Prescribing a digital transformation for life sciences

Your cognitive future in the life sciences industry

IBM Institute for Business Value

IBM Life Sciences

IBM enables life sciences companies to strategically define, develop and commercialize solutions that facilitate R&D innovation, help enhance quality of care and help improve healthcare cost efficiencies. IBM solutions, powered by Watson Health, can assemble the available data assets with knowledge- and data-driven analytics and create clinical, scientific and economic evidence to address multiple needs. IBM can play an integral part in enabling life sciences organizations as they seek to increase R&D productivity; drive growth; and enrich relationships between life sciences companies, payers, providers and patients. For more information on IBM data, analytics and solutions to address critical business issues in the life sciences industry, visit **ibm.com**/lifesciences.

IBM Watson Health

Advances in cognitive computing are changing how healthcare and life sciences companies plan to use data and insights. IBM Watson Health solutions provide data, analytics and insights to help advance innovation, empower people in their healthcare decision making and support condition-specific care management. IBM Watson Health solutions curate and analyze data to generate insights that can aid clinicians and researchers in identifying new research targets, assessing trial feasibility, locating viable trial sites and testing drug protocols. For more information, visit **ibm.com**/watsonhealth.

Transforming life sciences

Cognitive computing has arrived, and its potential to revolutionize the life sciences industry is enormous. With the power to unleash a new era of innovation and growth, cognitive systems help accelerate scientific discoveries, transform safety reporting, and improve execution and engagement for better care management. Our research indicates that life sciences leaders are poised to embrace this groundbreaking technology, which is an integral piece of the digital transformation puzzle.

Executive summary

Welcome to the age of cognitive computing, where intelligent machines simulate human thought processes to help solve vexing problems across industries. For life sciences, the timing for an industry game changer couldn't be better.

The life sciences industry as a whole has enjoyed a history of general success and profitability. However, recent societal, economic and industry influences are threatening traditional business models. While high rates of return and strong performances might have masked past challenges, the industry could be moving toward a landmark shift.

As entrants from other industries blur the traditional definition of life sciences, new partners are interacting and collaborating across customary boundaries. And an emerging healthcare ecosystem features life sciences in a major role across the continuum – from health and wellness to patient care – with a transfer in focus from products to patient impact. At the same time, the industry is experiencing changes based on rapidly advancing technological capabilities. Innovative solutions are powering extraordinary discoveries in areas like genomics, while increased digitization is enabling new modes of interaction and collaboration.

Although innovation is at the heart of life sciences, industry research and development (R&D) processes remain largely unchanged. While the pipeline of new drugs entering the market has strengthened, efforts to curb development costs and improve time to market have been less successful. In addition, life sciences organizations are facing increasing scrutiny over drug pricing. High costs and legacy business models have stifled innovation, and companies are being called upon to defend the value of their drugs.

87%

of life sciences executives **familiar with cognitive computing** believe it will play a critical role in the **future of their business.**

94%

of life sciences executives familiar with **cognitive computing** believe it will play a **disruptive role** in the industry.

96%

of life sciences executives familiar with cognitive computing intend to **invest in cognitive** capabilities.

As they contend with the challenges and opportunities stemming from these varied influences, life sciences organizations also have to manage increasing volumes of data – data brimming with hidden insights that could potentially tackle some of these issues. Unfortunately, most organizations are unable to unlock the full value of the data at their disposal. As the potential for insight increases with additional data, so, too, does the challenge in managing this data.

Advances in 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 machine learning systems can quickly help locate the proverbial needle in a haystack, identifying new patterns and insights – something particularly relevant in life sciences.

Our research reveals that cognitive solutions are already helping life sciences organizations chart new territory. As a follow up to our "Your cognitive future" reports, we have published a new series of industry-specific reports based on research conducted in early 2015. (For more information on the research, which included a survey of 81 life sciences executives, see the "Study approach and methodology" section).

In this report, we examine current and future life sciences applications and provide recommendations for those organizations seeking a cognitive journey. We also offer insights from industry executives who recognize the potential to transform life sciences – and plan to exploit cognitive capabilities to make their vision a reality.

Conquering industry forces

Although the life sciences industry has faced challenges over the past several years, it has still delivered successful returns for shareholders.[1] However, a set of new forces is shaping – and shifting – the life sciences arena:

Emerging ecosystems

According to the 2015 IBM Global C-suite Study, 83 percent of life sciences executives cite industry convergence as the trend most likely to impact their business in the next three to five years.[2] The boundaries between life sciences and other industries are rapidly eroding as life sciences organizations converge with other entities from healthcare and a host of other sectors.

For example, Lockheed Martin, a security and aerospace company, has partnered with genetic sequencing firm Illumina to develop personalized healthcare solutions based on individual genomes, as well as organized an alliance of industry, government and academia to brainstorm the future of healthcare technology.[3]

As the focus for life sciences shifts from products and services to patient outcomes, organizations must determine in what ecosystems they will participate and what roles they will play while simultaneously increasing collaboration both within and outside the industry.

Technology-driven innovation

According to life sciences executives surveyed for the 2015 IBM Global C-suite Study, technology has surpassed regulatory and market factors as the most significant external force impacting the enterprise.[4] This is not surprising, as rapid digitization and advanced technologies have opened the door to new business models and research advancements. Solutions in areas such as cloud, mobile and the Internet of Things (IoT) enable increased ecosystem collaboration.

What is cognitive computing?

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.

By opening their assets to one another through a platform approach, ecosystem partners can unlock significant value, offering new solutions and levels of communication and partnership. In addition, advances in analytics and cognitive computing continue to drive industry innovation in areas like genomics, translational medicine and nanotechnology.

Innovation of R&D

The number of new drug approvals in 2015 was the highest in almost 20 years.[5] However, the timeline for drug discovery and development has grown longer, likely due to the increasing complexity of drug trials and demands for more data from health insurers.[6]

Also growing are the average costs associated with drug development (including the cost of failures) – growing from USD 179 million in the 1970s to more than USD 2.6 billion in the 2000s to early 2010.[7] These expanding costs and timelines point to a need to reevaluate the R&D process as companies pick their best bets for the pipeline and work toward decreasing development costs and shortening timelines.

Value-based pricing

Consumers have long complained about rising drug prices, but recent media and political scrutiny has brought the issue to the forefront.[8] Life sciences companies are increasingly being asked to justify the pricing of therapies based on high cure rates or changes in drug category.[9]

As the pressure to be more transparent about costs increases, innovative pricing models are emerging. For example, several drug companies are considering "pay for performance pricing" for some drugs based on clinical outcomes.[10] "Reference pricing," which has become popular in a number of countries including Germany, Spain and Italy, refers to a system where prices are set based on the lowest-priced drug in the therapeutic class.[11] And Express Scripts has implemented an "indication-based pricing" pilot, in which different prices are paid for a single drug depending on how it performs in different indications.[12]

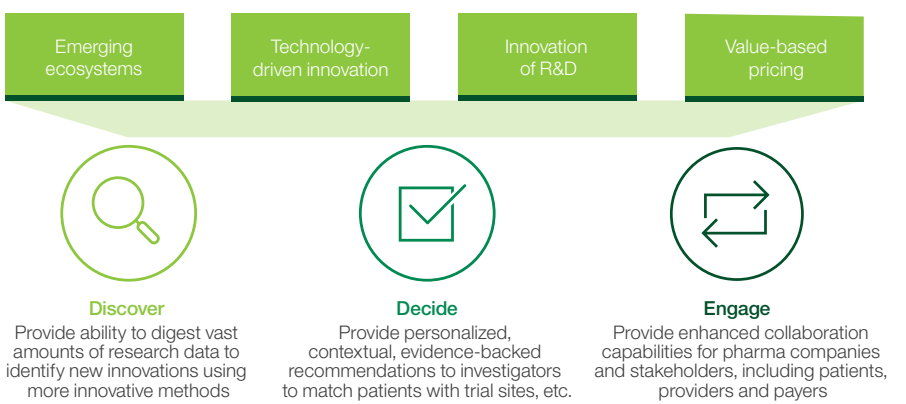
From disruption to focus

It's clear that life sciences organizations are operating in a challenging environment. Although the forces confronting the industry appear varied in nature, we identified key themes among them relating to innovation and discovery, decision making, and communication and engagement.

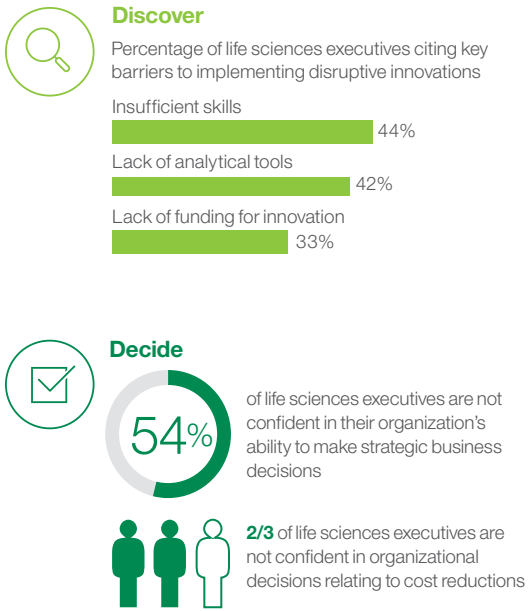
To rise above the disruption, we suggest life sciences organizations focus on improving their capabilities to *discover, decide* and *engage* (see Figure 1). New discovery capabilities can help unearth insights and ideas buried in masses of data, thereby facilitating research and innovation. Better decision capabilities that offer personalized, evidence-backed recommendations have the potential to transform clinical trials and pharmacovigilance. And increased engagement among payers, providers and patients helps improve communication and collaboration, potentially facilitating more effective outcomes.

Figure 1

From the four disruptive forces, three focus areas have come to light – all of which can facilitate increased patient centricity



Source: IBM Institute for Business Value.



Source: IBM Institute for Business Value.

Discover

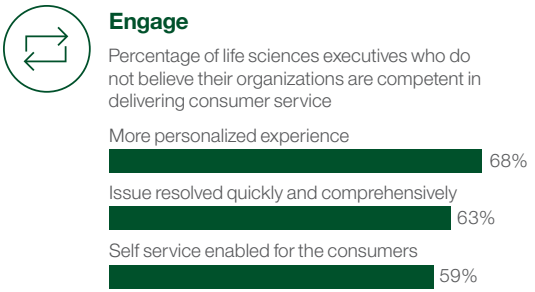
Innovation is the life blood of life sciences, and a clear majority of life sciences executives we surveyed actively pursue product and service innovation. However, they are challenged by a lack of appropriate skills and analytical tools. A 2015 U.K. survey revealed that nine out of ten pharmaceutical organizations expressed concerns about the quality and quantity of qualified applicants in areas such as bioinformatics, health informatics, statistics and data mining.[13] In addition, rigid analytics platforms (for example, non integrated platforms across collaborations within the healthcare ecosystem) can restrict innovation speed and momentum.

Decide

According to one study, the cost of developing a drug, when adjusted for inflation, increased 145 percent from 2004 to 2014.[14] In addition, protracted development and production timelines mean many decisions, like constructing a new plant for example, must be made years in advance of a drug coming to market. With stakes that high, effective decisions relating to cost and strategy are crucial. According to our survey, more than half of life sciences executives are not confident in their organizations' strategic decisions, and two-thirds lack confidence in cost reduction decisions. A potential reason could be that many organizations are forced to make decisions based on incomplete information because they lack the tools necessary to optimize the vast data at their disposal.

Engage

To meet the demands of today's payers and patients, life sciences organizations need to move away from a product focus and toward patient centricity. Although a clear majority of life sciences executives – 72 percent – understand the importance of a more personalized experience, 68 percent are unable to deliver. In addition, 63 percent indicated they are not satisfied with their ability to comprehensively and quickly address supplier, patient, physician, provider, payer and scientist concerns, while 59 percent are not satisfied with their ability to enable self service. A key roadblock in the path toward patient centricity relates to regulations about the level of engagement life sciences organizations can have with patients or caregivers, which varies around the world based on local laws.

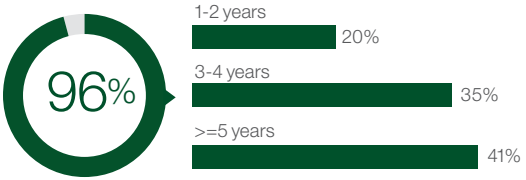


Source: IBM Institute for Business Value.

of life sciences executives familiar with **cognitive computing** believe it will play a **critical role** in their business

of life sciences executives familiar with **cognitive computing** believe it will play a **disruptive role** in the industry

96% of life sciences executives familiar with **cognitive computing** indicated they are **likely to invest** in it, with the majority doing so after two years



Source: IBM Institute for Business Value.

Cognitive opportunity in life sciences

Big data has been called the new natural resource.[15] And this resource continues to rapidly grow in volume, variety and complexity, particularly in life sciences. For example, the average person is expected to generate 1,100 terabytes of exogenous data (for example, data about sleep patterns, diet and exercise), 6 terabytes of genomic data and 0.4 terabytes of clinical data in his or her lifetime.[16] Despite an explosive growth of information across industries, less than 1 percent of the world's data is currently analyzed.[17]

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 for life sciences companies.

How can the life sciences industry bridge the gap between untapped opportunities and current capabilities? How can hidden insights that reside in data – structured and unstructured – be fully harnessed? The answer can be found through 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.

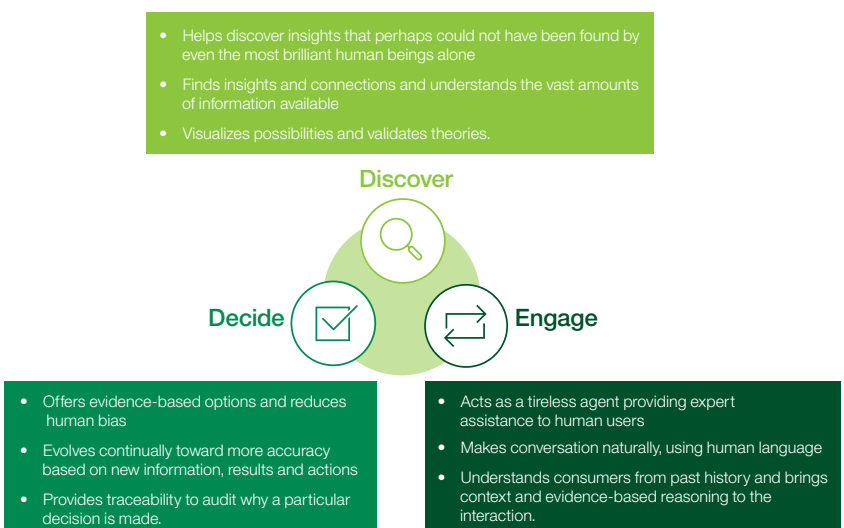
Life sciences executives agree that cognitive computing has the potential to radically change the industry. Among those familiar with the technology, 87 percent believe it will critically impact the future of their business, 94 percent believe it will play a disruptive role in the industry, and 96 percent intend to invest in cognitive capabilities.

So, how specifically can life sciences organizations leverage cognitive computing to address issues currently plaguing the industry? The cognitive computing paradigm has three capability areas that align with and specifically address the industry's need to improve discovery, decision making and engagement: Discover, Decide and Engage (see Figure 2).[18]

For life sciences organizations, cognitive computing and traditional analytics solutions can work together to solve different elements of a business challenge. Real-world evidence (RWE) includes structured and unstructured data originating from diverse sources including electronic medical records (EMRs), claims, radiological images, voice recordings, lifestyle tracker devices, literature and even social media. Given RWE is not only vast but also varied in type and source, the challenge is how to gain the most insights and, ultimately, benefit. While an analytics solution can handle structured data from an EMR or claims record, a cognitive computing solution can address unstructured elements from literature or social media.

Figure 2

There are three emerging capability areas for cognitive computing



Source: IBM Institute for Business Value.

Discover

Cognitive computing solution supports new discoveries and insights in medical research

With millions of medical scientific papers available and new ones continuously being published, it is humanly impossible for scientists to stay abreast of an ever-growing body of material. However, biologists and data scientists at a leading health sciences university are leveraging cognitive computing to generate insights to help accelerate research, unlock patterns and make discoveries with greater precision.

The university has developed a tool, powered by IBM Watson technology, that enables researchers to identify proteins that modify the tumor suppressor protein related to many cancers. The tool works by extracting information from scientific literature, automatically identifying direct and indirect references to protein interactions, which is knowledge that can be represented in network form. It then reasons over this network to predict new, previously unknown interactions.

Discovery capabilities

Cognitive systems can help users discover insights that perhaps might not be found by even the most brilliant scientists. Discovery involves finding patterns, insights and connections and understanding the immense amounts of information available around the world.

Some discovery capabilities have already emerged, such as in medical research, where robust corpora of information exist. Here, advanced cognitive capabilities have dramatically reduced research and discovery time (see sidebar: *Cognitive computing solution supports new discoveries and insights in medical research*). In addition to helping accelerate scientific discoveries, cognitive computing enables improvements to the actual discovery process.

In the near future, cognitive solutions could help accelerate research in many important areas. For example, though highly preventable, cardiovascular disease continues to be the leading cause of death in the United States.[19] A leading academic institution is exploring cognitive computing to help accelerate research comparing the genome and blood protein composition of those with and without cardiovascular diseases. It hopes to make great strides in developing personalized approaches by using cognitive capabilities to conquer the challenge of analyzing the vast amount of individual patient data in the context of all known data relating to cardiovascular diseases. In another example, pharmaceutical companies are looking at how cognitive capabilities could offer a holistic view of their pipeline portfolios, facilitating faster, more informed and higher-quality decisions about new treatments.

Decision capabilities

Cognitive systems aid in decision making and reduce human bias by offering evidence-based options. 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 life sciences professionals make more informed and timely decisions. For example, cognitive solutions can help organizations with decisions related to funding for clinical trials by offering new insights into the primary investigator, scientific topic and operational feasibility (see sidebar: *Cognitive computing capabilities enhance decision-making process for clinical trial funding*). In addition, life sciences organizations are embracing cognitive computing to assist in pharmacovigilance activities.

In the near future, pharma companies will likely transform their pharmacovigilance processes using cognitive capabilities to automate the detection, assessment and classification of adverse event information from structured and unstructured data from a variety of internal and external sources. This would help improve overall process efficiency and effectiveness, enabling higher quality and more consistent safety assessments. In addition, it would allow for a shift in focus to higher-value activities and increased confidence in identifying risks and benefits.

Decide

Cognitive computing capabilities enhance decision-making process for clinical trial funding

The assessment process for new clinical trials is a laborious one, requiring numerous individuals to extensively review growing volumes of medical and scientific literature and internal documents. With so much data, it is difficult to identify similar trials and avoid research duplication. In addition, there is no integrated view that measures impact from funding to publication or clinical trial success.

Cognitive capabilities can enhance the human decision-making process by rapidly uncovering information from multiple sources that support or oppose the proposal for a clinical trial. This includes enormous amounts of scientific data relating to the area of research and insights about the investigator's prior experiences, publications and collaborations. Cognitive capabilities can also help uncover potential risks, such as adverse effects or patient recruitment barriers, as well as similar trials previously performed or currently underway. Armed with data-driven insights and recommendations, researchers can make better decisions relating to clinical trial funding.

Engage

Pharmaceutical firm uses cognitive capabilities and advanced analytics to improve communication with HCPs

A pharmaceutical company wanted to improve its engagement with healthcare providers (HCPs). Specifically, the company was looking for a way to effectively leverage RWE and scientific literature to more quickly and easily answer HCP questions. In addition, it sought to generate more consistent marketing research and insights, as well as develop personalized, targeted HCP messaging.

By combining the power of cognitive computing with advanced analytics, the company is able to analyze large amounts of clinical data and scientific literature to develop novel hypotheses for insights-driven strategic planning. The knowledge-driven approach enables the company to validate hypotheses in real time across brand and function with improved understanding of real-time market changes. In addition, the company is able to create targeted messaging for delivery to specific HCPs through an interactive engagement application. The company went from distributing fragmented information to consistently delivering the right messages to the right HCPs.

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. These systems 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 dialogue with humans, these systems can understand patients based on their past medical history and bring context- and evidence-based reasoning to an interaction.

These capabilities can help the industry become more patient centric through improved engagement with patients, consumers and caregivers. In addition, cognitive systems can help life sciences organizations improve collaboration and communication with payers and healthcare providers (HCPs). (See sidebar: *Pharmaceutical firm uses cognitive capabilities and advanced analytics to improve communication with HCPs.*)

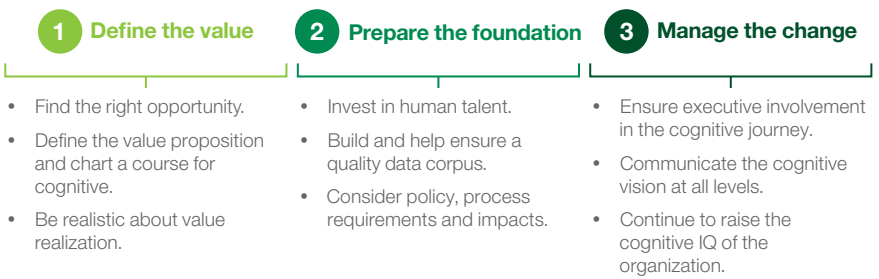
Future cognitive systems will likely have free-form dialogue capabilities, which could help the flow of information among individuals.[20] In the near future, cognitive capabilities will offer opportunities to help improve the clinical trial experience for patients. An effective interactive mobile patient engagement application could help clinical trial patients make more informed choices and better manage their diseases – and help researchers improve the patient retention rate and control trial costs. Also in the near future, a retail pharmacy plans to use cognitive computing technology to help predict medical emergencies among patients with chronic diseases based on physiological indicators and red flag behaviors.

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] Life sciences organizations can learn from pioneering organizations that have already implemented cognitive computing solutions by following three key sets of recommendations (see Figure 3).

Figure 3

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



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 organization is critical and includes several steps:

Find the right opportunity – Cognitive solutions are well suited to a defined set of challenges. Life sciences 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, such as research scientists, an inordinate amount of time to seek timely answers and insights from various information sources (for example, scientific literature) using potentially 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 apps that increase engagement for patients involved in clinical trials)?
- Does it involve a process or function that requires providing transparency and supporting evidence for ranked responses to questions and queries (such as creating targeted lists of Individual Case Study Reports and signal detection articles)?

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 to support research and development to better care management for the patient. In addition, establish a cognitive computing vision and roadmap with executive-level support. Continuously communicate roadmap progress with appropriate executives and stakeholders, such as providers, payers and patients.

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 research scientist, sales representative, etc.). 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- and time-intensive training process requires the commitment of human subject matter experts. In addition to domain expertise, a cognitive implementation also requires expertise in natural language processing, machine learning, database administration, systems implementation and integration, interface design and change management.

Life sciences executives in our survey identified "lack of skilled resources and technical expertise" as the number one barrier to implementing a cognitive solution, so acquiring the right talent could prove challenging. Establishing a cognitive center of excellence focused on building the right skills can be beneficial in this regard. As part of this, it's important to also recognize an additional intangible "skill" required for team members: intellectual curiosity. The learning process never ends – for the system, the users and the organization.

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 data from safety reporting) and unstructured data (from scientific articles, for example) from multiple databases and other data sources and even real-time data feeds. Data will likely emanate from new and untapped sources as well, such as social media posts that reveal behavioral insights. 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 if 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 life sciences, where regulatory requirements are stringent.

3. Manage the change

Cognitive systems are vastly different from traditional programmable systems. Explaining how best to apply this new technology to those unfamiliar with it can be challenging. 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 important. Address any fears, uncertainties and doubts head on, and leverage executive sponsors to reinforce the value of cognitive to your organization's mission.

Continue to raise the cognitive IQ of the organization – Education is critical to assuring cognitive is understood and adopted. Of particular importance is managing expectations related to system-generated recommendations. Cognitive systems are probabilistic and not deterministic. 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.

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.

Access IBM Institute for Business Value executive reports on your mobile device by downloading the free "IBM IBV" apps for your phone or tablet from your app store.

The right partner for a changing world

At IBM, we collaborate with our clients, bringing together business insight, advanced research and technology to give them a distinct advantage in today's rapidly changing environment.

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.

Are you ready for a cognitive journey?

As you prepare to transform your organization's cognitive computing future from vision to reality, ask yourself these questions:

- What life sciences data is not being leveraged that, if converted to knowledge, would allow you to exceed key objectives and business requirements?
- What is the cost to your organization and the wider life sciences ecosystem associated with making non-evidence-based decisions or not having the full array of options to consider when actions are being taken?
- What benefit would you gain in being able to detect hidden patterns locked away in your data? How would this accelerate innovation?
- What opportunities exist to create more engaging and personalized experiences across the wider life sciences ecosystem?
- What is your organizational expertise in cognitive computing? What would change if you could equip every employee to be as effective as the leading expert in the cognitive field?

About the authors

Heather Fraser is a pharmacist with over 30 years of industry experience in pharmaceutical R&D, consultancy and community pharmacy. She leads the Life Sciences and Healthcare team for the IBM Institute for Business Value, where she has published extensively on the future of the life sciences, healthcare and the emergence of the healthcare ecosystem. Heather holds an MBA from the University of Warwick. She can be contacted at hfraser@uk.ibm.com.

Lauren E. O'Donnell is the Global General Manager of the IBM Life Sciences Industry team. She helps clients address the industry imperative to improve the clinical development process, act on insights to help increase sales and enhance relationships across the ecosystem with business model transformation. Lauren's proven track record of success is a result of her extraordinary client insight, exemplary problem-solving skills and outstanding leadership competencies. She can be reached at lhodonne@us.ibm.com.

Louisa Roberts is a leader in the IBM Watson Health Life Sciences team, where she collaborates with clients throughout their cognitive journey to help ensure that predefined value is realized by the Watson enabled function/organization. She has worked with the world's top 20 pharma and biotech companies in strategy development, design and execution with significant success in optimizing results. Louisa has a master's degree in chemistry from Edinburgh University and an MBA from the Tuck School of Business at Dartmouth. She can be reached at louisa.roberts@us.ibm.com.

Dr. Sandipan Sarkar is the Cognitive Computing Leader for the IBM Institute for Business Value. His career spans over two decades and includes various technical leadership roles where he was responsible for crafting cutting-edge solutions and thought leadership to address intriguing business problems. Sandipan holds a PhD in computer science and engineering from Jadavpur University, India. His research interest lies in computational linguistics, information retrieval and machine learning. He can be reached at sandipan.sarkar@in.ibm.com.

Related publications

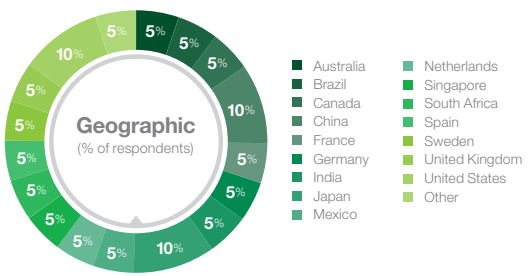
Fraser, Heather; Sandipan Sarkar; and Dave Zaharchuk. "A booster shot for health and wellness: Your cognitive future in the healthcare industry." IBM Institute for Business Value. September 2015. ibm.com/business/value/cognitiveindustry

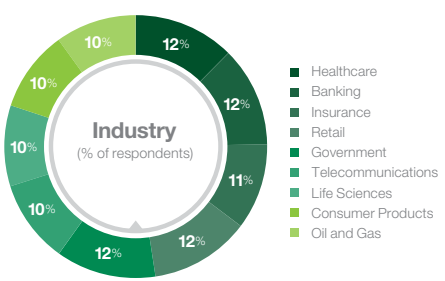
Fraser, Heather; Anthony Marshall; Teri Melese. "Reinventing life sciences: How emerging ecosystems fuel innovation." IBM Institute for Business Value in cooperation with the University of California, San Diego. April 2015. ibm.com/business/value/reinventingls

Sarkar, Sandipan, and David Zaharchuk. "Your cognitive future, How next-gen computing changes the way we live and work, Part II: Kick-starting your cognitive journey." IBM Institute for Business Value. March 2015. ibm.com/business/value/cognitivefuture

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 computing. 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 healthcare, banking, insurance, retail, government, telecom-munications, life sciences, consumer products, and oil and gas. The study also included interviews with subject matter experts across IBM divisions, as well as supplemental desk research.





Contributors and acknowledgments

Thanks to Neha Aggarwal, Senior Advisory Consultant, Strategy and Analytics, IBM Global Business Services, for her contributions. The authors also offer thanks to the following individuals for their assistance: Christine Bonini, Brian Frederiksen, John Harrington, Virginie Harris, Prasad Kodali, Hannah Kloeckner, Eric Lesser, John Piccone, Laila Rehan, Jake Schutz, Madeline Tolge and Neha Tuli. In addition, the authors would like to recognize the report's executive stakeholders: Jay Bellissimo, Rob Merkel and Shanker Ramamurthy.

Notes and sources

1 IBM Analysis and S&P Dow Jones Indices. McGraw Hill Financial (accessed April 3, 2015). http://us.spindices.com/

2 "Redefining Boundaries: Insights from the Global C-suite Study." IBM Institute for Business Value. November 2015. https://www-935.ibm.com/services/c-suite/study/pdf/ibm_global_csuite_study-2015.pdf

3 Jayakumar, Amrita. "Lockheed Martin's latest health partnership is very personal." *The Washington Post.* January 13, 2015. https://www.washingtonpost.com/business/capitalbusiness/lockheed-martins-latest-health-partnership-is-very-personal/2015/01/12/0136d04a-9a9b-11e4-bcfb-059ec7a93ddc_story.html; Jayakumar, Amrita. "Lockheed Martin tackles health care, with a little help from its friends." *The Washington Post.* July 30, 2015. https://www.washingtonpost.com/news/on-small-business/wp/2015/07/30/lockheed-martin-tackles-health-care-with-a-little-help-from-its-friends/

4 "Redefining Boundaries: Insights from the Global C-suite Study." IBM Institute for Business Value. November 2015. https://www-935.ibm.com/services/c-suite/study/pdf/ibm_global_csuite_study-2015.pdf

5 King, Simon. "2015 In Review: New drug approvals – the FDA hits a 19 year-record." FirstWorld Pharma. December 23, 2015. http://www.firstwordpharma.com/node/1340750#axzz41aGyHmB6

6 Perrone, Matthew. "First-of-a-kind drug approvals continued rise in 2015." Associated Press AP Big Story Website, accessed February 29, 2015. http://bigstory.ap.org/article/7b428f1665f544dbac60db70a8009d70/first-kind-drug-approvals-continued-rise-2015

7 "2015 Biopharmaceutical research industry profile." Pharmaceutical Research and Manufacturers of America. April 2015. http://www.phrma.org/sites/default/files/pdf/2014_PhRMA_PROFILE.pdf

8 Silverman, Ed. "Drug firms need to explain the prices." Stat. Boston Globe Media Partners. September 29, 2015. https://www.bostonglobe.com/business/2015/09/28/time-for-drug-industry-talk-about-prices/IrbnNgdvZrAikZwMZ2RDAP/story.html

9 Pollack, Andrew. "Drug Goes From $13.50 a Tablet to $750, Overnight." *The New York Times*. September 20, 2015. http://www.nytimes.com/2015/09/21/business/a-huge-overnight-increase-in-a-drugs-price-raises-protests.html?_r=0; Palmer, Eric. "Gilead warns of fatal reaction to Sovaldi, Harvoni and heart drug." FiercePharma. March 23, 2015. http://www.fiercepharma.com/story/gilead-warns-fatal-reaction-sovaldi-harvoni-and-heart-drug/2015-03-23

10 Hirschler, Ben. "Novartis to test new pricing model with heart failure drug." Reuters. June 30, 2015. http://in.reuters.com/article/us-novartis-heart-idINKCN0PA1N720150630

11 Frakt, Austin. "To reduce the cost of drugs, look to Europe." *The New York Times*. October 19, 2015. http://www.nytimes.com/2015/10/20/upshot/to-reduce-the-cost-of-drugs-look-to-europe.html?_r=0

12 McCallister, Erin. "How Express Scripts plans to do indication-based pricing for cancer drugs." BioCentury. July 20, 2015. http://www.biocentury.com/biotech-pharma-news/coverstory/2015-07-20/how-express-scripts-plans-to-do-indication-based-pricing-for-cancer-drugs-a02

13 "UK lacks the skills to research and develop the medicines of the future." ABPI News Release. November 11, 2015. http://www.abpi.org.uk/media-centre/newsreleases/2015/Pages/111115.aspx

14 Millman, Jason. "Does it really cost $2.6 billion to develop a new drug?" *The Washington Post*. November 18, 2014. https://www.washingtonpost.com/news/wonk/wp/2014/11/18/does-it-really-cost-2-6-billion-to-develop-a-new-drug/

15 Picciano, Bob. "Why big data is the new natural resource." *Forbes*. June 30, 2014. http://www.forbes.com/sites/ibm/2014/06/30/why-big-data-is-the-new-natural-resource/

16 J.M. McGinnis et al. "The Case for More Active Policy Attention to Health Promotion." Health Affairs 21, no. 2 (2002):78–93; IBM Watson analysis.

17 "New Digital Universe Study Reveals Big Data Gap: Less Than 1% of World's Data is Analyzed; Less Than 20% is Protected." EMC Press Release. EMC website. December 11, 2012. http://www.emc.com/about/news/press/2012/20121211-01.htm

18 Sarkar, Sandipan, and David Zaharchuk. "Your cognitive future, How next-gen computing changes the way we live and work, Part I: The evolution of cognitive" IBM Institute for Business Value. January 2015. http://www-935.ibm.com/services/us/gbs/thoughtleadership/cognitivefuture/

19 "Cardiovascular Disease Research." Johns Hopkins Medicine Website, accessed February 29, 2016. http://www.hopkinsmedicine.org/gim/research/content/cvd.html

20 "IBM Global Technology Outlook 2014." IBM Research. 2014.

21 Ibid.

IBM Global Business Services
Route 100
Somers, NY 10589

Produced in the United States of America
March 2016

GBE03744-USEN-02