical data

and other resources are well managed and that different parts of the organization can share data easily, without the impediments of inconsistent formats, definitions, and standards.

Some analytics competitors apply the same enterprise approach to people as to technology. Procter & Gamble, for example, recently created a kind of überanalytics group consisting of more than 100 analysts from such functions as operations, supply chain, sales, consumer research, and marketing. Although most of the analysts are embedded in business operating units, the group is centrally managed. As a result of this consolidation, P&G can apply a critical mass of expertise to its most pressing issues. So, for example, sales and marketing analysts supply data on opportunities for growth in existing markets to analysts who design corporate supply networks. The supply chain analysts, in turn, apply their expertise in certain decision-analysis techniques to such new areas as competitive intelligence.

The group at P&G also raises the visibility of analytical and data-based decision making within the company. Previously, P&G's crack analysts had improved business processes and saved the firm money; but because they were squirreled away in dispersed domains, many executives didn't know what services they offered or how effective they could be. Now those executives are more likely to tap the company's deep pool of expertise for their projects. Meanwhile, masterful number crunching has become part of the story P&G tells to investors, the press, and the public.

Senior executive advocates. A companywide embrace of analytics impels changes in culture, processes, behavior, and skills for many employees. And so, like any major transition, it requires leadership from executives at the very top who have a passion for the quantitative approach. Ideally, the principal advocate is the CEO. Indeed, we found several chief executives who have driven the shift to analytics at their companies over the past few years, including Loveman of Harrah's, Jeff Bezos of Amazon, and Rich Fairbank of Capital One. Before he retired from the Sara Lee Bakery Group, former CEO Barry Beracha kept a sign on his desk that summed up his personal and organizational philosophy: "In God we trust. All others bring data." We did come across some companies in which a single functional or business unit leader was trying to push analytics throughout the organization, and a few were making some progress. But we found that these lower-level people lacked the clout, the perspective, and the cross-functional scope to change the culture in any meaningful way.

CEOs leading the analytics charge require both an appreciation of and a familiarity with the subject. A background in statistics isn't necessary, but those leaders must understand the theory behind various quantitative methods so

Going to Bat for Stats

The analysis-versus-instinct debate, a favorite of political commentators during the last two U.S. presidential elections, is raging in professional sports, thanks to several popular books and high-profile victories. For now, analysis seems to hold the lead.

Most notably, statistics are a major part of the selection and deployment of players. *Moneyball,* by Michael Lewis, focuses on the use of analytics in player selection for the Oakland A's—a team that wins on a shoestring. The New England Patriots, a team that devotes an enormous amount of attention to statistics, won three of the last four Super Bowls, and their payroll is currently ranked 24th in the league. The Boston Red Sox have embraced "sabermetrics" (the application of analysis to baseball), even going so far as to hire Bill James, the famous baseball statistician who popularized that term. Analytic HR strategies are taking hold in European soccer as well. One leading team, Italy's A.C. Milan, uses predictive models from its Milan Lab research center to prevent injuries by analyzing physiological, orthopedic, and psychological data from a variety of sources. A fast-rising English soccer team, the Bolton Wanderers, is known for its manager's use of extensive data to evaluate players' performance.

Still, sports managers—like business leaders—are rarely fact-or-feeling purists. St. Louis Cardinals manager Tony La Russa, for example, brilliantly combines analytics with intuition to decide when to substitute a charged-up player in the batting lineup or whether to hire a spark-plug personality to improve morale. In his recent book, *Three Nights in August,* Buzz Bissinger describes that balance: "La Russa appreciated the information generated by computers. He studied the rows and the columns. But he also knew they could take you only so far in baseball, maybe even confuse you with a fog of overanalysis. As far as he knew, there was no way to quantify desire. And those numbers told him exactly what he needed to know when added to twenty-four years of managing experience."

That final sentence is the key. Whether scrutinizing someone's performance record or observing the expression flitting across an employee's face, leaders consult their own experience to understand the "evidence" in all its forms.

that they recognize those methods' limitations—which factors are being weighed and which ones aren't. When the CEOs need help grasping quantitative techniques, they turn to experts who understand the business and how analytics can be applied to it. We interviewed several leaders who had retained such advisers, and these executives stressed the need to find someone who can explain things in plain language and be trusted not to spin the numbers. A few CEOs we spoke with had surrounded themselves with very analytical people—professors, consultants, MIT graduates, and the like. But that was a personal preference rather than a necessary practice.

Of course, not all decisions should be grounded in analytics—at least not wholly so. Personnel matters, in particular, are often well and appropriately informed by instinct and anecdote. More organizations are subjecting recruiting and hiring decisions to statistical analysis (see the sidebar "Going to Bat for Stats"). But research shows that human beings can make quick, surprisingly accurate assessments of personality and character based on simple observations. For analytics-minded leaders, then, the challenge boils down to knowing when to run with the numbers and when to run with their guts.

Their Sources of Strength

Analytics competitors are more than simple number-crunching factories. Certainly, they apply technology—with a mixture of brute force and finesse—to multiple business problems. But they also direct their energies toward finding the right focus, building the right culture, and hiring the right people to make optimal use of the data they constantly churn. In the end, people and strategy, as much as information technology, give such organizations strength.

The right focus. Although analytics competitors encourage universal fact-based decisions, they must choose where to direct resource-intensive efforts. Generally, they pick several functions or initiatives that together serve an overarching strategy. Harrah's, for example, has aimed much of its analytical activity at increasing customer loyalty, customer service, and related areas like pricing and promotions. UPS has broadened its focus from logistics to customers, in the interest of providing superior service. While such multipronged strate-

THINGS YOU CAN COUNT ON

Analytics competitors make expert use of statistics and modeling to improve a wide variety of functions. Here are some common applications:

FUNCTION	DESCRIPTION	EXEMPLARS
Supply chain	Simulate and optimize supply chain flows; reduce inventory and stock-outs.	Dell, Wal-Mart, Amazon
Customer selection, loyalty, and service	Identify customers with the greatest profit potential; increase likelihood that they will want the product or service offering; retain their loyalty.	Harrah's, Capital One, Barclays
Pricing	Identify the price that will maximize yield, or profit.	Progressive, Marriott
Human capital	Select the best employees for particular tasks or jobs, at particular compensation levels.	New England Patriots, Oakland A's, Boston Red Sox
Product and service quality	Detect quality problems early and minimize them.	Honda, Intel
Financial performance	Better understand the drivers of financial performance and the effects of nonfinancial factors.	MCI, Verizon
Research and development	Improve quality, efficacy, and, where applicable, safety of products and services.	Novartis, Amazon, Yahoo

gies define analytics competitors, executives we interviewed warned companies against becoming too diffuse in their initiatives or losing clear sight of the business purpose behind each.

Another consideration when allocating resources is how amenable certain functions are to deep analysis. There are at least seven common targets for analytical activity, and specific industries may present their own (see "Things You Can Count On"). Statistical models and algorithms that dangle the possibility of performance breakthroughs make some prospects especially tempting. Marketing, for example, has always been tough to quantify because it is rooted in psychology. But now consumer products companies can hone their market research using multiattribute utility theory—a tool for understanding and predicting consumer behaviors and decisions. Similarly, the advertising industry is adopting econometrics—statistical techniques for measuring the lift provided by different ads and promotions over time.

In traditional companies, departments manage analytics —number-crunching functions select their own tools and train their own people. But that way, chaos lies.

The most proficient analytics practitioners don't just measure their own navels—they also help customers and vendors measure theirs. Wal-Mart, for example, insists that suppliers use its Retail Link system to monitor product movement by store, to plan promotions and layouts within stores, and to reduce stock-outs. E.&J. Gallo provides distributors with data and analysis on retailers' costs and pricing so they can calculate the per-bottle profitability for each of Gallo's 95 wines. The distributors, in turn, use that information to help retailers optimize their mixes while persuading them to add shelf space for Gallo products. Procter & Gamble offers data and analysis to its retail customers, as part of a program called Joint Value Creation, and to its suppliers to help improve responsiveness and reduce costs. Hospital supplier Owens & Minor furnishes similar services, enabling customers and suppliers to access and analyze their buying and selling data, track ordering patterns in search of consolidation opportunities, and move off-contract purchases to group contracts that include products distributed by Owens & Minor and its competitors. For example, Owens & Minor might show a hospital chain's executives how much money they could save by consolidating purchases across multiple locations or help them see the trade-offs between increasing delivery frequency and carrying inventory.

The right culture. Culture is a soft concept; analytics is a hard discipline. Nonetheless, analytics competitors must instill a company-wide respect for measuring, testing, and evaluating quantitative evidence. Employees are urged to base decisions on hard facts. And they know that their performance is gauged the same way. Human resource organizations within analytics competitors are rigorous about applying metrics to compensation and rewards. Harrah's, for example, has made a dramatic change from a rewards culture based on paternalism and tenure to one based on such meticulously collected performance measurements as financial and customer service results. Senior executives also set a consistent example with their own behavior, exhibiting a hunger for and confidence in fact and analysis. One exemplar of such leadership was Beracha of the Sara Lee Bakery Group, known to his employees as a "data dog" because he hounded them for data to support any assertion or hypothesis.

Not surprisingly, in an analytics culture, there's sometimes tension between innovative or entrepreneurial impulses and the requirement for evidence. Some companies place less emphasis on blue-sky development, in which designers or engineers chase after a gleam in someone's eye. In these organizations, R&D, like other functions, is rigorously metric-driven. At Yahoo, Progressive, and Capital One, process and product changes are tested on a small scale and implemented as they are validated. That approach, well established within various academic and business disciplines (including engineering, quality management, and psychology), can be applied to most corporate processes—even to not-so-obvious candidates, like human resources and customer service. HR, for example, might create profiles of managers' personality traits and leadership styles and then test those managers in different situations. It could then compare data on individuals' performance with data about personalities to determine what traits are most important to managing a project that is behind schedule, say, or helping a new group to assimilate.

There are, however, instances when a decision to change something or try something new must be made too quickly for extensive analysis, or when it's not possible to gather data beforehand. For example, even though Ama-

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zon's Jeff Bezos greatly prefers to rigorously quantify users' reactions before rolling out new features, he couldn't test the company's search-inside-the-book offering without applying it to a critical mass of books (120,000, to begin with). It was also expensive to develop, and that increased the risk. In this case, Bezos trusted his instincts and took a flier. And the feature did prove popular when introduced.

The right people. Analytical firms hire analytical people—and like all companies that compete on talent, they pursue the best. When Amazon needed a new head for its global supply chain, for example, it recruited Gang Yu, a professor of management science and software entrepreneur who is one of the world's leading authorities on optimization analytics. Amazon's business model requires the company to manage a constant flow of new products, suppliers, customers, and promotions, as well as deliver orders by promised dates. Since his arrival, Yu and his team have been designing and building sophisticated supply chain systems to optimize those processes. And while he tosses around phrases like "nonstationary stochastic processes," he's also good at explaining the new approaches to Amazon's executives in clear business terms.

Established analytics competitors such as Capital One employ squadrons of analysts to conduct quantitative experiments and, with the results in hand, design credit card and other financial offers. These efforts call for a specialized skill set, as you can see from this job description (typical for a Capital One analyst):

> High conceptual problem-solving and quantitative analytical aptitudes…Engineering, financial, consulting, and/or other analytical quantitative educational/work background. Ability to quickly learn how to use software applications. Experience with Excel models. Some graduate work preferred but not required (e.g., MBA). Some experience with project management methodology, process improvement tools (Lean, Six Sigma), or statistics preferred.

Other firms hire similar kinds of people, but analytics competitors have them in much greater numbers. Capital One is currently seeking three times as many analysts as operations people—hardly the common practice for a bank. "We are really a company of analysts," one executive there noted. "It's the primary job in this place."

Good analysts must also have the ability to express complex ideas in simple terms and have the relationship skills to interact well with decision makers. One consumer products company with a 30-person analytics group looks for what it calls "PhDs with personality"—people with expertise in math, statistics, and data analysis who can also speak the language of business and help market their work internally and sometimes externally. The head of a customer analytics group at Wachovia Bank describes the rapport with others his group seeks: "We are trying to build our people as part of the business team," he explains. "We want them sitting at the business table, participating in a discussion of what the key issues are, determining what information needs the businesspeople have, and recommending actions to the business partners. We want this [analytics group] to be not just a general utility, but rather an active and critical part of the business unit's success."

Of course, a combination of analytical, business, and relationship skills may be difficult to find. When the software company SAS (a sponsor of this research, along with Intel) knows it will need an expert in state-of-the-art business applications such as predictive modeling or recursive partitioning (a form of decision tree analysis applied to very complex data sets), it begins recruiting up to 18 months before it expects to fill the position.

In fact, analytical talent may be to the early 2000s what programming talent was to the late 1990s. Unfortunately, the U.S. and European labor markets aren't exactly teeming with analytically sophisticated job candidates. Some organizations cope by contracting work to countries such as India, home to many statistical experts. That strategy may succeed when offshore analysts work on stand-alone problems. But if an iterative discussion with business decision makers is required, the distance can become a major barrier.

The right technology. Competing on analytics means competing on technology. And while the most serious competitors investigate the latest statistical algorithms and decision science approaches, they also constantly monitor and push the IT frontier. The analytics group at one consumer products company went so far as to build its own supercomputer because it felt that commercially available models were inadequate for its demands. Such heroic feats usually aren't necessary, but seri-

ous analytics does require the following:

A data strategy. Companies have invested many millions of dollars in systems that snatch data from every conceivable source. Enterprise resource planning, customer relationship management, point-of-sale, and other systems ensure that no transaction or other significant exchange occurs without leaving a mark. But to compete on that information, companies must present it in standard formats, integrate it, store it in a data warehouse, and make it easily accessible to anyone and everyone. And they will need *a lot* of it. For example, a company may spend several years accumulating data on different marketing approaches before it has gathered enough to reliably analyze the effectiveness of an advertising campaign. Dell employed DDB Matrix, a unit of the advertising agency DDB Worldwide, to create (over a period of seven years) a database that includes 1.5 million records on all the computer maker's print, radio, network TV, and cable ads, coupled with data on Dell sales for each region in which the ads appeared (before and after their appearance). That information allows Dell to fine-tune its promotions for every medium in every region.

Business intelligence software. The term "business intelligence," which first popped up in the late 1980s, encompasses a wide array of processes and software used to collect, analyze, and disseminate data, all in the interests of better decision making. Business intelligence tools allow employees to extract, transform, and load (or ETL, as people in the industry would say) data for analysis and then make those analyses available in reports, alerts, and scorecards. The popularity of analytics competition is partly a response to the emergence of integrated packages of these tools.

Computing hardware. The volumes of data required for analytics applications may strain the capacity of low-end computers and servers. Many analytics competitors are converting their hardware to 64-bit processors that churn large amounts of data quickly.

You Know You Compete on Analytics When...

1. You apply sophisticated information systems and rigorous analysis not only to your core capability but also to a range of functions as varied as marketing and human resources.

2. Your senior executive team not only recognizes the importance of analytics capabilities but also makes their development and maintenance a primary focus.

3. You treat fact-based decision making not only as a best practice but also as a part of the culture that's constantly emphasized and communicated by senior executives.

4. You hire not only people with analytical skills but a lot of people with *the very best* analytical skills—and consider them a key to your success.

5. You not only employ analytics in almost every function and department but also consider it so strategically important that you manage it at the enterprise level.

6. You not only are expert at number crunching but also invent proprietary metrics for use in key business processes.

7. You not only use copious data and in-house analysis but also share them with customers and suppliers.

8. You not only avidly consume data but also seize every opportunity to generate information, creating a "test and learn" culture based on numerous small experiments.

9. You not only have committed to competing on analytics but also have been building your capabilities for several years.

10. You not only emphasize the importance of analytics internally but also make quantitative capabilities part of your company's story, to be shared in the annual report and in discussions with financial analysts.

The Long Road Ahead

Most companies in most industries have excellent reasons to pursue strategies shaped by analytics. Virtually all the organizations we identified as aggressive analytics competitors are clear leaders in their fields, and they attribute much of their success to the masterful exploitation of data. Rising global competition intensifies the need for this sort of proficiency. Western companies unable to beat their Indian or Chinese competitors on product cost, for example, can seek the upper hand through optimized business processes.

Companies just now embracing such strategies, however, will find that they take several years to come to fruition. The organizations in our study described a long, sometimes arduous journey. The UK Consumer Cards and Loans business within Barclays Bank, for example, spent five years executing its plan to apply analytics to the marketing of credit cards and other financial products. The company had to make process changes in virtually every aspect of its consumer business: underwriting risk, setting credit limits, servicing accounts, controlling fraud, cross selling, and so on. On the technical side, it had to integrate data on 10 million Barclaycard customers, improve the

quality of the data, and build systems to step up data collection and analysis. In addition, the company embarked on a long series of small tests to begin learning how to attract and retain the best customers at the lowest price. And it had to hire new people with top-drawer quantitative skills.

Much of the time—and corresponding expense—that any company takes to become an analytics competitor will be devoted to technological tasks: refining the systems that produce transaction data, making data available in warehouses, selecting and implementing analytic software, and assembling the hardware and communications environment. And because those who don't record history are doomed not to learn from it, companies that have collected little information—or the wrong kind—will need to amass a sufficient body of data to support reliable forecasting. "We've been collecting data for six or seven years, but it's only become usable in the last two or three, because we needed time and experience to validate conclusions based on the data," remarked a manager of customer data analytics at UPS.

And, of course, new analytics competitors will have to stock their personnel larders with fresh people. (When Gary Loveman became COO, and then CEO, of Harrah's, he brought in a group of statistical experts who could design and implement quantitatively based marketing campaigns and loyalty programs.) Existing employees, meanwhile, will require extensive training. They need to know what data are available and all the ways the information can be analyzed; and they must learn to recognize such peculiarities and shortcomings as missing data, duplication, and quality problems. An analytics-minded executive at Procter & Gamble suggested to me that firms should begin to keep managers in their jobs for longer periods because of the time required to master quantitative approaches to their businesses.

The German pathologist Rudolph Virchow famously called the task of science "to stake out the limits of the knowable." Analytics competitors pursue a similar goal, although the universe they seek to know is a more circumscribed one of customer behavior, product movement, employee performance, and financial reactions. Every day, advances in technology and techniques give companies a better and better handle on the critical minutiae of their operations.

The Oakland A's aren't the only ones playing moneyball. Companies of every stripe want to be part of the game.

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