Mission: Possible!

Your cognitive future in government

IBM Government

As the world becomes more populous, complex and dangerous, the work of governments at all levels becomes more challenging. IBM Government is creating solutions to help leaders leverage new business models, innovative capabilities and utilize the wealth of data available to build a robust and efficient public infrastructure, ensure safety and security, support the needs of individuals, facilitate sustainable economic growth and nurture stronger communities. For more information about IBM Government offerings, visit ibm.com/government.

IBM Watson

Watson is a cognitive system that enables a new partnership between people and computers that enhances and scales human expertise. For more information about IBM Watson, visit ibm.com/Watson.

A government renaissance

Welcome to the age of cognitive computing, where intelligent machines simulate human brain capabilities to help solve society's most vexing problems. Early adopters in government and other industries are already realizing significant value from this innovative technology, and its potential to transform government is enormous. Currently, cognitive systems are helping government organizations navigate complexity in operational environments and foster improved engagement with constituents. Our research indicates that government leaders are poised to embrace this groundbreaking technology and invest in cognitive capabilities to improve outcomes for government organizations across mission areas.

Executive summary

Technology is advancing more rapidly today than at any other time in human history. Amid the ever-growing market of new technologies, one capability – cognitive computing – is expected to be revolutionary for multiple industries and, indeed, society in general.

For government in particular, the timing for a game changer couldn't be better. Multiple disruptive forces are complicating the missions and operations of – and creating significant challenges for – government organizations globally. These include the increasing demand for services, citizen expectations for more engagement, and increasing operational risk and complexity – all compounded by stagnating economic growth and resource constraints. Government organizations at all levels must also contend with a growing need for resiliency and security.

To thrive amid the chaos of change, government leaders must be smarter in how they approach data. While the digital age has provided governments with a massive amount of data brimming with insights, organizations still struggle to unlock its full value. Advances in the pioneering area of cognitive computing can help bridge the gap between data quantity and data insights.

Cognitive-based systems can build knowledge, understand natural language and provide confidence-weighted responses. And these systems can quickly find the proverbial needle in a haystack, identifying new patterns and insights – something particularly relevant in complex government information environments.

87%

of government officials familiar with **cognitive computing** believe it will play a **disruptive** role in their organization.

83%

of government officials familiar with **cognitive computing** believe it will have a **critical** impact on the **future of their organization**.

100%

of government officials familiar with **cognitive computing** intend to **invest in cognitive** capabilities.

Our research reveals that cognitive solutions are already helping organizations across industries realize tremendous value. A follow up to the "Your cognitive future" reports, this is the latest in a new series of industry-specific reports based on research conducted in early 2015. This study was informed by a survey of 100 government executives from around the world. (For more information on our research, see the "Study approach and methodology" section at the end of the report.)

In this report, we examine current and future applications across various government mission areas and provide recommendations for those seeking a cognitive journey. We also offer insights from government leaders who understand how cognitive capabilities can help push the current boundaries of innovation and transformation in government organizations. These leaders recognize the potential to transform government – and are set to exploit cognitive capabilities to do so.

Conquering industry forces

Governments around the world are facing unprecedented disruption. From ever-increasing demands for services to continuing budgetary pressures amid stagnating economic growth, government leaders are bombarded by challenges and threats. We have identified multiple disruptive forces that are impacting and shaping the missions and operations of government organizations at all levels: increased demand and expectations; increased complexity; and fiscal and resource constraints.

Increased demand and expectations
Growing and aging populations are increasing the demand for services. According to the United Nations, the world's population reached 7.3 billion in the middle of 2015 and is expected to grow more than 32 percent by 2050.[1] Additionally, both global life expectancy and the age-dependency ratio (dependents to working-age people) are expected to rise an additional 10 percent through 2050 – placing even greater pressures on the budgets and resources of governments globally.[2,3]

As demand for services increases, so too do customer expectations for improved and enhanced access to services through multiple channels. Rising expectations challenge government organizations to provide convenience, quality, transparency, promptness and personalization in services across channels. Fifty-nine percent of government leaders surveyed for this IBM Institute for Business Value (IBV) study believe customers will demand more personalized experiences in the next three years. However, according to another of our

What is cognitive computing?
Cognitive computing is a new computation paradigm. Different types of cognitive computing solutions offer various capabilities, including…

- Learning and building knowledge from various structured and unstructured sources of information

- Understanding natural language and interacting more naturally with humans

- Capturing the expertise of top performers and accelerating the development of expertise in others

- Enhancing the cognitive processes of professionals to help improve decision-making

- Elevating the quality and consistency of decision-making across an organization.

IBV studies, 63 percent of government organizations do not have an integrated digital strategy and are not prepared to address these challenges.[4]

Meeting rising demand and expectations places greater pressures and demands on, and expectations for, public resources and services, requiring government organizations to operate smarter and more efficiently.

Increased complexity
Growing geopolitical instability and asynchronous threats are increasing operational risks and complexity. More than 90,000 terror attacks occurred from 2006 through 2014 and resulted in the deaths of more than 130,000 people.[5] Global terrorist attacks in 2014 alone caused 32,272 deaths – an 81 percent increase over 2013.[6] Meanwhile, migration surges resulting from conflicts and global warming are posing significant challenges for governments around the world, and no relief is in sight. Germany alone raised its estimate of refugee arrivals to 800,000 in 2015 – more than double the original forecast of 300,000.[7]

Operational and mission complexity is not confined to the physical world. The explosion of data is creating both new opportunities and challenges for government organizations. Big data creates new possibilities for governments to provide tailored and targeted services for citizens and businesses, make more informed decisions and drive innovations. However, increased dependence on IT and a need to operate in cyberspace has exposed new vulnerabilities for society and governments. Government entities fall prey to more than 20 percent of all cyberattacks globally.[8]

Navigating these complex operating and information environments challenges existing decision-making capabilities and increases the need for enhanced innovation capacity to drive operational improvements.

Fiscal and resource constraints

Economic stagnation and resulting austerity measures continue to place financial pressures on government budgets. Government revenues as a percentage of gross domestic product (GDP) declined from 2007 to 2008, but rebounded slightly in 2009 through 2013.[9] However, while the government share of GDP is increasing, GDP growth itself is in decline. GDP growth continued to stagnate through 2014, and forecasts through 2020 do not anticipate growth rising above 4 percent.[10]

With revenues declining, many governments have looked to debt financing to address budget shortfalls. As a result, global government debt has increased by more than 75 percent from Q4 2007 through Q2 2014.[11] For governments facing these challenges, reducing fraud and maximizing revenue collection become priorities. In Greece, for example, leaders characterize tax evasion as a national sport, with as much as EUR 30 billion going uncollected each year – a hefty sum for a government in such economic distress.[12]

Budgets are not the only area where governments are projecting deficits. The shortage of skilled resources and recruitment challenges create further challenges for governments globally. In our 2013 Global C-suite Study survey, government leaders identified skilled

resources as one of the top three external factors impacting their organizations in the next 3 to 5 years.[13] However, many government organizations are having difficulty finding and retaining people with the necessary talent and skills.[14]

From disruption to focus

It's clear that governments are operating amid turmoil. Although the forces challenging government organizations appear varied in nature, we identified key themes among them relating to citizen engagement and collaboration, innovation in operations and services, and decisions and outcomes.

Figure 1

To cope with a broad range of disruptive forces, governments need strong capabilities in engagement, discovery and decision-making

Increased demand and expectations	Increased complexity	Fiscal and resource constraints

Engage
Provide expert assistance and extend capabilities of human experts by leveraging deep insights from vast amounts of information

Discover
Provide ability to digest vast amounts of data to identify new avenues, navigate complexity and implement new ideas

Decide
Provide personalized, contextual, evidence-backed recommendations to support decision-making at all levels

Source: IBM Institute for Business Value.

To rise above the disruption, we suggest government organizations focus on improving their capabilities to engage, discover and decide (see Figure 1). Increased engagement among citizens, businesses and government organizations can improve communication and collaboration, thus improving citizen satisfaction, business climates and, ultimately, economic vitality. New discovery tools and capabilities can help unearth insights and ideas buried in the masses of data encountered today, thereby facilitating innovation in delivering public services and conducting operations across government mission areas. And better decision capabilities will allow for evidence-based recommendations at the different citizen and business touch points, and across government mission and functional business areas.

Engage: Today's citizens demand more personalized service from the organizations with which they interact, and governments are no exception. Although a clear majority of the government leaders we surveyed understand these demands, most are unable to deliver. In fact, 58 percent believe they are not effectively delivering personalized services, while 61 percent believe they are not addressing citizens' concerns with speed and comprehensiveness. In addition, 62 percent are not satisfied with their ability to enable self-service options for citizens (see Figure 2).

Currently, government organizations are unable to effectively understand citizen and business needs, and the complex and siloed nature of their operations precludes them from effectively engaging with both citizens and businesses. Enabling more integrated, compelling and valuable citizen and business experiences can improve the quality of citizen services and the ease of doing business – thus improving economic vitality.

Figure 2

Cognitive capabilities align to the most pressing issues facing government leaders

Engage
Government leaders that believe they're not competent in providing personalized citizen experience

58%

Discover
Key challenges of government leaders in pursuing disruptive innovation

Insufficient skills 58%
Lack of quality/reliable data 55%
Lack of analytical tools 54%
Organizational complacency 53%

Decide
Government organizations are weak in making cost-reduction decisions

67%

Source: IBM Institute for Business Value.

Discover: Government organizations are embracing innovation. Fifty-four percent of government executives surveyed are actively pursuing industry model innovation while 42 percent are trying for process and operations innovation. However, respondents cite insufficient skills, lack of analytical tools and complacency as their greatest challenges in these areas. The inability of government organizations to attract innovative talent and harness the potential value in the vast amounts of information to which they have access, combined with complacency resulting from a lack of competitive pressure, throttles their speed of innovation.

Decide: In the resource-constrained environments in which most government organizations operate, effective decision-making is critical. And yet, many government decisions are made without supporting evidence or data. For example, it is estimated that less than 1 percent of the U.S. federal government's USD 3 trillion annual spending is backed by even the most basic evidence.[15] More than two-thirds of the government executives we surveyed indicate they are weak in making decisions about reducing costs, while 62 percent indicate weakness in resolving citizen issues. Government decision-making is an intrinsically complex process, and it requires the ability to address ambiguity and consider many potentially conflicting factors. Existing analytics and decision support capabilities do not allow organizations to make use of all available information in making important decisions.

Cognitive opportunity in government

Big data has been called the new natural resource.[16] And this resource continues to rapidly grow in volume, variety and complexity, particularly in government. For example, U.S. federal agencies are projected to store 2.63 petabytes of data in 2015 alone.[17] Despite the explosive growth of information across industries, less than 1 percent of the world's data is currently analyzed.[18]

While effective for a number of applications, traditional analytics solutions cannot fully exploit the value of big data. They are unable to adapt to new problem domains or handle ambiguity and are only suitable for structured and unstructured data with known, defined semantics (the relation of words and phrases and what they mean). Without new capabilities, the data paradox of having too much data and too little insight will continue.

How can government organizations bridge the gap between untapped opportunities and current capabilities? How can hidden insights that reside in data – structured and unstructured – be fully harnessed for discovery, insight, decision support and dialogue? The answer is cognitive computing. Cognitive-based systems build knowledge and learn, understand natural language, and reason and interact more naturally with human beings than traditional programmable systems.

Government executives agree that cognitive computing has the potential to radically change the sector. Among government leaders familiar with the technology, 87 percent believe it will play a disruptive role in the industry, 83 percent believe it will critically impact the future of their organizations and 100 percent intend to invest in cognitive capabilities (see Figure 3).

Figure 3

Government leaders globally see the value in cognitive and intend to leverage it in their organizations


83% of government leaders familiar with cognitive computing believe it will be critical for their organization in the future
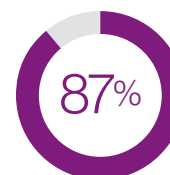
87% of government leaders familiar with cognitive computing also believe it will play a disruptive role in governments

100% of government leaders familiar with cognitive computing indicated they are likely to invest in this technology in the future with the majority doing so in the next 4 years
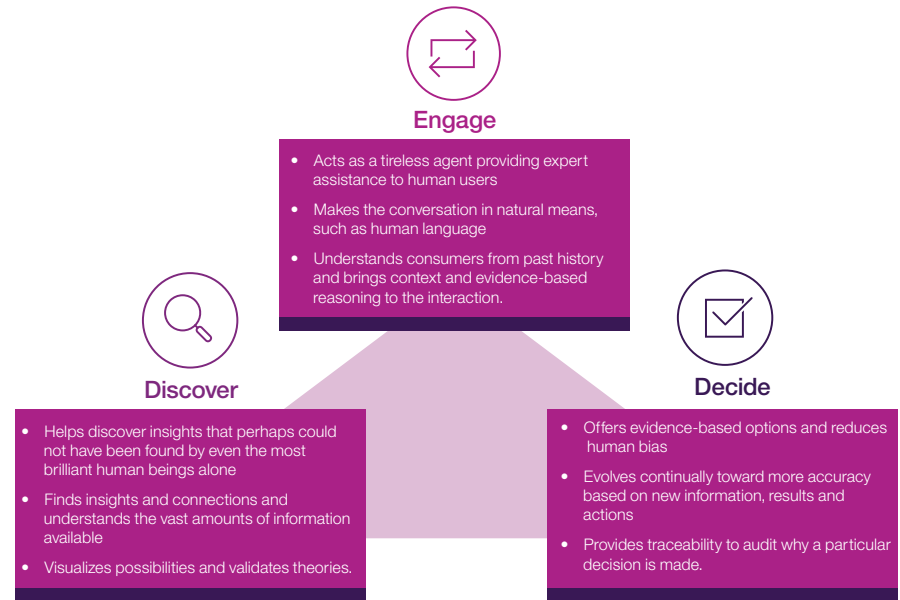

1-2 years 20%
3-4 years 53%
>=5 years 27%
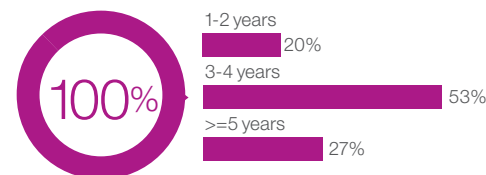
Source: IBM Institute for Business Value.

So, how specifically can government organizations leverage cognitive computing to address the issues they face? This new computing paradigm has three capability areas that align with and specifically address three critical areas of focus for government organizations: engage, discover and decide (see Figure 4).[19]

Figure 4

Cognitive computing can help governments enhance their capabilities

Engage

- Acts as a tireless agent providing expert assistance to human users
- Makes the conversation in natural means, such as human language
- Understands consumers from past history and brings context and evidence-based reasoning to the interaction.

Discover

- Helps discover insights that perhaps could not have been found by even the most brilliant human beings alone
- Finds insights and connections and understands the vast amounts of information available
- Visualizes possibilities and validates theories.

Decide

- Offers evidence-based options and reduces human bias
- Evolves continually toward more accuracy based on new information, results and actions
- Provides traceability to audit why a particular decision is made.

Source: IBM Institute for Business Value.

Engagement capabilities

Cognitive systems can fundamentally change the way humans and systems interact and significantly extend the capabilities of humans by leveraging their ability to provide expert assistance. They provide advice by developing deep domain insights and bringing this information to people in a timely, natural and usable way. Here, cognitive systems play the role of an assistant – albeit one who does not require sleep, can consume vast amounts of structured and unstructured information, can reconcile ambiguous and even self-contradictory data, and can learn.

Because they are able to engage in deep dialogue with humans, these systems can understand humans based on the natural language based interaction and information shared with government, and can deliver personalized services. Today, these types of cognitive systems help citizens receive answers to queries related to government services and policy areas by interacting in natural language (see sidebar, "A national government leverages a cognitive computing solution to enhance citizen interactions").

Future cognitive systems will be able to develop expertise in the complex policy environments of governments to provide advice and guidance to citizens and businesses. These systems will also be capable of providing decision support to improve and expedite service delivery. For example, entrepreneurs may engage in a dialogue with a cognitive assistant to seek advice on setting up a business in a city. The cognitive assistant can help them navigate complex regulatory policies and procedures and even guide them to secure necessary permits and licenses.

Engage

A national government leverages a cognitive computing solution to enhance citizen interactions

Citizens often face difficulty when navigating through the complex portfolio of government services. Moreover, citizens expect that government entities understand their needs and can provide personalized services tailored to their specific circumstances. Although this national government had access to valuable information, it lacked the capability to derive the insights required to understand citizens' needs and provide personalized services.

To address this challenge, this national government is deploying a cognitive computing system that citizens will access from government websites to interact in natural language and receive expert answers to a broad variety of queries about multiple policy and service areas, including income tax, employment and work permits, and workplace health and safety. The cognitive system will help citizens better navigate government services and receive personalized advice while promoting greater citizen satisfaction in their government.

Discover

An immigration agency deploys a cognitive solution to enhance risk-management capabilities

As one of the major destinations for immigrants and visitors, a national-level immigration agency has access to a huge – and overwhelming – amount of data. Existing agency systems handle different information threads in isolation and are unable to fully utilize and exploit all available data. Moreover, the government's decision to merge the immigration agency with the border force has exasperated the information overload.

The agency has turned to a cognitive computing solution to address these problems. The cognitive platform will leverage millions of open source documents relevant to selected strategic, operational and tactical intelligence activities to provide greater insights. The solution will help the agency better manage the information overload problem by discovering hidden signals in a very noisy world of unstructured, open source data.

Discovery capabilities

Governments around the world have access to huge volumes of information. This access provides institutions with an immense opportunity to discover valuable and useful insights. Cognitive systems can help users find insights that even the most brilliant human beings might overlook. Discovery involves finding connections and understanding the vast amounts of information available within an enterprise and around the world.

Some discovery capabilities have already emerged. For example, an immigration agency is using a cognitive computing solution to help navigate a complex information environment. The system helps the agency discover and assess risks based on vast amounts of available information and take strategic, operational and tactical actions in mitigating them (see sidebar, "An immigration agency deploys a cognitive solution to enhance risk management capabilities").

In the near future, cognitive solutions are expected to discover insights by connecting many more disparate factors, which otherwise would not have been possible by human experts. One potential application is in social services. An employment assistance counselor, for example, might get assistance from cognitive systems to discover the root cause of a chronically unemployed citizen's struggle to find a job. A cognitive system can analyze historical case data from multiple disparate sources to discover and advise the counselor of tailored intervention strategies that he or she may not have otherwise considered.

Decision capabilities

Cognitive systems aid in decision-making and reduce human bias by offering evidence-based recommendations. They continually evolve based on new information, results and actions. Current cognitive systems perform more as advisors by suggesting a set of options to human users, who ultimately make the final decisions.

These systems are helping public sector professionals make more informed and timely decisions. For example, in the healthcare area, IBM Watson for Oncology is a cognitive computing solution that quickly analyzes patient data, fast-growing medical literature, guidelines from world-class experts and the experience of specialists – and then identifies personalized treatment options for the clinician to consider (see sidebar, "University of Texas MD Anderson Cancer Center's cognitive solution provides personalized cancer treatment options").[20]

Cognitive solutions can help government organizations gain valuable insights and detect patterns in near-real time from multiple data streams with different levels of detail. Such capabilities can help public safety agencies navigate complex information environments and more efficiently and effectively detect potential threats to the safety and security of citizens.

Decide
University of Texas MD Anderson Cancer Center's cognitive solution provides personalized cancer treatment options

Caring for more than 100,000 patients each year in Houston, and tens of thousands more throughout its regional and national network, MD Anderson has accumulated an unprecedented breadth and depth of clinical oncology data and knowledge. Extracting actionable insights from this information, however, poses a significant challenge. The volumes of data also block the pipeline through which clinical research can be completed, evaluated, approved and ultimately used in patient care.

IBM has designed a cognitive computing-based Oncology Expert Advisor to integrate the knowledge of the institution's clinicians and researchers and help them to develop and fine tune treatment plans for patients, while alerting them to adverse events that may occur throughout the cancer care continuum. The solution will enable comparison of patients based on a new range of data-driven attributes and subsequently help researchers to continually advance cancer care.

The way forward

Despite the enthusiasm for cognitive, organizations should realize there is often a steep learning curve. In terms of system implementation and user interaction, cognitive systems are fundamentally different than traditional programmatic systems.[21] Government organizations can learn from pioneering organizations that have already implemented cognitive by following three key sets of recommendations (see Figure 5).

Figure 5
Organizations with cognitive computing experience have identified three critical action areas for success

① **Define the value**	② **Prepare the foundation**	③ **Manage the change**
• Find the right opportunity. • Define the value proposition and chart a course for cognitive. • Be realistic about value realization.	• Invest in human talent. • Build and help ensure a quality corpus. • Consider policy, process requirements and impacts.	• Ensure executive involvement in the cognitive journey. • Communicate the cognitive vision at all levels. • Continue to raise the cognitive IQ of the organization.

Source: IBM Institute for Business Value.

1. Define the value

Early planning helps ensure the greatest return on investment of resources. Defining the value of cognitive to your government organization is critical and includes several steps:

Find the right opportunity – Cognitive solutions are well suited to a defined set of challenges. Government organizations need to analyze the specific problem to determine if cognitive capabilities are necessary and appropriate:

- Does the challenge involve a process or function that today takes humans an inordinate amount of time to seek timely answers and insights from various information sources, such as social cases, tax records and economic reports, using various techniques in making a decision or thinking through a problem?

- Is there a need for users to interact with the system in natural language (such as a citizen on a mobile device seeking advice and assistance in addressing a complex policy question)?

- Does it involve a process or function that requires providing transparency and supporting evidence for ranked responses to questions and queries (such as crime detection)?

Define the value proposition and chart a course for cognitive – Identify both the differentiated value provided by cognitive computing and the business value up front – from quicker decisions about budget allocations to cost savings. In addition, establish a cognitive computing vision and roadmap with executive-level support. Continuously communicate roadmap progress with appropriate executives and stakeholders, such as public representatives and citizens.

Be realistic about value realization – The benefits of cognitive computing systems are not realized in a single "big bang" at the time of initial deployment. Rather, these systems are evolutionary and improve and can lead to increasing value over time. Communicate this reality to stakeholders and specify benefits for the government bodies, citizens and others. Consider using a phased rollout or deploying the solution to a subset of trusted users who understand the technology's evolutionary nature.

2. Prepare the foundation

Prepare the foundation for a successful cognitive computing solution implementation by focusing on the following:

Invest in human talent – Cognitive solutions are "trained," not programmed, as they "learn" with interactions, results and new pieces of information and help organizations scale expertise. Often referred to as supervised learning, this labor-intensive training process requires the commitment of human subject matter experts (SMEs). A cognitive implementation also requires expertise in natural language processing, machine learning, database administration, systems implementation and integration, interface design and change management.

Build and help ensure a quality corpus – Cognitive systems are only as good as their data. Invest adequate time in selecting data to be included in the corpus, which might include structured (such as tax records) and unstructured (such as social case documents) data from multiple databases and other data sources and even real-time data feeds and social media. Data will likely emanate from new and untapped sources as well, including social media, economic reports, crime reports and weather updates. In addition, invest in records digitization to secure the future of your organization's corpus, focusing on both historical and new documentation.

Consider policy, process requirements and impacts – Assess any potential impact on processes and how people work. Because users interact with cognitive systems in entirely different ways than traditional input/output systems, processes and job roles could be impacted. In addition, consider whether any data policy changes are necessary. Obtaining necessary data could test the boundaries of existing data-sharing policies and might require new or modifications to existing policies, regulations and agreements – particularly in government, where security and privacy requirements are stringent.

3. Manage the change

Compared to traditional programmable systems, cognitive systems are a whole new ballgame. As such, change management is more critical than ever – even more so in an industry already experiencing so much change across its ecosystem.

Ensure executive involvement in the cognitive journey – Executive involvement should begin with active participation in defining the cognitive vision and roadmap and continue throughout the journey. This includes executive participation in regular reviews of incremental progress and value realization.

Communicate the cognitive vision at all levels – Because cognitive computing is new and not completely understood by most, regular communication at all levels is critical. Communications should consider all stakeholders, including executives, elected officials, citizens and businesses, in the complex government ecosystem that may be impacted. Address any fears, uncertainties and doubts head on, and leverage executive sponsors to reinforce the value of cognitive to the organization's mission.

Continue to raise the cognitive IQ of the organization – Education is critical to assuring that cognitive is understood and adopted. Of particular importance is managing expectations related to system-generated recommendations. Cognitive systems are probabilistic (where several possible outcomes exist, with assigned probabilities) and not deterministic (where every input has fixed outcomes). While accuracy rates will improve as a system learns over time, the rate will never reach 100 percent. Educate stakeholders early on about accuracy rates, and conduct regular reviews on incremental improvements.

Ready or not? Ask yourself these questions

- What opportunities exist to create more engaging and personalized experiences for your citizens and the wider government ecosystem?

- What data from internal government and public sources aren't you leveraging that, if converted to knowledge, could allow you to meet key objectives and business requirements?

- What is the cost to your organization and the wider government ecosystem associated with making non-evidence-based decisions, or not having the full array of possible options to consider when actions are being taken?

- What benefits could you gain in being able to detect hidden patterns locked away in your data? How would this accelerate research, citizen services and the like?

- What is your organizational expertise skill gap in cognitive computing? What might change if you could equip every employee to be as effective as the leading expert in that position or field?

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Study approach and methodology

As a follow up to the initial IBM Your cognitive future research study, we conducted additional research in early 2015 to dive deeper into select industries and explore opportunities for cognitive. Through a survey conducted by the Economist Intelligence Unit, IBM gained insights from more than 800 executives from around the world representing a variety of industries, including n from government, plus others from healthcare, banking, insurance, retail, telecom-munications, life sciences, consumer goods, and oil and gas. The study also included interviews with subject matter experts across IBM divisions, as well as supplemental desk research.

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