IBM Global Business Services
Business Analytics and Optimization

Executive Report

IBM Institute for Business Value

In collaboration with *Saïd Business School at the University of Oxford*

Saïd Business School
UNIVERSITY OF OXFORD

Analytics: The real-world use of big data in healthcare and life sciences

How innovative healthcare and life sciences organizations extract value from uncertain data

IBM® Institute for Business Value

IBM Global Business Services, through the IBM Institute for Business Value, develops fact-based strategic insights for senior executives around critical public and private sector issues. This executive report is based on an in-depth study by the Institute's research team. It is part of an ongoing commitment by IBM Global Business Services to provide analysis and viewpoints that help companies realize business value.
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Saïd Business School at the University of Oxford

The Saïd Business School is one of the leading business schools in the UK. The School is establishing a new model for business education by being deeply embedded in the University of Oxford, a world-class university and tackling some of the challenges the world is encountering. You may contact the authors or visit: *www.sbs.ox.ac.uk* for more information.

By Peter Mooiweer and Rebecca Shockley

"Big data" – which admittedly means many things to many people – is no longer confined to the realm of technology. Today it is a business imperative and is providing solutions to long-standing business challenges for healthcare and life sciences companies around the world. As you will read in this report, healthcare and life sciences companies are leveraging big data to transform their processes, their organizations and, soon, their industries.

Our newest global research study, "Analytics: The real world use of big data," finds that healthcare and life sciences executives are recognizing the opportunities associated with big data.[1] But despite what seems like unrelenting media attention, it can be hard to find in-depth information on what healthcare and life sciences organizations are really doing. In this industry-specific paper, we will examine how healthcare and life sciences industry respondents view big data – and to what extent they are currently using it to benefit their businesses. The IBM Institute for Business Value partnered with the Saïd Business School at the University of Oxford to conduct the 2012 Big Data @ Work Study, surveying 1,144 business and IT professionals in 95 countries, including 67 respondents from the healthcare and life sciences industries, or about 6 percent of the global respondent pool.

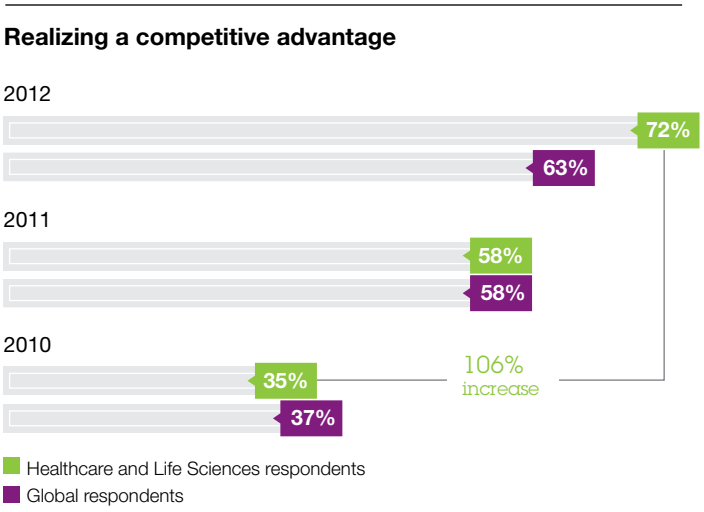
Big data presents both challenges and opportunities for healthcare and life sciences companies. Today, the healthcare industry is focused on outcomes; yet, the future is unclear as regulations change throughout the world, government participation shifts, and the habits and demands of the healthcare consumer continue to evolve. The demographics of the healthcare consumer are changing; it is estimated that by 2017, the number of adults aged 60 and older will outnumber children under the age of 5.[2] Healthcare providers are looking for improvements in care as they seek to encourage consumers to live healthier and to avoid ultra-costly acute interventions. New medical technologies and treatments, new healthcare business models and an overall industry restructuring are poised to help populations grow healthier. For health plans, provider networks and patients, data continues to drive increasingly complex yet vital payment networks. Healthcare data – be it for new treatments, smarter payments or more effective resource management – will be central to the future of healthcare.

For life sciences companies, data drives the research and development function as well as other critical areas such as finance, marketing and risk management. The drive for optimized processes in life sciences is clear: A new, successful drug may cost US$1.9 billion or more to develop; globalization of drug distribution brings with it new regulation and higher scrutiny of safety, comparative effectiveness, ethics and quality.[3] Data will also play a critical role in the life sciences industry's future as it seeks to improve clinical development processes; act on insights from patients, payers and providers to drive growth; and enhance relationships across the entire life sciences and healthcare ecosystem.

So the question for many of these companies remains: How do they harvest and leverage this information to gain a competitive advantage?

We found that 72 percent of healthcare and life sciences companies report that the use of information (including big data) and analytics is creating a competitive advantage for their organizations, compared with 63 percent of cross-industry respondents (see Figure 1). For healthcare and life sciences, the percentage of respondents reporting a competitive advantage rose from 35 percent in 2010 to 72 percent in 2012, a more than 100 percent increase in two years.[4]

Our study found that healthcare and life sciences companies are taking a business-driven and pragmatic approach to big data. The most effective big data strategies identify business requirements first, and then tailor the infrastructure, data sources and analytics to support the business opportunity. These organizations extract new insights from existing and newly available internal sources of information, define a big data technology strategy and then incrementally extend the sources of data and infrastructures over time.



Source: "Analytics: The real-world use of big data," a collaborative research study by the IBM Institute for Business Value and the Saïd Business School at the University of Oxford. © IBM 2012

Figure 1: **Healthcare and life sciences companies are outpacing their cross-industry peers in their ability to create a competitive advantage from information and analytics.**

Organizations are being practical about big data

Our Big Data @ Work survey confirms that most organizations are currently in the early stages of big data planning and development efforts, with healthcare and life sciences companies generally similar to – and perhaps a touch ahead of – our global pool of cross-industry counterparts. While a lower percentage of healthcare and life sciences companies are focused on understanding the concepts (20 percent of healthcare and life sciences companies respondents compared with 24 percent of global organizations), the majority are either defining a roadmap related to big data (50 percent of healthcare and life sciences companies, slightly more than the cross-industry pool responses of 47 percent), or have big data pilots and implementations already underway (30 percent of healthcare and life sciences companies compared to 28 percent of large organizations). (See Figure 2.)

Big data activities

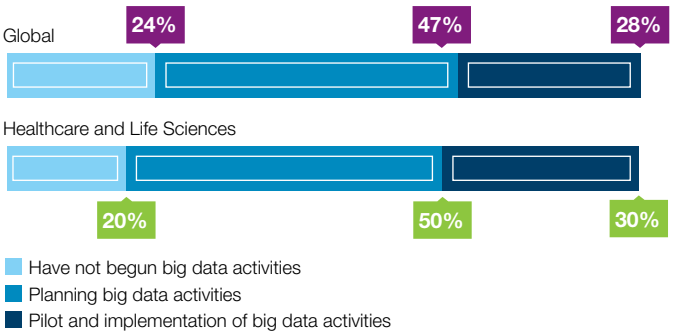


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Figure 2: **Four out of five healthcare and life science companies have either started developing a big data strategy or implementing big data activities, outpacing their cross-industry peers.**

In our global study, we identified five key findings that reflect how organizations are approaching big data. For a more in-depth discussion of each of these findings, please refer to the full study, "Analytics: The real-world use of big data."[5] In this industry analysis, we will examine the maturity of healthcare and life sciences organizations with respect to these key findings, as well as reveal our top-level recommendations directed at the needs of healthcare and life sciences market companies.

1. Customer (consumer, patient, member) analytics are driving big data initiatives

When asked to rank their top three objectives for big data, just under half of the healthcare and life sciences industry respondents with active big data efforts identified customer-centric objectives as their organization's top priority (see Figure 3). This is consistent with what we see in the marketplace, where healthcare and life sciences companies strive to be more customer centric by considering the customer as the central organizing principle, around which data insights, operations, technology and systems revolve. By improving their ability to understand customers' health, financial and treatment needs, healthcare and life sciences organizations are better positioned to deliver new customer-centric services, products and experiences that help them quickly seize market opportunities with more predictable costs.

Big data objectives

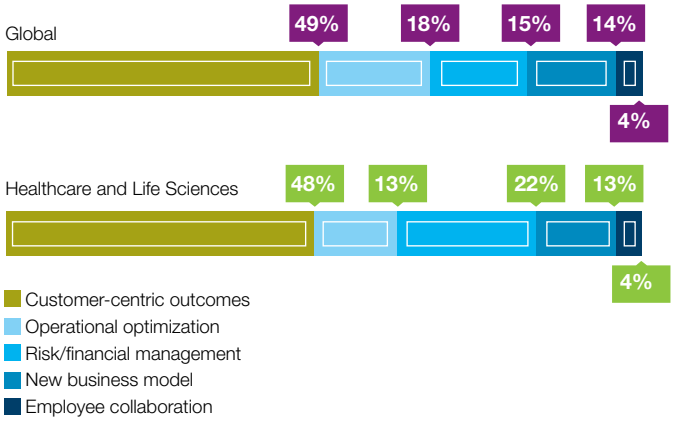

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Figure 3: **Almost half of big data efforts underway by healthcare and life sciences companies are focused on achieving customer-centric outcomes; almost a quarter are focused on risk and financial management.**

For example, a leading Chinese university hospital with top-caliber medical expertise is ambitious to serve a wider population and broader area. To meet its expansion objectives, the hospital needed to create a shared electronic health record system among community hospitals and healthcare centers throughout Beijing. It also wanted to provide more responsive, proactive care to patients with chronic conditions, hoping to improve the patients' general well–being and reduce or prevent acute attacks.

The hospital is working to implement a community-wide electronic healthcare record system based on a service-oriented architecture (SOA) and international medical information standards. The record system converts disorganized files into standardized, interoperable formats using a Clinical Data Architecture (CDA) adaptor. In addition, the system will include telemedicine functionality that leverages mobile telecommunications and real-time messaging alert services. This functionality enables continuous monitoring and real-time alert capabilities, helps mitigate worsening of patients' conditions, reduces acute attacks and improves quality of life. It's an interconnected and responsive system that creates longitudinal electronic health records, allowing personalized health assessments and treatments based on individual medical circumstances and enables the hospital to provide optimized care for its patients and to expand its reach.

Not surprisingly, "risk and financial management" was a strong second objective among healthcare and life sciences companies, with 22 percent of respondents identifying it as the top big data objective. This perhaps reflects the industries' needs to identify fraud, process payments optimally and comply with global regulations.

2. Big data requires a scalable and extensible infrastructure

The promise of achieving significant, measurable business value from big data can only be realized if organizations put into place an information foundation that supports the rapidly growing volume, variety and velocity of data. However, since infrastructure is not something most business executives know well, we asked only the IT executives and analysts to report on the state of big data infrastructure within their organizations. Among the healthcare and life sciences respondents, business-side respondents far outweighed the number of IT respondents; as such, there were too few to consider a statistically significant sample. Thus, our comments here reflect the responses from the cross-industry pool of respondents.

Among the global respondents, almost two-thirds report having started their big data journeys with an information foundation that is integrated, scalable, extensible and secure. Four information management components were cited most often as part of respondents' big data initiatives.

Integrated information is a core component of any analytics effort, and it is even more important with big data. As noted in the 2011 IBM Institute for Business Value study on advanced analytics, an organization's data has to be readily available and accessible to the people and systems that need it.[6]

Master data management and the integration of key data types – customer, product, vendor, employee and the like – require cross-enterprise data that is governed according to a single enterprise standard. The inability to connect data across organizational and department silos has been a business intelligence challenge for years. This integration is even more important, yet much more complex, with big data. Among cross-industry respondent organizations with active big data efforts, 65 percent consider their integrated information capability to be sufficient to support big data.

The next most prevalent information management foundation components in big data initiatives are a scalable storage infrastructure and high-capacity warehouse. Each supports the rapid growth of current and future data coming into the organization.

On the surface, a combination of adding storage and one or more larger servers can support the growth of an information management foundation. However, it is important to understand that anticipating and architecting the infrastructure are key to delivering the business value of the intended business case. Organizations need to consider how best to support the ebb and flow of data to enable users to access data when needed, as well as how data can be analyzed within the business's time constraints (whether days, hours, seconds or milliseconds). This balanced configuration and deployment of servers and storage results in a more optimized infrastructure.

These technologies also manage the increasing velocity of inbound – and stored – data by enabling consistent, automated data movement across the enterprise as more people require access to additional – and different – types of information. Emerging technologies such as data tiering and compression and scale-out file systems, along with in-memory databases, are enabling the management of much larger workloads than conventional warehouses. For many organizations, improving the capability to manage growing volumes is the first big data priority, followed closely by addressing the expanding variety of data.

Strong security and governance processes are in place at 58 percent of the organizations that report having active big data efforts underway. While security and governance have long been an inherent part of business intelligence, the added legal, ethical and regulatory considerations of big data introduce new risks and expand the potential for very public missteps, such as a company losing control of data or using it in questionable ways.

As a result, data security and, especially, data privacy are a critical part of information management, according to several interviewed subject matter experts and business executives. Security and governance will become even more important and daunting as organizations embrace new sources of information, especially social media data. Compounding this challenge, privacy regulations are still evolving and can vary greatly by country.

A Canadian research hospital relies on a scalable infrastructure that supports big data capabilities to better care for patients. The hospital uses a first-of-its-kind, stream-computing platform to capture and analyze real-time data from medical monitors, alerting hospital staff to potential health problems before patients manifest clinical signs of infection or other issues. Detecting medically significant events even before patients exhibit symptoms enables proactive treatment before the condition worsens, eventually increasing the success rate, potentially saving lives. The key to early detection of and quick response to subtle changes in vital statistics that may signal a life-threatening condition involves finding a way to make better use of the information produced by monitoring devices. The solution employed by the hospital uses a new information processing architecture that enables near-real-time decision support through the continuous analysis of streaming data using sophisticated, targeted algorithms, providing a flexible platform that can adapt to a wide variety of medical monitoring needs. This gives clinicians the unprecedented ability to interpret vast amounts of heterogeneous data in real time, enabling them to spot subtle trends. The hospital combines physician and nurse knowledge and experience with technology capabilities to yield more robust results than can be provided by monitoring devices alone.

3. Initial big data efforts are focused on gaining insights from existing stores of internal data

Most early big data efforts are targeted at sourcing and analyzing internal data, and we find this is also true within healthcare and life sciences companies. According to our survey, healthcare and life sciences respondents reported internal data as the primary source of big data within their organizations. This suggests that healthcare and life sciences companies are taking a pragmatic approach to adopting big data – using the new technologies and capabilities on stores of existing, somewhat familiar data – and that there is untapped value still locked away in these internal systems.

All of the healthcare and life sciences respondents are analyzing transactions (100 percent) and more than three out of four use log data (79 percent) within their active big data efforts (see Figure 4). Much of this is machine-generated data produced to record the details of every operational transaction and automated function performed within the healthcare and life sciences companies' business or information systems – data that has outgrown the ability to be stored and analyzed by many traditional systems. As a result, in many cases this data has been collected for years, but not analyzed

Unlike most of their peers in other industries, three out of four (75 percent) of healthcare and life sciences companies are analyzing audio data compared with just 38 percent of global respondents, suggesting a leadership position in this relatively new and emerging space.

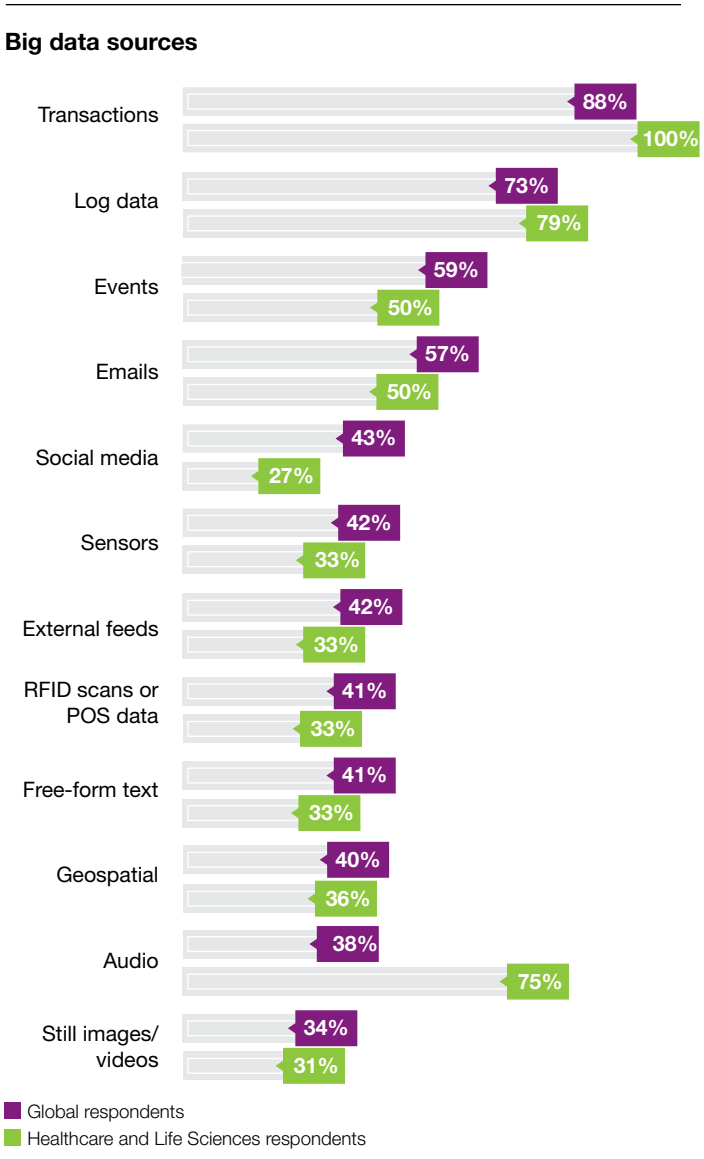

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Figure 4: **Healthcare and life sciences companies are focusing initial big data efforts on transactional, log data and audio recordings, all key internal sources of information.**

4. Big data requires strong analytics capabilities

Big data itself does not create value until it is put to use to solve important business challenges. This requires access to more and different kinds of data, as well as strong analytics capabilities that include both software tools and the requisite skills to use them.

Examining those healthcare and life sciences companies engaged in big data activities reveals that they start with a strong core of analytics capabilities designed to address structured data such as basic queries, data visualization and data mining – all categories where healthcare and life sciences companies responded higher than the cross-industry pool of respondents (see Figure 5). Healthcare and life sciences generally responded similarly to other industries regarding their adoption of technologies such as simulation (50 percent), natural language text (45 percent), geospatial analytics (50 percent), streaming analytics (29 percent), video analytics (36 percent) and voice analytics (25 percent).

A national marine institute relies on big data and analytics to gain more leverage – and insights – from environmental information. The institute uses near-real-time data to promote business, research and public safety, nurturing its emerging "blue economy" by listening to sensors in the sea. Previously, the institute collected environmental data from six buoys in a local bay and stored it in a local database. Compiling this data to perform any trend analyses or draw conclusions, however, was particularly complicated and outside parties struggled to view it.

To make better use of the environmental data it collected, the institute deployed a number of new sensor platforms throughout the bay to gather and distribute – in near real time – data regarding environment conditions, pollution levels and marine life. The new sensors allow users to access

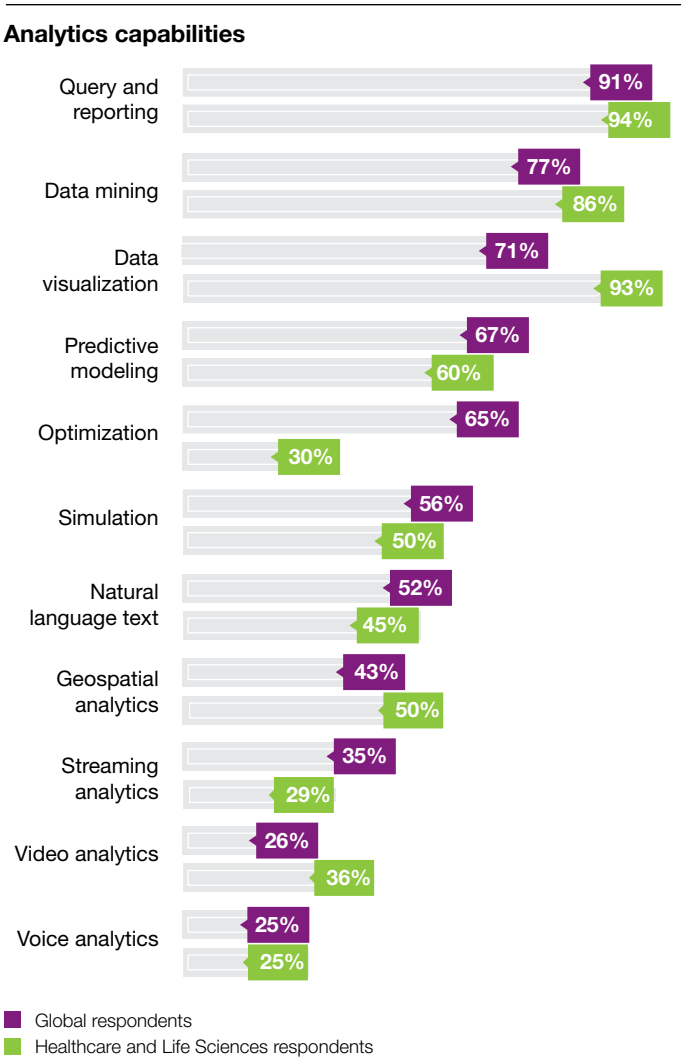

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Figure 5: **Healthcare and life sciences organizations have a strong base of analytics capabilities, which were built to support robust business intelligence platforms.**

this compiled data via customizable portals that support various trending and modeling efforts. And users can even set alarms to notify them when certain conditions arise, such as a potential flood or sudden increase in pollution.

These capabilities increase the accuracy of flood predictions and support automated alarm systems, improving public safety. The new system has economic benefits as well, fostering new businesses and overall growth by providing seafood, shipping and monitoring operations with streaming maritime data. It also provides researchers across the globe with straightforward access to real-world data, encouraging advances in various fields (e.g., wave energy).

5. The current pattern of big data adoption highlights healthcare and life sciences companies' hesitation, but confirms interest too

To better understand the big data landscape, we asked respondents to describe the level of big data activities in their organizations today. The results suggest four main stages of big data adoption and progression along a continuum that we have identified as Educate, Explore, Engage and Execute. For a deeper understanding of each adoption stage, please refer to the global version of this study.[7] Healthcare and life sciences companies were generally consistent with the global respondents (see Figure 6).

Big data adoption

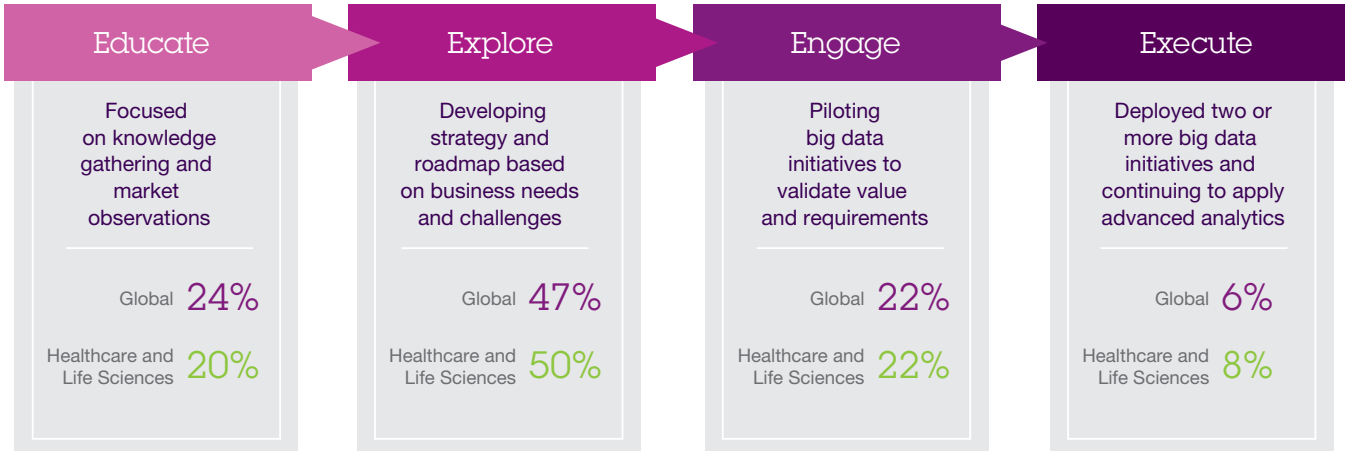

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Figure 6: **Most healthcare and life sciences companies are developing either big data strategies or pilots, but almost one in 10 have moved to embedding those analytics into operational processes.**

- **Educate** - Building a base of knowledge: 20 percent of healthcare and life sciences respondents
- **Explore** - Defining the business case and roadmap: 50 percent of healthcare and life sciences respondents
- **Engage** - Embracing big data: 22 percent of healthcare and life sciences respondents
- **Execute** - Implementing big data at scale: 8 percent of healthcare and life sciences respondents

At each adoption stage, the most significant obstacle to big data efforts reported by healthcare and life sciences firms is the need and ability to articulate measurable business value. For executives to embrace the investment in time, money and human resources necessary to create business value from big data, they must understand the potential or realized business value. Organizations must be vigilant in articulating this value, forecasted based on detailed analysis when needed and tied to pilot results where possible.

Recommendations: Cultivating big data adoption

IBM analysis of our Big Data @ Work Study findings provided new insights into how healthcare and life sciences companies at each stage are advancing their big data efforts. Driven by the need to solve business challenges, in light of both advancing technologies and the changing nature of data, healthcare and life sciences companies are starting to look closer at big data's potential benefits. To extract more value from big data, we offer a broad set of recommendations tailored to healthcare and life sciences organizations as they proceed down the path of big data.

Commit initial efforts to customer-centric outcomes

It is imperative that organizations focus big data initiatives on areas that can provide the most value to the business. For most healthcare and life sciences companies, this will mean beginning with customer analytics that enable better, more finely tailored products for customers (including patients, members and providers in many instances) based on increased insights regarding their needs and future behaviors. Healthcare and life sciences organizations use these insights to generate enhanced services, drive research and development, improve brand performance, drive customer loyalty, adjust pricing, improve patient outcomes and enhance customer satisfaction.

To effectively cultivate meaningful relationships with their customers and payers within the healthcare ecosystem, healthcare and life sciences companies must connect with them in ways their customers and partners perceive as valuable. The value may come through more proactive outreach and more timely, informed or relevant interactions; it may also come as organizations improve the underlying operations in ways that enhance the overall experience of those interactions.

Healthcare and life sciences companies should identify the processes that most directly affect customers, pick one and start; even small improvements matter as they often provide the proof points that demonstrate the value of big data and the incentive to do more. Analytics fuels the insights from big data that are becoming essential to creating the level of depth in relationships that customers expect.

Define a big data strategy with a business-centric blueprint

A blueprint encompasses the vision, strategy and requirements for big data within an organization and is critical to establishing alignment between the needs of business users and the implementation roadmap of IT. A blueprint defines what organizations want to achieve with big data to ensure pragmatic acquisition and use of resources.

An effective blueprint defines the scope of big data within the organization by identifying the key business challenges to which it will be applied; the sequence in which those challenges will be addressed; the business process requirements that define how big data will be used; and the architecture, which includes the data, tools and hardware needed to achieve it. It serves as the basis for developing a roadmap – with a keen eye on dependencies – to guide the organization through a practical approach to develop and implement its big data solutions in ways that create sustainable business value.

Start with existing data to achieve near-term results

To achieve near-term results while building the momentum and expertise to sustain a big data program, it is critical that healthcare and life sciences companies take a pragmatic approach. As our respondents confirmed, the most logical and cost-effective place to start looking for new insights is within the organization's existing data store, leveraging the skills and tools most often already available.

Looking internally first allows organizations to leverage their existing data, software and skills and to deliver near-term business value and gain important experience as they then consider extending existing capabilities to address more complex sources and types of data. While most organizations will need to make investments that allow them to handle either larger volumes of data or a greater variety of sources, this pragmatic approach can help reduce investments and shorten the timeframes needed to extract the value trapped inside these untapped sources. It can help accelerate the speed to value and enable organizations to take advantage of the information stored in existing repositories while infrastructure implementations are underway. Then, as new technologies become available, big data initiatives can be expanded to include greater volumes and variety of data

Build analytics capabilities based on business priorities

The unique priorities of each company should drive the organization's development of big data capabilities, especially given the margins and specific production and distribution challenges that most healthcare and life sciences firms face today. The upside is that many big data efforts can concurrently help reduce costs and increase revenues, a duality that can bolster the business case and offset necessary investments.

For example, healthcare organizations are using big data to understand the effects of specific health outcomes across broad populations, enabling them to proactively reach out to improve member behavior with the strategy of preventing more expensive acute interventions, such as treating heart attacks and strokes. Others are using predictive analytics to identify fraudulent claims in their financial processing. Life sciences companies are using data analytics to model and predict how various proteins can be folded and formed without using a physical bioreactor, enabling them to follow more reliable leads when it comes to researching and developing new pharmaceuticals.

Healthcare and life sciences companies should focus on acquiring the specific skills needed within their organization, especially those that will increase the organization's ability to analyze unstructured data and visualize its analysis to make it more consumable to business executives.

Create a business case based on measurable outcomes

To develop a comprehensive and viable big data strategy and the subsequent roadmap requires a solid, quantifiable business case. Therefore, it is important to have the active involvement and sponsorship from one or more business executives throughout this process. Equally important to achieving long-term success is strong, ongoing business and IT collaboration. The business case must go beyond the costs of analytics projects and systems; justification should be based on business outcomes such as reducing costs of care or quickening drug development speed-to-market.

Getting on track with the big data evolution

An important principle underlies each of these recommendations: Business and IT professionals must work together throughout the big data journey. The most effective big data solutions identify the business requirements first, and then tailor the infrastructure, data sources, processes and skills to support that business opportunity.

To compete in a consumer-empowered economy, it is increasingly clear that healthcare and life sciences companies must leverage their information assets to gain a comprehensive understanding of markets, customers, products, distribution channels, competitors, employees and more. Healthcare and life sciences companies will realize value by effectively managing and analyzing the rapidly increasing volume, velocity and variety of new and existing data, and putting the right skills and tools in place to better understand their operations, customers, providers and the healthcare ecosystem as a whole.

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