Analytics: Dawn of the cognitive era

How early adopters have raised the bar for data-driven insights

IBM Cognitive and Analytics

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Evolving analytics to the next level

The rise of cognitive systems marks the birth of a new era. Cognitive capabilities take analytics to the next level, fundamentally changing how systems are built and interact with humans. Although still in its infancy, cognitive computing is already being operationalized by a small group of visionaries around the globe. Our seventh annual analytics study indicates close to three-fourths of organizations are ready – at least from a data and analytics standpoint – to follow these leaders. However, joining the cognitive era also requires the right data mindset, a robust data ecosystem, and new and enhanced skills.

Executive summary

Welcome to the dawn of the cognitive era.

Almost three-quarters of more than 6,000 organizations have the data and analytics capabilities needed to start their cognitive journey, according to our 2016 Cognitive and Analytics Survey.

In the cognitive era, which is profoundly different than those before it, data comes alive. Today's programmatic codes give way to systems that redefine how data is used, adding fundamentally new capabilities to create systems that interact with humans naturally to interpret data, learn from virtually every interaction, and propose new possibilities through probabilistic reasoning.

Data in the cognitive era engages with humans on a sensory level. People speak; systems listen and respond. Data *sees* the world around us, *feels* the wind and the rain, *hears* the rhythms of music, *smells* the comforts of home, and *tastes* with a global palate.[1] In the cognitive era, data shifts from calculations in spreadsheets to shaping the decisions of everyday life.

It's almost mind-boggling how quickly things have changed. When the IBM Institute for Business Value (IBV) analytics team began this research series in 2010, the focus was on educating executives about how analytics could create value; most still relied on gut instincts and limited descriptive data.[2] By 2012, a majority of organizations had matured to the use of diagnostic and predictive analytics.[3]

That same year, we started surveying organizations on the use of cognitive computing, only to quickly realize most who responded were confusing it with prescriptive analytic techniques, such as text analytics and machine learning.[4] Prescriptive analytics are coded algorithms that trigger predefined actions if certain thresholds are met within a specific set of data. These type of analytics solutions provide the platform on which cognitive systems are constructed.

Almost 3/4 of organizations surveyed have the data and analytics capabilities needed to implement cognitive systems.

However, only 4% of organizations have at least one cognitive system in operation.
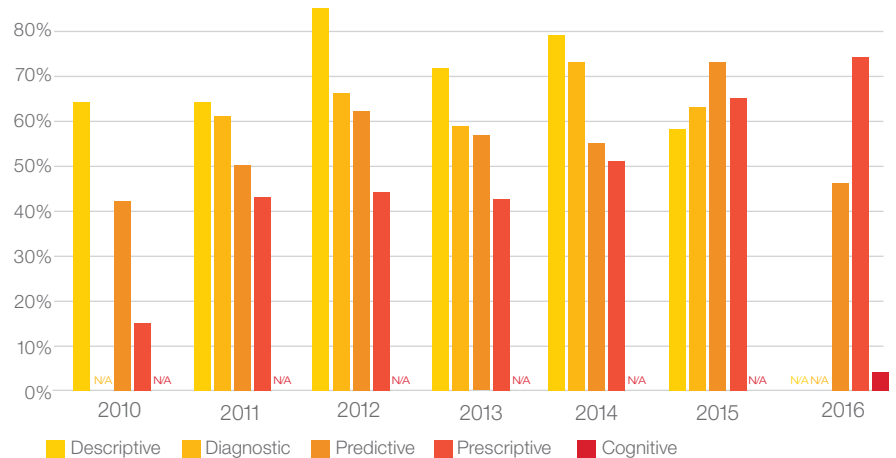
89% of the cognitive early adopters are more profitable and more innovative than their industry peers.

In this, our seventh annual analytics research study, we find 74 percent of organizations are pervasively using at least one type of prescriptive analysis. And once a majority of organizations achieve widespread use of an analytic level, the competitive advantage evolves to the next level of analytic maturity. Competitive differentiation is now greater for those using the fifth level: cognitive (see Figure 1).

Figure 1

Once a majority of organizations achieve pervasive use of an analytic level, the competitive advantage evolves to the next level

Adoption by analytic level

Sources: IBM Institute for Business Value Analytics surveys 2010-2016.
Note: Majority of organizations achieved pervasive use of the techniques in the year noted, based on annual analysis of the global marketplace by the IBM Institute for Business Value. Due to changes in questions and survey designs, analytics level data is not available for some years, which are marked N/A. For more information, see the "Study approach and methodology" section.

Cognitive advances data analysis to the level of cognition, which is "the mental act or process by which knowledge is acquired."[5] Cognitive systems ingest data from interactions, transactions and observations, then interpret, analyze and act upon it while simultaneously retaining the knowledge learned through the process. A cognitive business leverages a range of analytics capabilities (including descriptive, predictive, prescriptive and cognitive systems) using a well-governed data ecosystem that can manage both high volumes and multiple sources of structured and unstructured data, integrated with security, mobility and cloud components.

Currently, operational use of cognitive systems is nascent, with only a set of intrepid organizations – representing 4 percent of the global marketplace – blazing a trail on their cognitive journey. These cognitive early adopters, already market leaders, are now exploring the new frontiers of competitive differentiation that cognitive systems reveal; hence, we call them Cognitive Explorers. These pioneering organizations have at least one cognitive system already in operation.

Cognitive Explorers are using targeted implementations to understand how the next generation of analytics works and to learn – alongside the systems – how to create new kinds of value. They are found in each of the 19 industry groups we surveyed across all geographic regions. And according to respondents, these organizations are all-around outperformers: 84 percent report they outperform competitors in revenue creation; 91 percent report they are more effective at what they do than competitors; 89 percent report they are more profitable than similar organizations; and 89 percent report they are more innovative than most in their industry.

Definition of cognitive used in the survey:

Cognitive computing refers to next-generation information systems that understand, reason, learn and interact. These systems do this by continually building knowledge and learning, understanding natural language, and reasoning and interacting more naturally with human beings than traditional programmable systems.

For a closer look at what cognitive early adopters are doing, please read: *The cognitive advantage: Insights from early adopters on driving business value.* **ibm.com**/cognitive/advantage-reports/

We foresee rapid adoption of initial cognitive systems among other organizations. The most likely candidates have moved beyond descriptive and diagnostic, predictive and routine industry-specific capabilities. Representing 70 percent of our survey, these organizations, which we refer to as Cognitive Capable, are using advanced programmatic analytics in three or more departments.

We predict this shift to cognitive will occur within the next 12 to 14 months for many organizations. In fact, 28 percent of Cognitive Capable organizations in our survey already have pilots or implementations underway – this is in addition to the Cognitive Explorers that have already operationalized a cognitive system.

In addition to our survey research, we also analyzed more than 100 real-world cognitive systems among IBM clients. We discovered that most early adopters are targeting business development activities such as knowledge distribution, research and product development; external constituent and customer management; and sales and service activities including advisory services and other customer service interactions. Although present across industry groupings, most of the organizations analyzed were within financial services and public sector organizations (including healthcare). The majority of these organizations start with a specific use case, first taking a "toe in the water" approach before expanding their cognitive capabilities.

There is more to the transition from prescriptive analytics to cognitive systems than new software or hardware. Entry into the cognitive era requires a solid data and analytics ecosystem. This environment requires a corporate culture and mindset ready to engage with the science of data and strong governance to create agility and speed. It requires data, as much as possible, in all its various forms. A cognitive environment is an analytic evolution, building on the analytics of today to create the marketplace of tomorrow.

In a modern data ecosystem, requisite for cognitive systems, many of the components may or may not reside within the "four walls" of an organization. We see every flavor of "as a service" in the marketplace, with vendors and consultants offering to outsource, manage or maintain a portion of the data and analytics lifecycle. The advent of cloud computing technologies has expanded an organization's data ecosystem exponentially.

Cognitive Explorers are exploiting the opportunities of this modern architecture. In the following sections, we highlight the data and analytics ecosystem components that differentiate organizations that have successfully moved beyond prescriptive analytics into cognitive systems. Examining the governance, data and analysis traits that constitute the data ecosystem of these Cognitive Explorers offers a look at what it takes to succeed in the cognitive era.

Figure 2

Cognitive organizations embrace the science of data

Almost 6 out of 10

Cognitive Explorers strongly agree their organization is ready to adopt cognitive computing

Only 3 out of 10

Cognitive Capables strongly agree their organization is ready to adopt cognitive computing

Establishing an organizational cornerstone for cognitive

There is no reason to expect that the organizational fundamentals of data and analytics success – culture, leadership and governance – will change in the cognitive era. Looking at the traits of Cognitive Explorers, we find organizations continue on the path set by prescriptive analytics but with increased vigor. In cognitive organizations, the data strategy evolves, leadership is raised to the C-suite, and the need for business direction in the governance is amplified.

Though some elements of the modern data system might exist outside the organization, the one component that firmly resides within the "four walls" is the mindset and structures embedded within the organization that govern the use of data and analytics. A cognitive mindset is an evolution from the data-driven culture many are still striving to achieve.

Cognitive organizations embrace the science of data and foster a culture where insight is infused into every action, interaction and decision. We know from past research that the strength of the culture and strategic support given to data and analytics are directly correlated to the success of those programs within an organization.[6] We predict the same is true in the cognitive era.

Cognitive Explorers are confident their organization is ready to embrace a cognitive future. Almost six out of ten of these trailblazers strongly agree their organization is ready to adopt cognitive computing, compared to three out of ten Cognitive Capable respondents (see Figure 2).

One early adopter with a clear cognitive mindset is Mueller, Inc., a privately held company that employs a workforce of 700 across four manufacturing and distribution centers in the South Central United States.

"At Mueller, we're committed to technology; it's a foundational pillar of our company. And technology is helping us gain efficiencies and differentiate ourselves from others in the marketplace," explains Mark Lack, director of cognitive analytics at Mueller, Inc. "This has allowed us to explore correlations in data that we never would have thought to look for."

To date, Mueller has implemented cognitive systems to assist with revenue forecasting, supply chain management, marketing, employee health and safety, and talent management. Within the first 12 months after implementation, one solution realized a tangible ROI of 113 percent, creating a net annual benefit of more than USD 780,000, and reducing scrap metal waste by 20 to 30 percent. Another solution reduced the time spent creating reports by more than 90 percent, while a third solution resulted in a 90 percent improvement in the time-to-value in data processing.

Along with confidence and the right mindset, a strong strategy is required to step into the cognitive era. While a majority of all organizations now have a data and analytics strategy, only a quarter have evolved that strategy to include cognitive capabilities. Slightly more than half of Cognitive Explorers (56 percent) have developed a cognitive computing strategy, compared to 30 percent of Cognitive Capables.

"Having these cognitive analysis capabilities at our fingertips gives us unlimited insight into how we can improve our business."

Mark Lack, Director of Cognitive Analytics, Mueller, Inc.

"CDOs are responsible for creating an enterprise-wide data strategy. They provide leadership to enable cognitive, data-driven systems and business processes that lead to enterprise transformation."

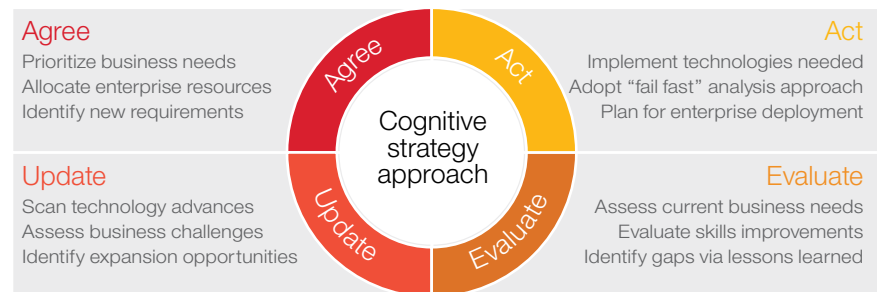**Inderpal Bhandari,** IBM Global Chief Data Officer

A strategy should guide an organization from one milestone to the next and chart the course for Cognitive Explorers and Cognitive Capables alike. We recommend an iterative, ongoing approach to developing and maintaining a data strategy, regardless of maturity, based on our qualitative experience with thousands of organizations around the globe (see Figure 3).

We also discovered that almost two-thirds of Cognitive Explorers and more than half of Cognitive Capable organizations currently manage data at the enterprise level. These findings are consistent with the growing rise of Chief Data Officers: Fifty-six percent of Cognitive Explorers have appointed a CDO, while 44 percent of all respondents employ a CDO (up from 31 percent in 2015).[7] Enterprise management simplifies and streamlines data by establishing metadata and master data management, as well as transparent lines of data ownership, lineage and usage.

A majority of Cognitive Explorers have implemented a business-driven governance system, and almost two-thirds have enterprise-level data management and infrastructure governance. Nearly half of all organizations now have common data management standards.

Figure 3
We recommend an iterative approach to data and cognitive strategy at every level

Agree
Prioritize business needs
Allocate enterprise resources
Identify new requirements

Act
Implement technologies needed
Adopt "fail fast" analysis approach
Plan for enterprise deployment

Update
Scan technology advances
Assess business challenges
Identify expansion opportunities

Evaluate
Assess current business needs
Evaluate skills improvements
Identify gaps via lessons learned

Cognitive strategy approach

Course of action:

Create a cognitive mindset through strategy and structure

Adopting a mindset that embraces the science of data is a big step in the cognitive journey. It includes a willingness to infuse insight into every action, interaction and decision. Similar to the organizational change required to become a data-driven organization, the need for a cognitively minded culture will be equally as important – and equally challenging – in the era ahead.

Just as an enterprise data strategy was an important driver for earlier levels of analytics maturity, an enterprise-level strategy puts the cognitive mindset into action, providing the vision and practical steps to transform an organization into a cognitive business. We also cannot overstress the need for strong change management practices and communication.
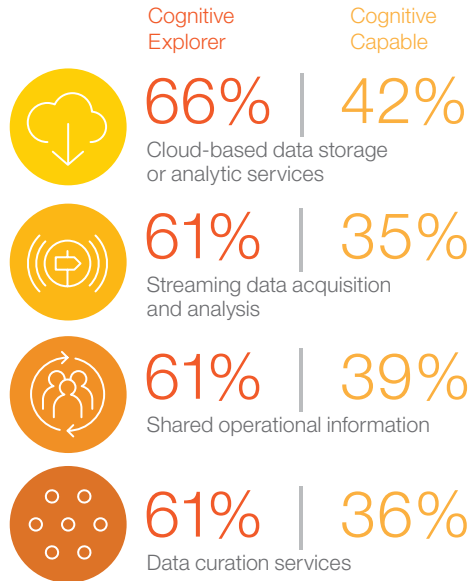
Executives can accelerate their move toward cognitive by prioritizing strong data governance – master data and metadata management, common data definitions, data lineage and transparency.

The consistency and standardization created through governed data curation services and common data standards support the growing use of self-service analytics within organizations. Self-service analytics solutions enable business users – even those with no background in statistics or computer science – to access data and graphics-driven tools to spot business opportunities. This kind of environment is an ideal training ground for cognitive.

Building a solid cognitive data foundation

Figure 4

Cognitive Explorers far outpace others in their adoption of the components needed for a modern data ecosystem

Percentage of organizations that have made extensive infrastructure investments

Cognitive Explorer | Cognitive Capable

66% | **42%**
Cloud-based data storage or analytic services

61% | **35%**
Streaming data acquisition and analysis

61% | **39%**
Shared operational information

61% | **36%**
Data curation services

The data ecosystem is already undergoing a fundamental shift: the combination of open source and cloud-based technologies is transforming the environment from an in-house collection of discrete (and often disparate) products to systems of unified, cloud-based microservices components. A modern data architecture requires the ability to ingest and digest the 4Vs of data (volume, variety, velocity and veracity) from both internal and external sources, and then integrate that data into enterprise processes.[8] The need for these capabilities is amplified in the cognitive era.

Cognitive Explorers far outpace others in their adoption of the components needed for a modern data ecosystem. Two-thirds of Cognitive Explorers have made extensive investments in cloud-based data storage or analytics services compared to less than half of Cognitive Capables. Cognitive Explorers are at least 150 percent more likely than Cognitive Capables to have made significant investments in a number of areas: Technologies to support ingesting and analyzing streaming data; data curation services to keep data lakes from becoming data swamps; and solutions to establish shared operational information enabling lightning fast responses to customer and operational transactions (see Figure 4).

Having that ability to rapidly ingest new data, curate integrated information and analyze that data to gain insights and deploy new capabilities at a reduced cost can redefine an organization's operating model: just look at The Weather Company. In 2012, the company began to transform its technology foundation and culture for a move to cloud, which would enable the company to scale up data-driven weather prediction and API-based delivery of content around the globe. Written primarily in Java and Scala and leveraging many of today's leading open source technologies, the platform now ingests and analyzes billions of events and dozens of terabytes every day (see sidebar: *It's raining data at The Weather Company*).

It's raining data at The Weather Company

A lot happens in the 62 miles between earth and space. The Weather Company (TWC) continuously maps the atmosphere to deliver forecasts covering over 2.4 billion locations, and it all starts with data. This data is collected from a variety of sources, including satellites, more than 200,000 personal weather stations, millions of mobile phone users, radar systems and greater than 50,000 airline flights every day.

In many ways, weather is the original big data problem. In 2013, TWC launched its newly modernized platform to run natively on the cloud. Built on a microservices architecture, the platform is designed for the operational efficiency required to process 15 billion events a day, scaling up to 26 billion events during a weather event without sacrificing performance. The weather API is one of the most-used public APIs. The platform is robust enough to handle between 15 and 26 billion transactions each day, coming at 100,000 to 150,000 per second, depending on the weather.

The highly efficient platform helps TWC turn big data into better decision making. It has enabled the company to offer products and services that help other businesses use weather data and forecasting to help grow retail, save energy, reduce turbulence and turn insurance into prevention.

Figure 5

Cognitive systems require the ability to ingest and provision a wide variety of both internal and external data sources

Percentage of organizations leveraging data from various sources

	Cognitive Explorer	Cognitive Capable
Social media	69%	52%
Customer-generated text	65%	57%
Real-time events and data	60%	52%
Market data	65%	52%
Weather data	35%	18%

Even more than today's prescriptive analytic applications, cognitive systems require the ability to ingest and provision a wide variety of data sources both internal and external to the organization, while decreasing the latency of delivering that data to systems, applications and users across the ecosystem. Both Cognitive Explorers and Cognitive Capables are focused on ingesting social media data, customer-generated text and real-time events, again with about two-thirds of the cognitive early adopters collecting and analyzing the data compared to about half of those using only prescriptive analytics (see Figure 5).

Cognitive Explorers also outpace other organizations in collecting and analyzing data from customer activities (55 percent versus 49 percent of Cognitive Capables), mobile applications (56 percent versus 44 percent), and Internet of Things (IoT) sensors and actuators (54 percent versus 38 percent). Forward-thinking organizations are using this data to perform "analytics at the edge," analyzing data as close to the source application as possible, by leveraging the consistency and speed created through a microservices-based data architecture (see sidebar: *Data fabric weaves together new type of architecture*).

Executives know the significance of a well-managed data ecosystem. When asked how the organization could improve its use of analytics, both Cognitive Explorers and Cognitive Capables cited key components of the data ecosystem: improved data management (47 percent and 42 percent, respectively), augmenting internal data with external sources (33 percent and 31 percent), integration of organizational data (31 percent and 30 percent), and consistent data across systems (31 percent and 29 percent). Internal analytics skills and better tools rounded out the top choices.

Data fabric weaves together new type of architecture

Data fuels the world of business. The value of products and services, business models and innovations comes down to understanding the data that is embedded in or underpinning their creation.

Among leading organizations, we see a new type of data architecture emerging: a fabric-based architecture constructed from microservices that pinpoint data movements and calculations to create lightning fast and accurate actions. This new architecture transforms its layers from the rigid, cost-laden landscape of today into a flexible, loosely woven tapestry of purpose-driven threads that connect and deliver data and analytics with the simplicity and speed needed in the digital age.

Utilizing microservices, the architecture's various components can weave together a myriad of ways to answer the needs of diverse business problems. It must be designed to offer rich support for hybrid cloud/on-premise environments, as well as support for today's diverse data types.

It's the pinpoint precision created by these threads of microservices that is the defining capability of a fabric. By providing common provisioning points for data, analytics and closed-loop engagement activities via microservices, the transactional processing time is lightning fast; the infrastructure components are nimble, creating agility capable of managing dynamic ecosystem requirements; and the real-time actively engaged digital ecosystem of dreams becomes reality. We foresee more organizations reshaping the rigid data landscapes of today into the fluid data fabrics of tomorrow.

Look for an IBM Institute for Business Value expert perspective on this new enterprise reference architecture in 2017.

Course of action:

Construct a data ecosystem that adds context and depth

Few Cognitive Capables have the data ecosystem needed to support cognitive systems, despite the current infrastructure's ability to support pervasive prescriptive analytics. Most organizations have the conceptual piece parts – some still under construction – but few have formed an ecosystem that allows them to leverage the technology in ways that create a meaningful impact throughout the business.

Cognitive systems create opportunities to expand the use of the structured data known and accessible today. Yet, they thrive when augmented with new sources of data, whether it is unstructured data lying "dark" within the organization or information from external sources that adds context and depth to understanding business challenges.

Traditional systems were built to be programmed, so they lack the ability to glean insight from the variety and volume of today's data. Cognitive systems necessitate the ability to support ingesting and analyzing streaming data; well-governed data curation services create the ability to analyze signals from the data lake and determine which signals matter most to the business.
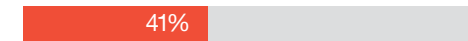
Focusing on the skills of the future

The pervasive use of prescriptive analytics provides an ideal platform for advancement into the cognitive era. These advanced types of programmatic computations are the platform on which cognitive systems are constructed. Organizations can build on the same skills they sharpened to perform prescriptive analytics to transition to cognitive. That being said, we find many organizations will need to acquire or hire the specialized skills and talent necessary to move forward.

Forty-one percent of Cognitive Explorers use between five and nine different types of prescriptive analytics within their organization, more than double the 19 percent of Cognitive Capable orga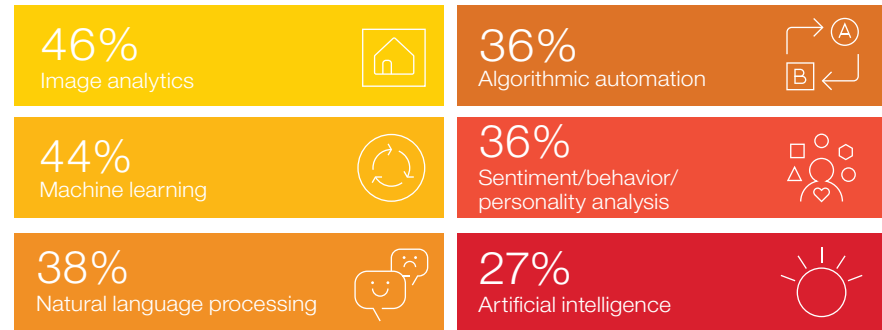nizations that do. Cognitive explorers are 40 percent more likely than Cognitive Capables to have shared analytics expertise within their organization (58 percent versus 42 percent); this strategy allows them to optimize valuable resources while diversifying the available skillset overall.

While they lag in use of prescriptive analytics and shared analytics expertise, many Cognitive Capable organizations are on the threshold of advancing. The average Cognitive Capable organization uses three to four different analytics techniques pervasively – across three or more departments and functions within their organization. Among Cognitive Capables, almost half use image analytics and machine learning; more than one-third use natural language processing, algorithmic automation and people analysis; and more than a quarter use artificial intelligence. Use of any one of these capabilities can serve as an entry point for the cognitive journey, and use of a combination often amplifies the results (see Figure 6).

Forty-one percent of Cognitive Explorers use between five and nine different types of prescriptive analytics within their organization, more than double the 19 percent of Cognitive Capable organizations that do.

Cognitive Explorers

41%

19%

Cognitive Capables

Figure 6

Cognitive Capable organizations use at least one prescriptive analytic technique that could be enhanced by a cognitive solution

Adoption of prescriptive analysis by Cognitive Capable organizations

46% Image analytics	36% Algorithmic automation
44% Machine learning	36% Sentiment/behavior/ personality analysis
38% Natural language processing	27% Artificial intelligence

Cognitive Explorers identified their greatest need to improve the data ecosystem was better analytics skills, while Cognitive Capables identified their greatest need as being data management skills. Cognitive Explorers are targeting advanced mathematical modelers (57 percent compared to 34 percent of Cognitive Capables), data architects (57 percent compared to 41 percent) and data visualization specialists (50 percent compared to 43 percent).

Course of action:

Amplify analytic capabilities with cognitive systems

Cognitive systems elevate and amplify the business processes currently targeted by most organizations using prescriptive analytics. These analytics are the platform on which cognitive systems are constructed.

Organizations that have not yet advanced into prescriptive analytics, and therefore lack some of the components critical to a cognitive system, can leapfrog competitors by using application program interfaces (APIs) to expand the ecosystem and acquire key capabilities. These interfaces can provide standardized, easy-to-use access to key capabilities that would be difficult, if not impossible, to recreate internally.

Both Cognitive Explorers and Cognitive Capables should diversify their data sciences teams. Organizations need to think strategically and seek candidates – whether to acquire or hire – whose skills vary from those within their team. Consider the trade-offs: Are they adding analytic breadth or depth to the team, and which is more important? Do analysts need data with context – and a data acquisition specialist – or better curation capabilities to make data more accessible and consistent?

For more information

To learn more about this IBM Institute for Business Value study, please contact us at iibv@us.ibm.com. Follow @IBMIBV on Twitter, and for a full catalog of our research or to subscribe to our monthly newsletter, visit: **ibm.com**/iibv.

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IBM Institute for Business Value

The IBM Institute for Business Value, part of IBM Global Business Services, develops fact-based strategic insights for senior business executives around critical public and private sector issues.

Welcome to the dawn of the cognitive era

The cognitive era ushers in a new kind of analytics, integrating data-driven insights into interactions, transactions and decisions throughout an organization's ecosystem. Cognitive analytics have the potential to reshape the landscape of modern businesses. The competitive advantage from data insight has now shifted to those organizations that are seizing the opportunity to leverage cognitive capabilities to transform business processes, impact business outcomes, and engage customers in the new era ahead.

Are you ready?

As you prepare to join the cognitive era, we offer five key questions to ask yourself as you get started:

- Am I ready for the cognitive journey?
- How can I expand the use of my current prescriptive capabilities?
- Do I have the capabilities needed for self-service analytics?
- How can I transform business processes to actively engage with customers?
- Is my organizational data platform designed for "fast fail" projects and cognitive analytics?

About the authors

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Related publications

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Contributors

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Study approach and methodology

This study is based on data from the 2016 Cognitive and Analytics Survey, conducted for the IBM Institute of Business Value by the third-party vendor Oxford Economics. The global cross-industry survey polled more than 6,000 pre-qualified C-level panelists on their organizations' current and future uses of data, analytics and cognitive computing. The blinded survey was conducted from July to September 2016.

The pre-2016 data in Figure 1 was extracted from the past IBV Analytics series studies conducted between 2010 and 2015. Information on all maturity levels was not collected each year, and the survey panels – while global, cross-industry and statistically significant – varied from year to year. All data is self-reported.

The identification of respondents as Cognitive Explorers is based on the organization's current use of cognitive computing at an operating level. The identification of respondents as Cognitive Capable is based on the use of one or more predefined types of advanced (prescriptive) analytics, listed in Figure 6. All data is self-reported.

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