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Inside Ops

TAPPING ADVANCED ANALYTICS AND BIG DATA FOR LEADING-EDGE OPERATIONS

INSIDE OPS

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LEADING-EDGE OPERATIONS

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PREFACE

WELCOME TO THE THIRD edition of BCG's *Inside OPS*, a biannual collection of our thought leadership focusing on operations and related topics.

Smart homes, social media, mobile applications, the Internet of Things, and other technologies are generating an unprecedented amount of multistructured data. This big data has the potential to transform businesses and industries and to unlock tremendous value. Big data by itself can't change the world—but applying the insights gleaned through the analysis of big data makes it possible for companies to transform the way the world does business. The time has come to value data as a winning strategic asset.

BCG recently teamed up with Amazon to quantify the benefits of using big data. The survey, which studied 167 companies in five sectors, examined the factors that differentiate leaders from the rest of the pack and explored how leaders gain competitive advantage from big data analytics. Leaders in big data generate an average of 12% more revenue than those that do not maximize their use of analytics, according to the survey. Leaders also have faster growth rates and a greater ability to innovate.

But advanced analytics comprises a plethora of new technologies, and leaders—particularly those who don't have a quantitative background—must struggle to cut through the hype surrounding the field, understand the available options, and determine how best to apply each of the advanced analytics techniques to its best advantage. It's a daunting challenge.

Addressing that challenge and finding ways to improve decision making through the use of advanced analytics is the topic of one of the articles included in this edition of *Inside OPS,* whose theme is "tapping big data and advanced analytics for leading-edge operations." Other articles address how to debunk myths about big data, how digital technologies are raising the stakes in customer service, and how companies mst bridge the trust gap with customers to avoid failures. This edition also features a Q&A with Gaurav Nath, a partner and managing director in our London office who describes the importance of analytics as a transformation opportunity and not merely as a tool.

At BCG, we design data-driven strategies to transform businesses and provide targeted expertise in analytics to help solve some of the toughest problems. We have recently launched our model factory in Paris: The Innovation Center for Operations, which enables clients to

experiment with and assess in action such Industry 4.0 solutions as collaborative robots, 3D printing, augmented reality, and big data. The center features two real, end-to-end assembly and production lines as well as visionary technology demonstrators. Our objective is to improve companies' competitive advantage by realizing benefits in productivity, quality, flexibility, and speed. The center reinforces our commitment to innovation, Industry 4.0, and the use of advanced technologies in operations.

I hope you enjoy reading these articles. Please send any comments or thoughts to opsmarketing@bcg.com.

Warm regards,

Christian Greiser
Global Leader, Operations Practice
Senior Partner and Managing Director

USING ADVANCED ANALYTICS TO IMPROVE OPERATIONAL DECISIONS

OPERATIONS LEADERS ROUTINELY MAKE critical decisions across the entire value chain. What combination of raw materials will minimize total cost? How can we plan production to maximize throughput? How can we schedule maintenance tasks to minimize disruptions?

Although such decisions typically involve complex tradeoffs, managers have often made them using rules of thumb or basic data analysis. Today, though, leaders can apply advanced analytics techniques—supported by cheaper computing power and improved data capture mechanisms—to make better-informed decisions that optimize value.

However, many operations leaders must climb a steep learning curve to understand the best ways to apply advanced analytics. For those without quantitative backgrounds, sorting through the hype and distinguishing among popular terms in the analytics field—such as big data, operations research, decision support, and Industry 4.0—can be a daunting task. Because these terms are often used synonymously, it is challenging for leaders to determine how they can employ each of these techniques to the best advantage. Indeed, many businesses are losing potential value because they cannot spot the opportunities to make the most of advanced analytics.

Building comprehensive expertise in the available analytics techniques is beyond the call of duty for most operations leaders. However, it is essential to gain a better understanding of how to use advanced analytics to inform business decisions.

We recommend thinking about analytics in terms of three categories: analysis, modeling, and optimization. These categories follow the application of analytics from performance measurement to predictive modeling to optimal decision making. (See Exhibit 1.)

Analysis: What Happened in the Past?

The most basic use of analytics entails gathering and analyzing data about the company's past performance. This backward-looking analysis describes and summarizes a selection of KPIs, typically over time. In doing so, the analysis provides insights regarding the factors that drive value; it can also suggest interventions to increase value. By gaining this visibility, the company also obtains a fact base for modeling future performance and making decisions that optimize value creation.

The fact base is typically presented using business intelligence software (such as Tableau, QlikView, or Tibco Spotfire). The dashboards created by such software give nonspecialists the ability to perform complex data

EXHIBIT 1 | Advanced Analytics Enables Better Decisions

ANALYSIS	MODELING	OPTIMIZATION
MEASURE AND UNDERSTAND	EXPERIMENT	DECIDE

Examples

- Performance dashboards
- Root cause analysis

- Testing interventions to remove bottlenecks
- Forecasting equipment performance

- Network optimization
- Sales and operations planning
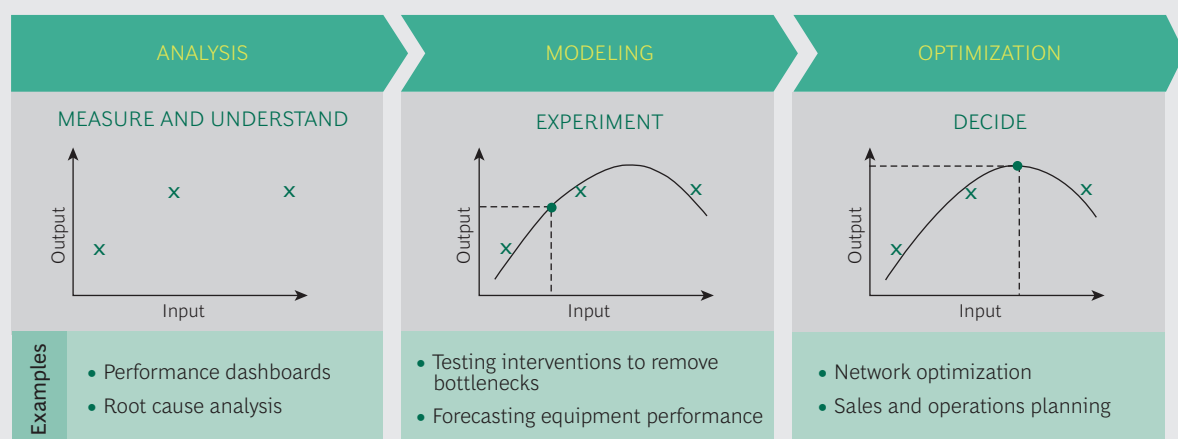
analysis. With a few clicks, a manager or executive can generate an impressive array of insights from millions of data points. Only five years ago, a specialist with computer science skills would have needed hours to generate such extensive insights.

On the most basic level, companies can use the insights to identify where value may be "leaking" from the business. A manufacturer we worked with found that welders' productivity is 15% lower on Fridays, for instance. Another company found that its sales staff typically provided the maximum authorized discount to customers rather than negotiating on price—a common problem throughout businesses. Insights like these point to the need for corrective actions, such as enhanced approaches to motivating workers or improvements to training programs.

Modeling: What Does the Future Hold?

A model is an abstract representation of a business. A company can use a model to predict how it might perform in the future under different scenarios. Modeling makes it possible for companies to experiment with their operations in a risk-free manner. Companies can test different strategies, and make mistakes, in a virtual representation of reality.

A company must be able to use models effectively to test how changing variables in the

business environment will affect company performance. And, because business leaders are often skeptical about the accuracy of the results, analytics teams must be prepared to demonstrate that models are realistic. For a model to be realistic, it must be fit for purpose—that is, it must be a sufficiently accurate representation of the business system. The availability of the appropriate data is also a prerequisite.

Many different modeling tools exist, and the correct tool for a specific application depends on the characteristics of the system being modeled. For example, bulk commodity supply chains are typically modeled using "discrete event simulation," a technique designed to emulate systems that have complex dynamics.

Applications for supply chains and equipment performance illustrate the potential for using models to inform decision making.

Simulation Models for Supply Chains. Supply chains often have complex, dynamic characteristics, such as variability arising from breakdowns or changes in demand or supply patterns. They typically require a buffer or inventory to manage this variability. A model of a supply chain must emulate these dynamics.

For example, we have used a supply chain model to help mining companies decide where to invest capital. The model allows

companies to test what happens if they change variables, such as the number of trains or the frequency of conveyor belt breakdowns. A leading mining company used this model and discovered that its operations could be served by a single-track rail line, rather than the double-track line proposed by project engineers. This insight enabled the company to avoid a planned $500 million capital expenditure.

Supply chain models are also useful for testing different operating strategies or philosophies. For example, a port authority applied the insights from modeling to change the rules by which ships were brought through a tidally constrained channel. Applying the new rules enabled the port to increase its capacity by 5%.

Machine Learning for Equipment Performance. Machine-learning techniques are used to model very complex systems, such as jet engines and copper smelters. These techniques use historical data to learn the complex, nonlinear relationships between inputs and outputs. We used a machine-learning algorithm to help a metals company model the performance of a copper smelter, including the highly complex relationships among temperature, oxygen, flux, and feed rate. The predictive insights generated by the machine-learning algorithm proved superior to those obtained from models developed by the company on the basis of physics and chemistry. The company applied the insights to improve yield by 0.5% to 1.0%, amounting to tens of millions of dollars in additional value.

Optimization: What Decisions Maximize Value?

The payoff from applying analytics arises from using the results of modeling to make decisions that optimize value creation. By experimenting with a model to test the results of different decisions, a company can often determine the actions required to achieve the optimal outcome. However, some business problems involve such a complex array of variables that the potential solutions literally number in the trillions. Optimization techniques help companies determine the

solutions to these highly complex business problems.

An optimization technique is a mathematical algorithm that calculates which decisions will maximize value in a given set of circumstances, taking into account the objectives and the applicable business rules or constraints. These techniques are prescriptive: they tell companies what to do. In modeling, the input is a set of decisions and the output is the value that would result from implementing these decisions. Optimization reverses this relationship: the input is the value-maximizing objective and the output is the set of decisions that would achieve the objective. (See Exhibit 2.)

Optimization techniques help companies find solutions to highly complex problems.
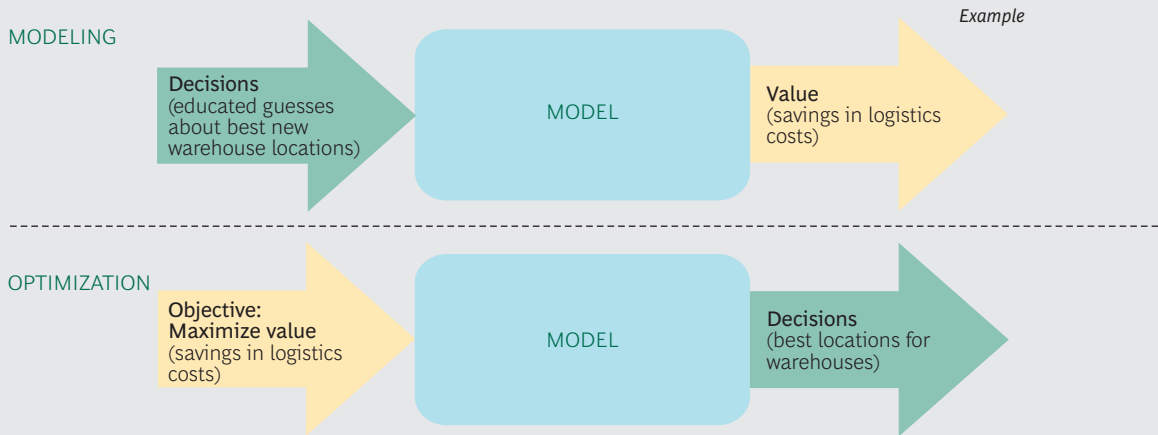
The sophistication of optimization techniques has increased exponentially during the past decade, making it possible to solve a much wider variety of problems. The following examples illustrate the scope and potential for value creation for companies across industries:

- **A Foundry.** Foundry operations are remarkably complex, making it nearly impossible for an operator to determine the optimal schedule of tasks. One foundry applied an optimization algorithm to overcome this complexity. Inputs included the foundry's goal for the number of components manufactured per week as well as constraints relating to the availability of labor and material. The output of the optimization was the order in which components should be manufactured. By implementing this decision, the foundry increased capacity by 20% while reducing delivery times.

- **A National Broadband Network.** A national broadband network is engaged in a multiyear project to roll out internet service across the country. The network

EXHIBIT 2 | Optimization Prescribes How to Maximize Value

IF MODELING IS UNDERSTANDING HOW TO PLAY CHESS,
OPTIMIZATION IS UNDERSTANDING HOW TO WIN.

Example

MODELING

Decisions
(educated guesses
about best new
warehouse locations) → MODEL → Value
(savings in logistics
costs)

OPTIMIZATION

Objective:
Maximize value
(savings in logistics
costs) → MODEL → Decisions
(best locations for
warehouses)

Source: BCG experience.

comprises a variety of technologies, whose cost and speed vary significantly, as does the number of engineers, construction workers, and managers required to build and maintain them. To determine the optimal mix of technologies and the schedule for rolling them out, the company applied an optimization algorithm. The objective of the optimization was to maximize net present value. The constraints included the number of engineers available and limitations on debt. The output was a fully optimized rollout plan that specified which technologies to use in which locations and how to sequence the rollout. The optimized plan has enabled the network to reduce its funding requirement by $2 billion.

• **A Poultry Company.** A poultry company had been using rules of thumb to make complex decisions about how to produce and process birds in order to most profitably meet its customers' needs. Poultry production is a complex business with challenging constraints. For example, suppose the sales team asks the operations team to produce an additional 100 tons of breast meat. Boosting production of breast meat by this amount will also generate an additional 150 tons of leg meat and 40 tons of wings. Significant waste will result if the sales team does not consider wheth-

er it can sell the additional tonnage of leg meat and wings.

To determine how to address this type of complexity while meeting customer demand, the company used an optimization algorithm. The output specified the quantity of each type of meat to produce in each factory, which size of birds to process, and how to most efficiently transport the products to customers. It also specified which customers were not profitable to serve. The optimized approach is expected to generate additional EBIT of more than $20 million. The approach has allowed the business to serve a large new customer it had previously believed it lacked the capacity to serve. The additional business is worth millions of dollars of margin, and demand can be met with no additional capital investment.

• **A Steel Producer.** A steel producer sought to redesign its supply chain to meet customer demand at minimal cost. Taking into account the capacity constraints of production lines and warehouses, an algorithm specified the optimal supply chain for 2025—one that would enable a flow of goods across the producer's network at the lowest cost. The producer has already reduced logistics costs by 10% through better decisions

about which products to make where and how to distribute them.

Getting Started

As a first step to enhancing the value derived from analytics, a company should review its value chain to identify all the business decisions it is currently making. Look for decisions that are:

- Difficult to make owing to their complexity

- High margin, because the difference between good and best (that is, optimal) has a material impact on value

- Currently being made using gut instinct or unsophisticated analytics tools (such as spreadsheets)

Advanced analytics is a fundamental enabler of operational excellence.

If all three circumstances exist, analytics can almost certainly be valuable to support decision making. Having identified the decisions to prioritize, most companies will need new expertise—either in-house or provided by a third party—to match their business problems to the most appropriate analytics technique. When building an in-house analytics function, it is important to create clear linkages and feedback mechanisms between the field and analytics teams to ensure that the new function is effective and continues to add value over time.

Companies should be mindful that developing support tools to compute the optimal decisions represents only a small part of the work necessary to capture the benefits of analytics. To convert insights into actions, a company must establish processes that enable company-wide, optimal decision making. It must also ensure that decision rights and accountabilities promote the use of these processes and the analytics systems. Finally, it must establish

KPIs that incentivize employees to use these advanced techniques and implement the recommendations from analytics teams.

L EADING companies are already capturing significant savings and a competitive edge from applying advanced analytics in operations. Today's applications are just the starting point. In many industries, advanced analytics has the potential to transform how companies manage their operations. Companies that fail to understand and pursue the opportunities risk falling permanently behind the leaders in their increasingly competitive markets. Now is the time to embrace advanced analytics as a fundamental enabler of operational excellence.

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THE DOUBLE GAME OF DIGITAL MANAGEMENT

MANAGING IN TIMES OF BIG DATA AND ANALYTICS

DIGITAL TECHNOLOGIES ARE PROFOUNDLY transforming not just products, services, and business processes but also management itself and the inner workings of companies. A new generation of executives is relying on data analytics and artificial intelligence to support and make decisions.

Our aim is to demystify these once-arcane fields and show how they have moved out of the laboratory and into the executive suite. Executives need to address several fundamental quandaries: How should you, your team, and your organization evolve? What does it mean for leadership and management behavior, as well as for organizational structure and the composition of teams? What skills will employees need, and what levels of performance can you expect from them? How will the role of IT systems shift as their ease of use, flexibility, and intelligence increase?

Digital technologies are profoundly transforming management itself.

We are at the cusp of a new era of data-driven management. As an executive, you have a chance to tap into new sources of power and knowledge, but only if you upgrade your own analytical arsenal and model the change in behavior that you expect of your people.

Beyond the Weather, Toward the Climate

Data-driven management touches the entire organization. Many executives, however, see data-driven management only from within their own silo. Marketing may see it as an exercise in consumer insight and churn reduction. Manufacturing may view it as a tool to optimize processes and effectiveness.

Viewed more holistically, data-driven management refracts into five major sets of activities: innovative offerings and business models, operational analytics, customer and commercial analytics, enterprise and risk analytics, and the underlying systems and capabilities that support all of the above.

Even at the functional program level, data-driven management is a challenging activity that can create substantial value—or destroy it through ill-fated projects.

Faced with a flurry of promising initiatives and the challenge of managing the portfolio of "use cases" for analytics (its myriad applications across the business), it is easy for executives to fail to shift their focus from today's weather to the broader climate, from tactics to strategy. They frequently do not

think deeply enough about how to create an effective data-driven company as a whole, leaving their business exposed today and unprepared for things to come.

Becoming and Managing a Data-Driven Company

Executives who want to sharpen their analytic edge and manage a data-driven company need to start with themselves, then move on to their team and finally to their organization. Such a transformation requires actions along four critical dimensions, as well as a double-game perspective. (See the exhibit below.)
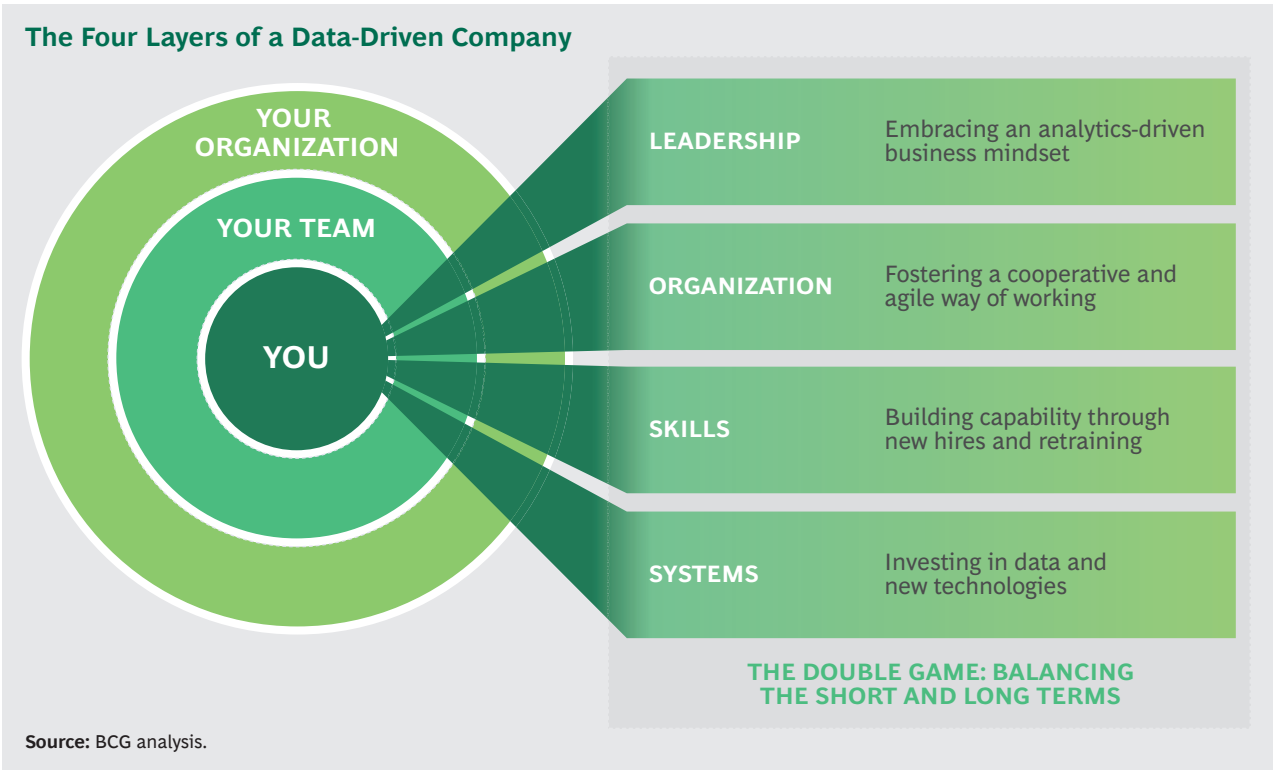
Leadership: An Analytics-Driven Business Mindset. The best data-driven companies have a data-driven culture. Executives at these companies—ranging from digital attackers, such as Amazon, to century-old companies like Procter & Gamble—make decisions on the basis of rich, near-real-time data. Data analytics has evolved into a core general-management skill, similar to corporate finance and cost accounting. While executives would never base their decisions entirely on such information, they also would not proceed without it. They are comfortable

leading discussions and teams centered on data analytics.

Data-driven companies embrace the democratization of data. Managers and employees can access and interpret a wide variety of company data using intuitive self-service tools. They explore topics and generate answers more quickly and with less friction than if they had to go to specialized data analytics or business intelligence teams.

At Amazon, many managers spend 5% to 10% of their time working directly with databases, constantly striving to define and measure the right metrics. In meetings, they are expected to condense their findings into concise, data-rich documents that will frame subsequent discussions and decisions. This culture extends all the way to recruiting, with candidates for management positions assessed on their skills and eagerness to get their hands dirty with data.

At P&G, managers have access to standardized datasets, powerful data visualization tools, intuitive dashboards, and immersive conference rooms with large wall-screen data displays. More than 50,000 employees also have access to a "decision cockpit" that dis-

The Four Layers of a Data-Driven Company

LEADERSHIP	Embracing an analytics-driven business mindset
ORGANIZATION	Fostering a cooperative and agile way of working
SKILLS	Building capability through new hires and retraining
SYSTEMS	Investing in data and new technologies

YOUR ORGANIZATION
YOUR TEAM
YOU

THE DOUBLE GAME: BALANCING THE SHORT AND LONG TERMS

Source: BCG analysis.

plays critical data in near real time. These methodologies collectively form a sort of common language.

Organization: Cooperative and Agile Ways of Working. The organizational challenges of creating a data-driven company fall into two main areas:

- How to balance the advantage of scale with local entrepreneurship and knowledge of specific businesses or local markets

- How to reduce friction between business owners and quants in order to become more effective and faster

A company's choices will depend on its specific capabilities and its need to boost entrepreneurial activity, reduce friction, and foster cooperative performance.

Companies should embrace agile principles that originated in software development.

A global beverage company wanted to retain local entrepreneurship, its core strength, while leveraging analytics to improve the customer experience and its own go-to-market activities. Local teams, however, lacked data analytics skills and scale. Headquarters could provide the data analytics but was too far removed from regional operations.

Ultimately, the company decided to create a global SWAT team consisting of ambitious, business-savvy executives paired with analytics and IT executives. This team worked with local teams to launch projects for specific use cases in individual markets and was responsible for platform development and knowledge transfer. The approach balanced speed, scale, and cross-regional fertilization with strong local buy-in and skills building.

Companies should improve the cooperation between business owners and quants by embracing agile principles that originated in

software development two decades ago. Agile is becoming the method of choice for organizations aiming to transform areas where time to market is critical.

At a leading retailer, for example, the analytics team developed new applications with business owners by forming small, multidisciplinary project teams. These teams had the authority to act independently. Working in two-week "sprints," they created working versions of an application and then sought direct user feedback that they used to build the next version. This iterative approach drastically improved mutual understanding, shortened development time, and reduced delivery risks.

Skills: Simultaneously Hiring and Transforming. Organizations need to evolve and refresh their skills to address the fast pace and changing requirements of data analytics and other technologies. In doing so, they need to build up their dedicated analytics teams—predominantly by hiring—as well as train their core workforce.

AIG, a leading insurance company, created a "science team," hiring 90% of its 130 members externally. Recognizing the need to blend data analytics into the fabric of the business, the team recruited behavioral economists, psychologists, and change management experts in addition to analytics specialists. This cross-functional team devised not only sophisticated, novel solutions but also creative ways to implement them. Other companies have hired "data driven" officers, ranging from middle managers to senior leaders, as a way to create a new mindset. An executive from a major online retailer put it bluntly: "Experienced external hires for management positions are often not used to drilling down to the raw data. They come from the 'aggregated' world. I rather focus on hiring young and clever people."

In addition to building dedicated units of analytics specialists, leading consulting companies have become models for how to train the broader workforce. For them, the scarce resource is generalist consultants at all levels, who can bridge the gap between data analytics and business opportunities, not data sci-

entists and IT specialists. These companies are making heavy use of modern intuitive analytical and visualization tools and are rapidly expanding and tailoring their development programs so that consultants can conduct rigorous data analysis and tightly frame the tougher challenges for the specialists. When data analytics is widely applied, innovation and entrepreneurship start to flourish.

Systems: Investing in Data and Steering the New Technologies. Historically, discussions about data and IT systems have been tedious and technical, delivery has been slow and expensive, and productivity results have been disappointing. So why bother?

The answer is rather simple. With data analytics developing into a source of competitive advantage, and with speed, ease of use, and machine intelligence changing the role of IT, executives have no choice but to embrace the topic.

Data has become a form of currency that companies use to generate business value.

Data has become a form of currency that companies use to generate business value. P&G, for instance, is constantly investing in new sources of data and improving data quality. Its approach varies by market. In mature markets, P&G receives high-quality data from retailers via data warehouses. In some emerging markets, mom-and-pop shops are still a major distribution channel, and they cannot afford to make large technology investments. So P&G leverages mobile phones to provide support in ordering, store design, and product placement, while concurrently collecting business data.

Building the system infrastructure to support data analytics can be tricky on many fronts. The technology is new and rapidly evolving. And companies must make critical choices about the optimal technology stack and the best vendors. To master these challenges, they must take several critical steps:

- Establish priorities that are based on the value of concrete business use cases and derive their technological requirements over the short to medium term.

- Invest in IT expertise. Hire outside data analytics specialists who align with the changing role of IT departments. These outsiders often provide fresh ideas about better, faster ways to do things.

- Refrain from lengthy and costly cross-integration of legacy systems. Instead, leverage modern technology to extract and clean data and deposit it in a common location—for example, a "data lake"—from which multiple systems can extract it.

The Double Game: Balancing the Short and Long Term

When embarking on transformational programs, companies and executives easily fall into one of two traps. They become either too tactical or too visionary. The unrelenting rush of real-time data can trigger a flood of short-term, detail-oriented discussions and a reflex to make instant decisions, neglecting to define longer-term aspirations. Conversely, a singular focus on the long game misses immediate opportunities. An effective way to balance action and direction is to simultaneously *extrapolate* and *retropolate.*

Extrapolation focuses on creating and following a roadmap of specific and relevant short-term data-driven opportunities. Retropolation starts with long-term (and possibly extreme) scenarios and desired target states and derives requirements to reach them. An overlay of the two perspectives exposes gaps in current initiatives, forcing executives to adjust the speed and direction of their programs.

The most notable gap often involves the use of artificial intelligence and the automation of cognitive processes. The good news is that executives—when they understand the difference between what they are doing now and what the future will bring—often speed up and broaden the use of data analytics.

Finding the right balance between the short and long terms also involves a review of gover-

nance. A leading machinery vendor is playing the double game by establishing a data analytics leadership council. The goal of the cross-functional group, which consists of senior business leaders, data analytics experts, and the CIO, is to explicitly balance the different time horizons, approaches, and investments.

Most important, avoid procrastination. To quote a famous Russian proverb, as adapted during the collapse of the Eastern bloc, "Who comes too late is punished by life."

A Checklist for Leaders

The following questions should help executives create a data-driven organization:

How can we strengthen our analytics-driven mindset?

- How can I upgrade my personal analytics arsenal?

- How can I drive my teams toward more analytics-based decision making?

- Does the organization have the ability to make use of "democratized data"?

How can we improve the organizational context so that individuals can do their best work?

- What would be an optimal structure that balances global scale and local or decentralized entrepreneurship?

- Are we fully leveraging the advantages of interdisciplinary, agile teams?

- What short-term programmatic approach should we be taking to achieve medium-term goals?

How can we transform the organization's skills through training and hiring?

- What parts of our general workforce should we most urgently train in analytics and how?

- Where should we leverage external hiring to strengthen our organization?

Where should we expand investments in data and systems renewal?

- Where should we acquire new data, and where should we improve existing data sets?

- Are our business priorities reflected in our big data technology roadmap?

- Have we invested in the know-how required to make the appropriate technological choices?

How can we further strengthen our double game?

- What is the long-term vision toward which our portfolio of initiatives is building?

- What is our short- to medium-term roadmap?

- Are we exploring artificial intelligence aggressively?

- How can we strengthen our governance to continuously ensure a balance of exploration and exploitation?

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ADVANCED ANALYTICS IS A TRANSFORMATION OPPORTUNITY

Q&A WITH GAURAV NATH

GAURAV NATH, A BCG partner, recently responded to questions about the importance of using big data and analytics because of their potential to transform businesses and to unlock tremendous value.

In your experience working with companies across various industries, how are big data and analytics transforming organizations and value chains?

Big data and analytics will drive the next step change in companies' ability to engage with consumers. Supply chains, for instance, are being transformed in four fundamental ways:

- Value chains are moving from being sequential to being simultaneous. I call it a move from a customer journey to an immersive social network where actions are decentralized.

- Transparency is, inevitably, becoming comprehensive.

- There is a massive improvement in companies' ability to manage complexities and fragmentation.

- And, at the same time, speed to action is increasing dramatically.

What are some of the myths about big data, and how should companies debunk them?

People often think that the benefits of big data can be achieved through the piecemeal application of use cases. That is not true. The power of big data is multiplied exponentially when a comprehensive set of use cases operate together seamlessly, with one integrated view across the supply chain. For instance, you can use big data for advanced demand forecasting, inventory tracking, and so on, but the real value comes from building all of these together. In that way, the impact of decisions across all variables can truly be understood

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In a short span of time, all companies will be knowledge companies.

Also, advanced analytics cannot be a stand-alone division, separate from the functions. It needs to be an integral part of the company at the grassroots level because it is an enabler for the organization to work faster and more efficiently. In a short span of time, all companies will be knowledge companies. Big data will drive that evolution.

The key is to understand that while big data is a powerful lever, it is a means to an end, not an end itself. Many companies ask us what they should do about big data. In re-

sponse, I say that the first crucial step is to prioritize the core business issues for your organization and the industry. One needs to closely examine the challenges and compromises that have become status quo and have forced these issues to surface. Then, ask yourself where improving the flow of knowledge could break these compromises by bringing transparency, managing complexity, and providing a seamless view of the organization. That is where advanced analytics can help.

How do you see winners succeeding with big data? What gives them the edge?

Winners will be those that accomplish the following four things:

- Approach big data from a business perspective.

- Do so in a seamless, decentralized way.

- Operate in a way that is neither sequential nor incremental.

- Treat advanced analytics as a transformation rather than a tool.

Companies that are quick to adopt big data as a part of their culture will naturally succeed and will have an edge. To stretch an old analogy, the true power of advanced analytics is within reach when you aim to understand the impact of a butterfly on a thunderstorm, a thousand miles away. It is not about just the butterfly or the thunderstorm by itself; it's about understanding the relationship between the two and looking at all aspects in entirety. This is, of course, an exaggeration, but it makes the point that companies that can manage to really embed big data and analytics will be winners.

**What is the real-world impact of using advanced analytics in operations?**

We have seen a dramatic impact from adopting a culture of advanced analytics within organizations. The impact can be disruptive and the potential is huge across most business measures, from profitability to revenue and market share.

Could you tell us more about leveraging BCG's Digital Ventures and Gamma businesses in your client cases?

Because of the pace of change, digital inevitably leads to specialization and a best-of-breed approach. Our specialist divisions are intended to help us bring the best capabilities to our clients. BCG Digital Ventures focuses primarily on vertical disruption, and Gamma focuses on analytics. There are multiple ways of working with these teams, quite different from the classical BCG generalist approach.

GAURAV NATH

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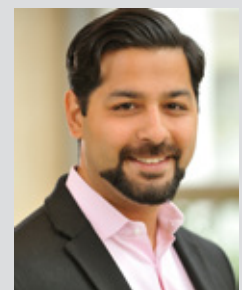
DIGITAL TECHNOLOGIES RAISE THE STAKES IN CUSTOMER SERVICE

I N MANY WAYS, DIGITAL technologies have had polar-opposite impacts for consumers and companies: For consumers, life has been simplified and empowered by devices such as smartphones and innovations such as social media. For companies, business has been made more complex by the need to manage many more channels and points of interaction—in-store, on the phone, online, e-mail, social media, and mobile apps, to name a few. With so many channels, platforms, and devices to get right, companies frequently struggle to craft effective customer pathways and make the most of customer interactions. And they have difficulty defining the right metrics to measure success.

Customers spread the word about their experiences—whether positive or negative—far and wide among friends and family. Social media extends and magnifies the impact of each advocate—and critic. Conversations about the customer experience boost financial performance. BCG research shows that brands with high levels of advocacy significantly outperform those that are heavily criticized. In our sample, the top-line growth of the highest- and lowest-scoring brands differed by 27 percentage points on average.

Getting the service component right is critical. Not only does service have a big impact on loyalty, but service operations are an excellent laboratory for the wider organization.

With digital channels and tools constantly emerging, companies must become (to borrow a term from the world of software development) more *agile,* iterating quickly to adapt to rapidly changing conditions. Companies need to develop both the infrastructure and the in-depth customer understanding to manage this transition.

Social media extends and magnifies the impact of each advocate—and critic.

Getting service right is far easier said than done, and many companies struggle. For example, research done for this report by BCG and NICE Systems—surveying 1,704 consumers, ages 18 through 65, in five markets (Australia, France, the Netherlands, the UK, and the US)—found that overall satisfaction ratings for self-service channels, including the all-important digital channels, declined by ten points, from 65% reporting satisfaction in the previous survey, in 2013, to 55%.

The addition of digital channels to a company's service mix brings new challenges for traditional organizations: each additional channel creates new customer experiences that must be carefully considered and man-

aged. Complexity has become a fact of life and a source of barriers of many kinds. Consumer data is scattered across the different channels and touch points, and it is often difficult for a company to gain a consolidated view of a customer's interactions. Worse still, the data is typically highly disparate and unstructured. All of this makes it hard to turn data into operational actions. And companies have to balance security requirements and regulatory limitations with the speed, simplicity, and reliability that customers expect from a digital experience.

Our research examined the state of customer service in three industries—retail banking, insurance, and telecommunications—and shines a light on the main challenges that companies face in managing customer service pathways in an increasingly omnichannel world.

Service Channels Are in Flux…

Not only is the usage of digital channels rising but the nature of that usage is evolving, making it difficult for companies to know where to place their bets.

Across the three industries we surveyed, large majorities of customers use digital channels. (See Exhibit 1.) In some industries, digital pathways have become more important than voice—presenting companies with an important opportunity given the low cost of managing digital interactions (once they get them right). In retail banking, for example, web-based self-service has surpassed both in-person contact and the call center as the most-used service option. Of the 87% of respondents who use banks' web self-service offerings, 64% use them at least once a week. Customers appreciate the 24-7 availability and easy-to-use interfaces of online self-service.

Despite a lot of hype in their early years, social media and online forums are falling in popularity as service vehicles. After a rapid increase, from 16% in 2011 to 36% in 2013, usage dropped to 29% in the current survey. The decline was consistent across the three industries. It's possible, however, that social usage may pick up again as more companies approach social platforms as true customer service channels and not simply marketing opportunities.

EXHIBIT 1 | Digital Channel Use Is High but Varies by Industry
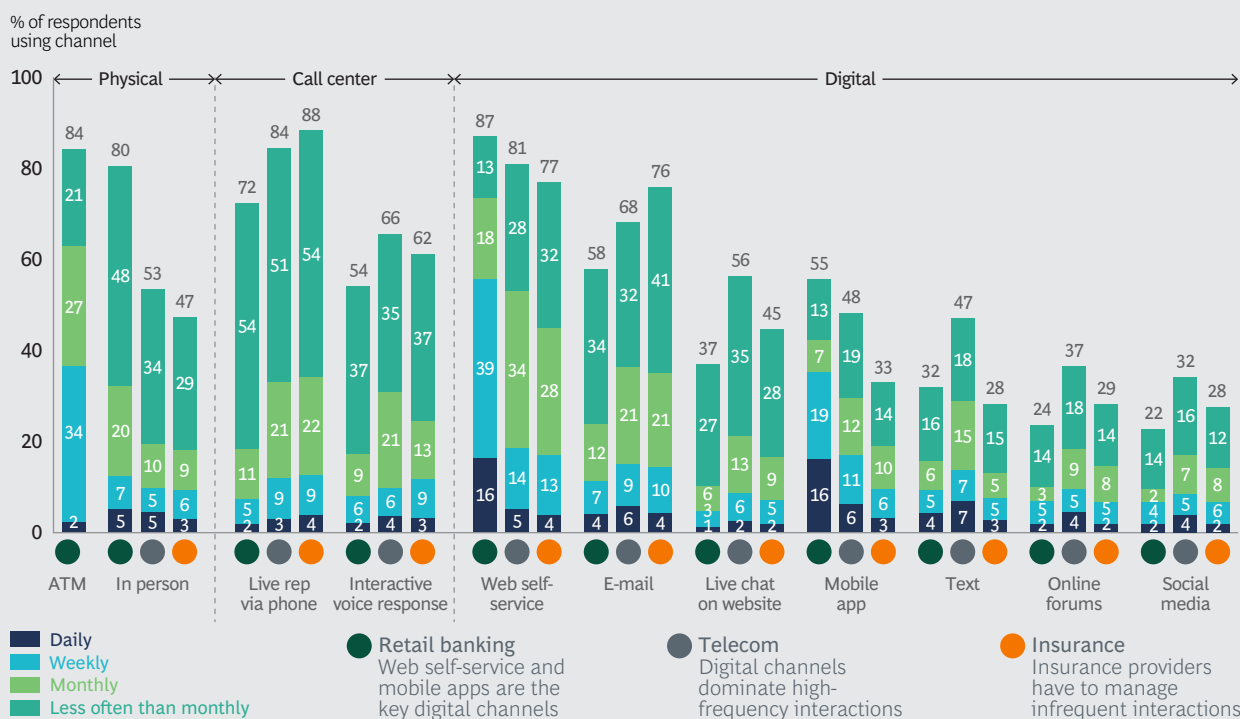
Sources: Survey of 1,704 service users conducted jointly by BCG and NICE Systems; NICE Systems analysis; BCG analysis.

Mobile apps are increasingly popular; 56% of banking customers now use apps, up 6% since 2013. This is a high-frequency channel, accessed daily by 16% of customers and at least weekly by 35%. Mobile apps are also increasingly popular in the telecommunications industry, with 48% of respondents now using apps (up 7% since 2013). In both sectors, it is the "anytime, anywhere" availability of apps that users value the most; 61% of banking users and 54% of telecom customers cite these attributes. And even with increasing mobile popularity, there is still plenty of room for growth.

Even as digital channels grow in popularity, traditional channels are hardly going away: 82% of all respondents start out or end up on the phone, although there is an important distinction to be made here. Customers that start out on the phone do so by preference; they represent an opportunity for the company to show how its service stands out. Those that end up on the phone use voice because other channels have failed, and they are likely already frustrated to some degree. A poor call center experience (which is far from uncommon), especially one that comes after the customer's problem has eluded resolution through other channels, can do real damage. Conversely, the impact of a good experience with a live rep is huge. The second-most-cited source of satisfaction in the current survey, at 49%, was "The rep already knows what I need and provides me with an immediate solution," behind only "My issue is immediately resolved" (51%).

…Fueling Increasing Complexity for Companies

Digital technologies have added at least seven channels to the customer service mix: website self-service, e-mail, website live chat, mobile app, text messaging, online forums, and social media. But the real added complexity comes in the omnichannel interaction that many pathways involve today. To build an overall picture of their service users, companies need to understand why a customer chooses a specific channel in each instance and how his or her journey progresses through channels over time. These factors can vary widely.

In retail banking, for example, almost all customers use a combination of channels to interact with their provider, creating a complex set of experiences. Banking customers use an *average* of 6.1 different channels for their interactions, and almost 20% of customers claim to have used at least 10 channels one or more times.

More than 96% of telecom customers use a combination of channels—the average customer uses 5.7 different channels; 15% say they have used at least 10.

While insurance providers have been less affected by the advent of digital channels, their customers use an average of 5.1 different channels for their interactions, with 15% claiming to have used at least 10.

A poor call center experience (which is far from uncommon) can do real damage.

These complex experiences are now a fact of life for providers, but companies and industries vary widely in their ability to manage them effectively. In retail banking and insurance, respondents who had used a single channel and respondents who had used more than one were equally likely to report a perfect interaction. Among telecom customers, 23% of respondents who used a single channel reported a flawless experience but only 14% of those using multiple channels reported the same.

To deliver a flawless experience, or even an acceptable one, companies need to carefully craft their customer pathways. This involves both the explicit design of the transition between channels, such as online click-to-connect, and the seamless sharing of information collected along the pathway at each stage. Productive use of customer pathway information is vital. Customers mark down the service experience when they encounter no recognition of what they have already done or are forced to repeat the same information multiple times. Anticipating customers' needs and addressing them proactively are other

factors that customers cite as features of a flawless experience.

Perfection is more often the exception than the rule these days. Many channels are managed in isolation: the mobile app has no link to the call center, and the call center is optimized without digital integration in mind. This needs to change, for the benefit of both customers and companies.

Self-service channels—which can identify the customer's immediate need—can play a significant role in improving call center performance. Information from other channels can be used to route calls to the appropriate staff, reduce the number of questions that need to be asked, and prevent the transfer of calls between multiple service reps. A quarter of consumers would be happy to use an interactive voice response (IVR) system—a generally unpopular channel—if they knew that by doing so, they would be routed to a more specialized rep who was aware of their IVR experience. Similarly, service reps trained to assist customers online (and given incentives to do so) can have a dramatic impact on digital adoption.

An omnichannel approach is the key to achieving two important goals: using custom-er service to further overall customer experience excellence, and driving significant savings for organizations as average call volumes and handle times are reduced and resolution at the time of the first call is improved.

Keeping Customers in Digital Channels

Regardless of the channel they start in, customers who don't get a resolution to their problem or the service they need most often seek help from a live rep on the phone or in a branch or store. (See Exhibit 2.) Banking customers are most likely to head to their local branch; insurance and telecom customers hit the phone. Either way, the flexibility of a live interaction is the primary appeal, along with the simple preference for speaking with a real person.

The issue for companies, of course, is that both of these channels carry a significant cost to serve—much higher than that of digital and other self-service interactions. Moreover, every switch to a new channel risks provoking customers' annoyance, especially if they believe their efforts thus far have been for naught or if the information they have provided is not captured at the next stage of the interaction.

EXHIBIT 2 | Most Users Still Go to a Live Rep via Phone If Unsuccessful with Another Channel
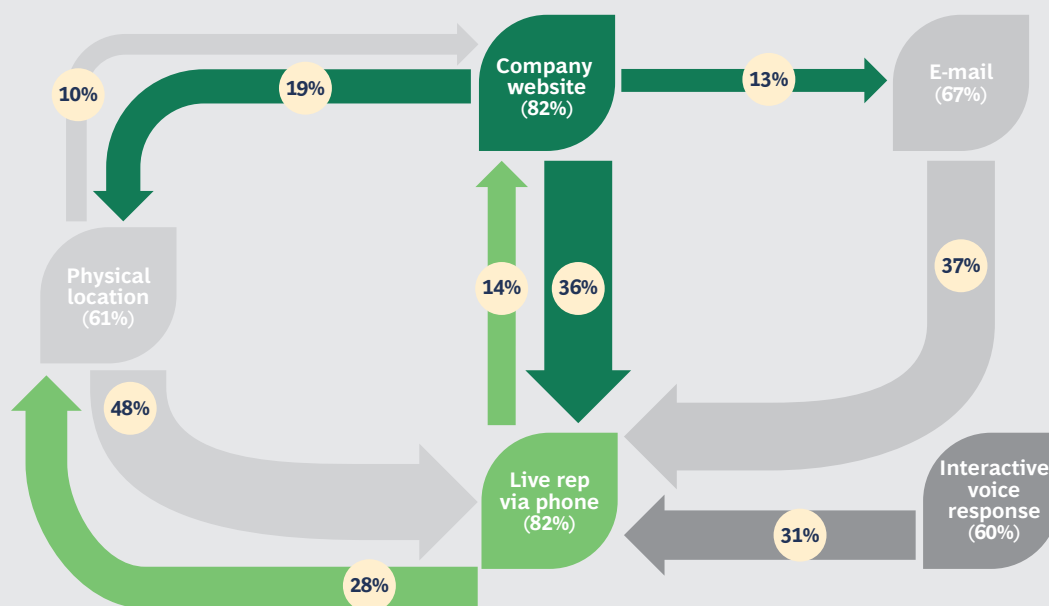
Sources: Survey of 1,704 service users conducted jointly by BCG and NICE Systems; NICE Systems analysis; BCG analysis.

Of the industries we studied, banks have been the most successful at addressing customer issues in self-service digital channels: they successfully resolve 65% and 57% of self-service interactions through their websites and mobile apps, respectively. Telecom and insurance companies' rates of success are much lower, particularly with respect to mobile apps.

Part of the reason for banks' success is the nature of the issues and inquiries they deal with—it's easier to move money between accounts using a smartphone, for example, than to resolve an insurance claim or address a communications service problem. But their success also reflects the investment that many banks have made in their systems and their strong focus on simplification. Banking is an industry that felt the heat of digital disruption early. As a result, most banks have invested significantly in digital capabilities, and many are taking a multiyear journey toward digital transformation.

Getting the Call Center Right

Customers rank the call center experience—both speaking to a live rep and using IVR—as the worst among all channels. This is a big problem for many companies because a large percentage of customers and prospective customers use the phone, either as their first choice or when they strike out on other channels. Technology can help make the call center experience more personal—and successful—by tracking the other channels that customers have used and the information that they have already imparted about their need or problem. This sort of capability is particularly important for personalizing the service experience and for turning around situations in which customers use the phone as a last resort.

Customers report multiple call center pain points. Enduring an excessive wait time is often the most frustrating aspect—and an experience that erases the benefit of a direct, immediate channel. Having to speak with multiple reps and repeat information is another pain point.

To build a good call center experience, companies need to make effective and productive use of information collected along the customer pathway. Call center technology must be able to deal with disparate data from different sources in real time. Customers want their needs anticipated and addressed—quickly and easily, without a lot of effort on their part. When service reps know what actions customers have already taken in a self-service channel and customers are not asked to repeat the same information during multiple steps, customers are much more likely to have a positive view of their experience.

Deep knowledge of customers' pathways can improve service-to-sales interactions.

Using deep knowledge of customers' pathways can also improve service-to-sales interactions, ensuring that each customer gets the best, most relevant offer. A personalized offer can be tailored to fit a customer's broader profile along with the specific pathway he or she has taken to that point. Tailoring such an offer not only increases the likelihood that the customer will accept the offer but can also increase satisfaction and retention. More than 30% of surveyed customers cited an attempt to sell them an irrelevant product as a top reason for leaving a provider.

Three Areas to Address

Customers want obtaining service to be easy, and delivering ease (while solving the problem or fulfilling the need) can have a big impact on satisfaction and loyalty. The vast majority of surveyed customers who had an experience that required very low effort (93%) reported that they were very or extremely satisfied. Almost two-thirds of those reporting extreme satisfaction said that their experience had increased their loyalty to their provider.

Companies can improve customer service by taking concrete steps in three ways:

- **Carefully Designing the Customer Pathway.** Tracking customers as they

engage in multichannel pathways, often to resolve a single issue, can help providers identify and resolve a number of challenges and help guide investment across channels. Companies can take multiple steps. They can map all customer pathways to understand significant patterns in customer behavior, for instance, and identify the root causes of dissatisfaction and churn.

- **Improving Self-Service Channel Containment.** To build a successful—and cost-effective—customer service operation, providers need a solid foundation of quality self-service options that can meet the majority of customer needs and contain customers within those channels, thus preventing the need for customers to attempt resolution by trying other channels. Among the steps that can help are identifying the root cause of each call going into the call center and understanding the flow of calls from digital channels to the call center.

- **Personalizing the Customer Experience.** Technology solutions, especially those employing big data and advanced analytics, can help personalize the service experience for customers. Using the tools available today, companies can personalize service-to-sales interactions in real time, drive both sales and satisfaction by combining "who the customer is" with "what the customer does" to present the best relevant offer, and more.

CUSTOMER service is just one aspect of a customer relationship experience that increasingly involves digital channels. Getting service right is one part of a broader necessity. Companies must find ways to manage all aspects of the increasingly digital customer relationship. Fast movers will find good news on two fronts: they will not only see improved results from better customer service but also build capabilities that can be applied more broadly, to other areas of their business, as the impact of digital technologies continues to grow.

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BRIDGING THE TRUST GAP
WHY COMPANIES ARE POISED TO FAIL WITH BIG DATA

Companies' data stewardship practices and consumers' expectations are fundamentally at odds. Most companies approach privacy and data usage from a narrow legal or regulatory perspective. They ask whether their data collection and management practices are consistent with laws and regulations and meet disclosure requirements. Unfortunately for most companies, consumers take a wider and much less legalistic approach to these issues. They want to be informed about how companies gather and safeguard data about them, and they want to understand the different ways in which companies *use* personal data. Additionally, they want that information delivered in clear language.

The lack of alignment between companies and consumers about data privacy has real consequences. When consumers perceive data misuse—when they are unpleasantly surprised by the collection or new use of personal data—they either reduce their spending drastically or boycott a company's products and services altogether. (See "Bridging the Trust Gap: The Hidden Landmine in Big Data," BCG article, June 2016.)

In this article, we highlight the results of a recent global survey of the data stewardship practices of 140 companies in eight industries. Our survey data suggests that most companies are being *recklessly conservative:* they are failing to pursue new uses of data that consumers are actually open to. When they do pursue a new use, they typically don't feel the need to inform and educate their customers or to ask for permission—something most consumers clearly want. With each mistake, companies are slowly but surely setting themselves up to fail with big data.

The Landscape of Data Stewardship

The requirements of data stewardship can be grouped into four major areas. Good performance in each will prove critical to capturing the value that lies in acceptable new uses of data and to avoiding the real economic harm of data misuse. However, while many companies are executing well in one or two areas, few—if any—are doing so in all of them.

Internal Policies and Procedures. Companies often do a great deal to document how they handle data, through public privacy policies and internal procedures governing data collection, management, and usage. We see a large gap, however, in the involvement of senior executives up front in creating and enforcing data privacy policies and procedures. That's a problem given the major business implications of the adverse reactions that customers might have to these decisions later on.

First, the good news: 76% of the companies we surveyed have privacy policies that explain how they collect, manage, and use consumer data; 54% have a separate and distinct set of internal guiding principles for how to use that data.

Few of the companies that have these policies and principles create or enforce them with C-suite or senior executive involvement, however. They may be adequately managing legal and technical risk, but they are not managing consumer risk—the source of the greatest upside and downside potential.

Of companies with privacy policies, 73% make legal or IT teams responsible, while only 22% give the responsibility to operating or executive teams; of companies with guiding principles, 59% make legal or IT teams responsible and just 34% assign responsibility to operating or executive teams. Industrial goods and insurance companies are the least likely to make operating or executive teams responsible for their guiding principles (22% and 23%, respectively); in the consumer, health care, energy, and technology, media, and telecommunications (TMT) industries, at least 40% of the surveyed companies make
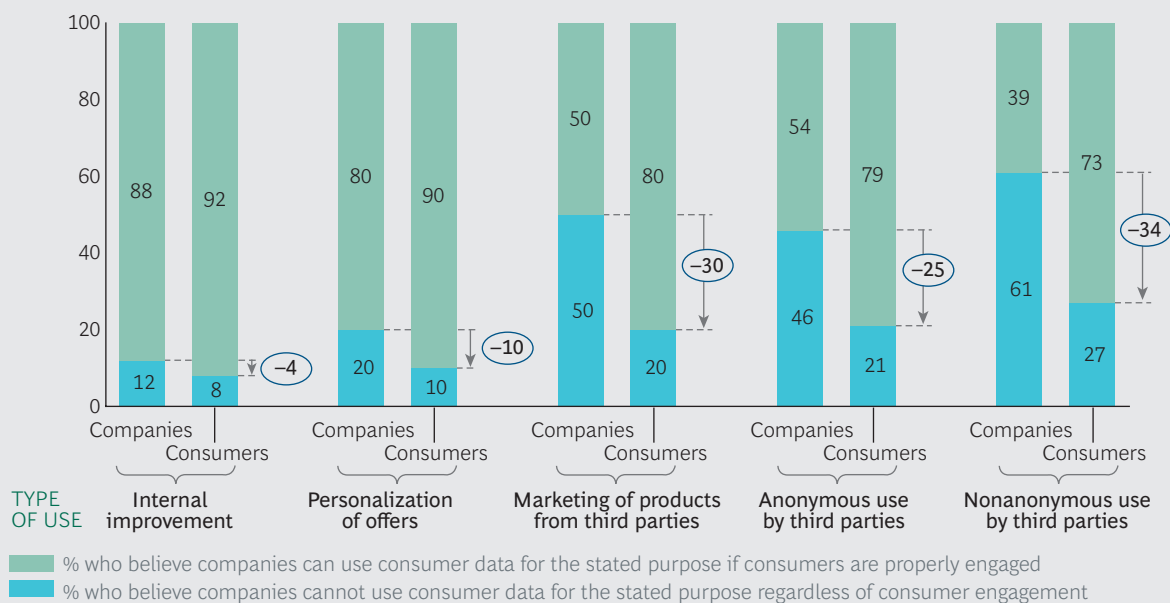
guiding principles the responsibility of operating or executive teams.

Data Use and Collection Practices. One of the most surprising findings of our survey was the degree to which companies pursue fewer uses of data than consumers are comfortable with. (See Exhibit 1.)

We asked consumers whether it was acceptable for companies to tap personal data for five types of use: the internal improvement of products and services, the personalization of offers, the marketing of products from third parties, the anonymous use by third parties (the data is not linked to a consumer's name), and the nonanonymous use by third parties (the data is linked to a consumer's name). The vast majority of consumers felt company use of data was acceptable in all cases, if (and only if) companies effectively informed them (transparency) and offered them some form of control (permissions). The use that drew the most negative response—use of nonanonymous data, or data linked to a consumer's name, by third parties—was nonetheless acceptable to 73% of consumer respondents.

We also gathered company opinions regarding the same types of use. Companies are

EXHIBIT 1 | Companies Are Not Using Data for New Purposes That Are Acceptable to Consumers

% who believe companies can use consumer data for the stated purpose if consumers are properly engaged
% who believe companies cannot use consumer data for the stated purpose regardless of consumer engagement

Sources: BCG Big Data and Trust Consumer Survey 2015 and BCG Big Data and Trust Company Survey 2015.
Note: Survey questions: "For each of these new uses, what do you believe your company must do to gain customer consent to use the data?" and "Which approval should an organization have from you for the following uses?"

generally comfortable using consumer data for internal uses, with 88% thinking that use for internal improvement is acceptable and 80% thinking that use for personalizing offers is acceptable. When it comes to third-party uses, however, companies are extremely—and, we argue, overly—cautious. Companies are 25 to 34 percentage points less likely than consumers to think a third-party use of consumer data is acceptable. For example, 50% of companies think consumer data could be used to market products from third parties, while 80% of consumers find this use acceptable. This caution is echoed across industries. For every industry surveyed, at least 40% of companies indicated that, in general, third-party data uses are unacceptable.

We believe companies are conservative in their pursuit of new data uses.

We believe companies are conservative in their pursuit of new data uses, in the hope that this will insulate them from risk. (The same finding applies to data collection.) But this is a misguided notion in terms of consumer perception.

Transparency About Current Practices.
Companies frequently fail to make sure consumers and prominent stakeholders are aware of and fully understand the data that companies hold and the ways they use it. Companies often do make important information about their data practices available, but they usually do so in a way that is ineffective. In general, they require consumers to take the initiative. Even when consumers do go looking for this information, they do not absorb nearly as much of the details as companies think, or hope, they do.

Most companies overwhelmingly rely on "pull" methods of notifying and engaging their customers, forcing customers to find or request important information about data privacy. Forty-one percent of companies make their privacy policy available to customers who request it, and 62% of companies post

the policy on their website. These figures are 44% and 20%, respectively, for information about the personal data a company holds and 49% and 24% for information about how companies use such data.
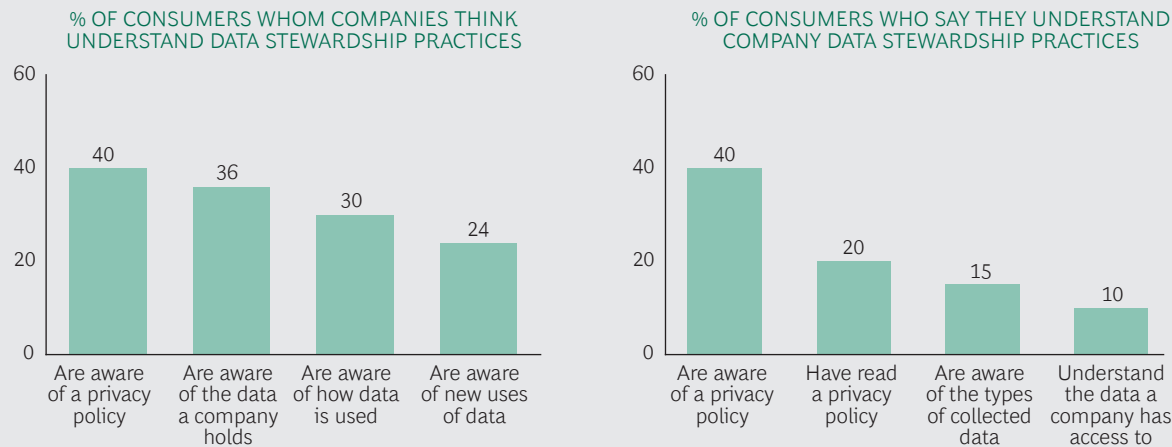
Far fewer companies engage their customers via "push" methods to actively send out important information:

- No companies in our survey send regular updates via e-mail or letter regarding their privacy policies or the data they hold about their customers.

- Only 8% of companies regularly send letters and only 4% regularly send e-mails about how they use consumer data.

- Only 16% send an update letter and 15% send an update e-mail when there is a change to their privacy policy, and those figures drop to 6% and 8%, respectively, for data held about consumers and 5% and 6% for how that data is used.

- Fourteen percent of companies said they had no way for their customers to view their privacy policies; this number grew to 38% and 33%, respectively, for the data that companies hold about consumers and how they use that data.

As a consequence, companies think that twice as many consumers, on average, understand their data stewardship practices at a detailed level as actually do. (See Exhibit 2.) Company and consumer estimates are in alignment when it comes to the percentage of consumers who are simply aware of privacy policies, but the fact that the figure is below 50% shows how ineffective companies are at getting this information out to their customers. Even less promising is the fact that only 10% of consumers said they believe they know what data a company holds about them, even though companies estimated that 36% of consumers have this knowledge.

This lack of knowledge represents a significant issue for companies. Given that the main cause of perceived data misuse is unpleasantly surprised consumers, the current lack of consumer understanding represents a signifi-

EXHIBIT 2 | A Knowledge Gap Exists Between Companies and Consumers

% OF CONSUMERS WHOM COMPANIES THINK UNDERSTAND DATA STEWARDSHIP PRACTICES

```
60

40          40
            36
                      30
20                             24



0
      Are aware   Are aware   Are aware   Are aware
      of a privacy of the data of how data of new uses
      policy      a company   is used     of data
                  holds
```

% OF CONSUMERS WHO SAY THEY UNDERSTAND COMPANY DATA STEWARDSHIP PRACTICES

```
60

40          40


20                   20
                               15
                                         10

0
      Are aware   Have read   Are aware   Understand
      of a privacy a privacy  of the types the data a
      policy      policy      of collected company has
                              data        access to
```

Sources: BCG Big Data and Trust Consumer Survey 2015 and BCG Big Data and Trust Company Survey 2015.
Note: Survey questions: "Are you aware of the privacy policies that describe how the companies you deal with treat your consumer data?"; "Have you read the privacy policies of the companies you deal with?"; "Do the companies you deal with list (online or in paper form) the data they collect about you?"; "Do you know which private data the companies you deal with have access to?"; and "To the best of your knowledge, what percentage of your customers are aware of your privacy policy, the data your company holds about them, how your company uses the data you hold, and new uses of data?"

cant risk. In fact, the absence of a committed effort to create transparency is reckless.

At present, organizations are not even getting recognition or credit for their conservative data usage. While only 11% of companies reported allowing third parties to use data on an anonymous basis and 4% reported allowing third parties to use data on a nonanonymous basis, consumers thought that 21% and 19% of companies, respectively, allow such uses. If companies cannot successfully educate consumers about how they use data about them, they are doomed to inhabit a world in which consumers presume that every new use they find out about is a misuse.

The absence of a committed effort to create transparency is reckless.

Notifications and Permissions for New Data Uses. Finally, few companies actively engage with customers about new uses of personal data or allow them to influence how companies use it. To assess company performance in this area, we asked companies about the same five types of use: the internal improvement of products and services, the personalization of offers, the marketing of products from third parties, the anonymous use by third parties, and the nonanonymous use by third parties. We offered a choice between five permission or notification methods: opt-in permission, opt-out permission, notification, payment for access to data, or no notification or permission required.

Of the companies in our survey, 26% to 56% thought that they did not need to take any action before using data for each of the five types of use. This compares with only 6% to 15% of consumers. Indeed, the vast majority of consumers want companies to take active steps to secure notification or permission.

More than 60% of consumers believed that opt-in or opt-out permissions should be required for all five types of use. Only two uses of data were acceptable to more than 10% of consumers without being preceded by action on the company's part: internal improvement and personalization of offers. Opt-in permission was the top choice among companies for marketing third-party products and allowing third parties to use consumer data on a nonanonymous basis. Paying consumers for access to data was by far the least popular option, with no more than 3% of companies thinking it was necessary.

To study how companies engage with customers about new uses of data, we also investigated whether companies offer customers ways to change or control the data that's collected about them or how it's used. Only 4% of companies offer their customers control over what data they collect and manage, and 4% offer control over how they use personal data.

There is no easier way for a company to be perceived as misusing data—and therefore to lose significant business—than by failing to engage with consumers about data use in the way that they expect. Actively engaging consumers through opt-in or opt-out permissions gives them the chance to say no, of course. But our research clearly shows that most consumers will allow most uses of data about them, particularly if things are explained in plain language rather than tech-speak or legalese.

The Consequences of Poor Data Stewardship

Companies are standing on the edge of a precipice. They are not showing consumers how seriously they take the issues of trust and privacy. They are failing to pursue profitable uses of data that consumers would find acceptable, and they are neglecting to actively and transparently educate consumers about how they use data. Finally, they are not engaging with consumers about new data uses in the ways consumers expect.

The wonder, then, is not that 20% of consumers today have perceived some sort of data misuse, but that the figure is not significantly higher. Data misuse is subjective, which means companies must not only perform much better at data privacy than their competitors but also be seen to take actions that reflect consumer expectations.

For more information, see the related slideshow, "Bridging the Trust Gap: Data Misuse and Stewardship by the Numbers."

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FOR FURTHER READING

The Boston Consulting Group publishes many reports and articles that may be of interest to operations executives. The following are some recent publications.

The Factory of the Future
A Focus by The Boston Consulting Group, December 2016

Sprinting to Value in Industry 4.0
A Focus by The Boston Consulting Group, December 2016

Tapping into the Transformative Power of Service 4.0
A Focus by The Boston Consulting Group, September 2016

Three Paths to Advantage with Digital Supply Chains
An article by The Boston Consulting Group, February 2016

The Most Innovative Companies
A report by The Boston Consulting Group, November 2015

The Robotics Revolution: The Next Great Leap in Manufacturing
A report by The Boston Consulting Group, September 2015

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Barcelona	Dubai	Los Angeles	Paris	Tel Aviv
Beijing	Düsseldorf	Luanda	Perth	Tokyo
Berlin	Frankfurt	Madrid	Philadelphia	Toronto
Bogotá	Geneva	Melbourne	Prague	Vienna
Boston	Hamburg	Mexico City	Rio de Janeiro	Warsaw
Brussels	Helsinki	Miami	Riyadh	Washington
Budapest	Ho Chi Minh City	Milan	Rome	Zurich
Buenos Aires	Hong Kong	Minneapolis	San Francisco	
Calgary	Houston	Monterrey	Santiago	
Canberra	Istanbul	Montréal	São Paulo	
Casablanca	Jakarta	Moscow	Seattle	
Chennai	Johannesburg	Mumbai	Seoul	