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Fade or flourish?

Rethinking the role of life sciences companies in the healthcare ecosystem

IBM Institute for Business Value

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The life sciences industry stands at a crossroads. Its business model is broken, and the surrounding healthcare ecosystem is changing dramatically. So how should companies respond? They can carry on as normal and potentially fade into insignificance or completely rethink how they engage with the other stakeholders in the healthcare ecosystem in an effort to flourish anew. In today's increasingly complex and fast-changing environment, business model innovation is critical to success. Yet few understand when to make a change or – more important – how to execute one.

Introduction

The challenges facing the life sciences industry are well documented. The industry's scientific and commercial productivity has declined, the blockbusters on which it has long relied for much of its financial prosperity have come off patent, sales forces are shrinking as physician access is restricted, and payers are increasing price pressures.[1] Economic, social and technological forces are simultaneously reshaping the world in which the industry operates.

Though the warning lights started flashing a decade ago, most executives have been engaged in solving immediate problems and, thus, less focused on the underlying causes.[2] The industry as a whole has generally resisted developing new business models and still relies on its traditional model of launching new blockbuster medicines or selling lots of generics. It has made little progress in improving the safety profile of existing therapies, determining which therapies work for which patients or reducing the number of adverse events. There have been no significant collaborations to share safety, toxicity and clinical data on a consistent basis. Effective patient adherence programs remain a largely theoretical concept. And while the industry remains data rich, it is weaker when it comes to turning data into insights.

The industry now faces a "moment of truth" similar to the one our own company experienced in the early 1990s (see sidebar: IBM's moment of truth). It can stick to its current course: consolidating, cutting costs, tinkering with adjacent market spaces, reorganizing the existing sales force and investing ever more money in searching for new medicines in crowded therapeutic areas. Or it can completely rethink how it engages with the healthcare ecosystem – i.e., all the entities, be they individuals, governments, healthcare providers, insurers or other life sciences companies, that help keep people healthy.

IBM's moment of truth

IBM faced a "moment of truth" in the early 1990s. Our traditional product-based business model was no longer working. In 1993, IBM posted what at the time was the biggest loss in the history of corporate America: US$8 billion. It had missed a number of key technology shifts and had become insular and marginalized in a changing technology landscape. IBM faced potential breakup or bankruptcy or both.

Choices had to be made, and those choices had implications. IBM's leadership chose to expand the traditional product-based model to include services and solutions. To do so, the company needed to transform the way that it conducted research, developed products, marketed and sold new offerings, acquired and developed talent, and operated in a global economy. As a result, IBM divested much of what we thought of as "core" when the company was first born.

IBM is now in its centennial year and, as it enters its second century, it is a vastly different company today than when the new path was chosen. While the company continues to transform today, the choices it made and the changes required to execute them have allowed IBM to flourish. This it has done at a time when the global technology industry has experienced an unprecedented revolution. Companies and technologies that did not exist when IBM began its transformation are major players and competitors.[3]

Those executives who choose the first course face the very real possibility of their companies fading into irrelevance or disappearing altogether. Those that choose the later will likely see their companies flourish and potentially be very different entities than they are today. They will join in setting the agenda, enhancing healthcare and radically redefining the industry (see Figure 1).

Challenges

- Declining R&D productivity
- The patent cliff
- Pricing pressures
- Compliance and drug safety regulations
- Reduction in commercial productivity

Changes

- Soaring healthcare costs
- Shift in funding mix
- New health information systems
- New care delivery models
- Greater scrutiny of outcomes
- New entrants from other sectors

Choices

Past and present – To fade or standstill
- Continue to consolidate
- Focus on crowded therapeutic areas and move into generics
- Expand in emerging markets
- Cut costs

Future – To flourish
- Rethink role in healthcare ecosystem
- Redefine your business
- Change global innovation model
- Take advantage of growth in emerging markets

Source: IBM Institute for Business Value analysis.

Figure 1: **The life sciences industry faces three big Cs.**

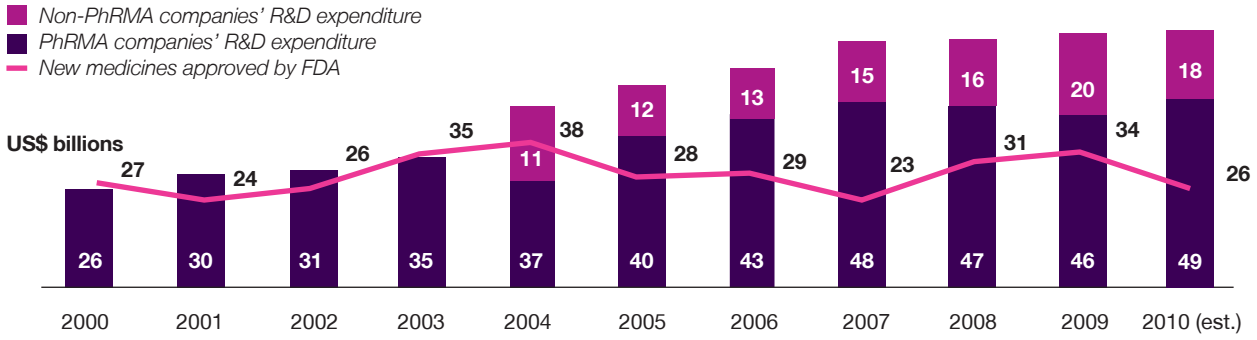
In the following pages, we will document the challenges facing the industry and provide data to support their real and acute nature for readers across the entire healthcare ecosystem. We will then focus in on the choices available to you – the global life sciences executive – and the implications of those choices to your company and the industry.

In this "moment of truth," what will you as a leader of the industry choose for your company? How will you transform in a rapidly changing environment? What is your "core"? Winners and losers will be chosen based on your actions. Will you fade or flourish?

Challenges galore

The deficit of breakthrough medicines

The pharmaceutical industry's problems with declining R&D productivity have been exhaustively documented. Between 2000 and 2010 industry spending on biopharmaceutical R&D more than doubled in North America alone.[4] But, as Figure 2 shows, there has been no corresponding increase in the number of new therapies reaching the market. Quite the reverse has happened: Phase III attrition rates more than doubled from 2004-2006 to 2007-2009.[5]



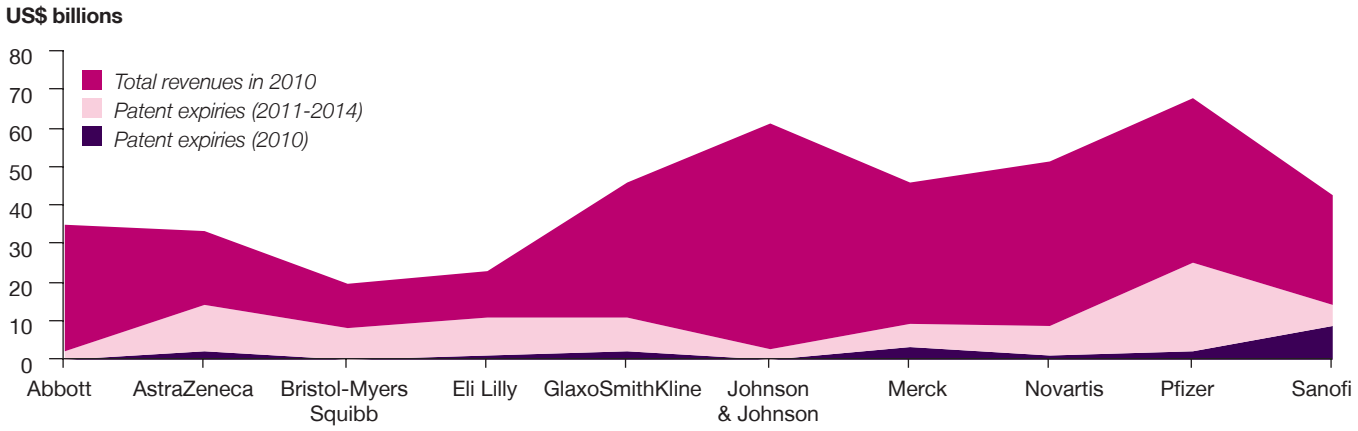
Sources: "Biotech 2008: A 20/20 vision to 2020." Burrill & Company. September 2008; "Cumulative Approvals for Medicines: 1990-2009." Innovation.org Web site; "Pharmaceutical Industry Profile 2011." Pharmaceutical Research and Manufacturers of America. April 2011. http://www.phrma.org/sites/default/files/159/phrma_profile_2011_final.pdf
Note: New medicines include those medicines approved by the Center for Drug Evaluation and Research (CDER) and Center for Biologics Evaluation and Research (CBER).

Figure 2: **R&D productivity has plummeted.**

It's not just the established pharmaceutical industry (pharma) companies that are struggling to develop safe, effective new medicines. The biotech sector is facing an equally uphill battle. In one recent analysis of 6,000 biotech projects available for late-stage licensing, fewer than 100 candidates showed potential to become best-sellers – and, even then, the aggregate revenues they were expected to generate were only about US$30 billion, barely three times the amount generated by Lipitor alone in its heyday.[6]

The patent cliff

The "patent cliff" is simultaneously wreaking havoc on pharma's revenues, with an estimated US$250 billion in sales at risk between 2011 and 2015.[7] The industry leaders are especially exposed. In 2010, they saw nine products collectively worth US$20.5 billion a year come off patent. The rights on another 31 treatments with annual sales of US$86.5 billion are slated to expire over the next four years, jeopardizing a full third of their current revenues (see Figure 3).[8]



Sources: Thomson Reuters; Company financial statements; IBM Institute for Business Value analysis. March 2011.

Figure 3: **Patent expiries are punching a big hole in pharma's revenues.**

Predictably, perhaps, the share prices of the companies with large market capitalization have been hit hard.[9] But there have been other ramifications as well. In 2009, numerous pharmaceutical companies made the choice to reduce their expenditures on R&D for the first time in history. And though R&D spending is projected to pick up again, the growth rate is expected to be just 2.3 percent, barely a third of the pace at which it was rising before.[10]

Pricing pressures

Healthcare payers everywhere are also trying to curb the amount of money they spend on medicines. Most mature economies already operate price controls of one kind or another (see Table 1). But some of them are exerting further pressure, as rising healthcare costs and large public sector deficits take their toll. In November 2010, for example, Germany passed a law limiting the amount companies can charge for new prescription drugs.[11]

Country	Free pricing	Direct price controls			Indirect price controls					
		International price comparisons	Price ceilings	Cost-benefit analyses	Reference pricing	Profit controls	Co-payments	Price-volume agreements	Negative lists	Positive lists
France		✓	✓	✓	✓		✓	✓		✓
Germany				✓	✓		✓		✓	
Italy		✓	✓	✓	✓		✓	✓		✓
Spain		✓	✓	✓	✓		✓	✓	✓	✓
United Kingdom	✓			✓		✓	✓		✓	
United States	✓					✓	✓	✓		✓
Canada		✓	✓	✓	✓		✓			✓
Japan		✓	✓				✓			✓

Source: "Pharma 2020: Taxing times ahead." PricewaterhouseCoopers. 2009.
Note: Updated to include changes in Germany, IBM Institute for Business Value, March 2011.

Table 1: **Healthcare payers in the mature economies are reining in the prices of medicines.**

Even the United States – a bastion of free-market enterprise – has been reining in prices. The Affordable Care Act of 2010 raised the minimum rebate on medicines for Medicaid beneficiaries, as well as increased the number of people who qualify for such rebates. It also mandated a 50 percent discount on the prices of branded treatments for patients in the Medicare "donut hole" and introduced an annual levy for brand-name manufacturers and importers based on market share. These measures are expected to save the U.S. healthcare system about US$98 billion between 2010 and 2019.[12]

Tougher rules and tighter regulation

Meanwhile, the regulations governing the development and manufacturing of medicines are getting more onerous. Both the European Medicines Agency (EMA) and the U.S. Food and Drug Administration (FDA) now place much more emphasis on risk management, for example.[13] The FDA is also developing an active surveillance system to monitor the safety of all approved medicines. The Sentinel System will collate healthcare data from multiple sources on a real-time basis and analyze it with powerful analytics, enabling the FDA to identify and evaluate safety issues very rapidly and to assess adverse events that don't get reported through its passive reporting systems (e.g., heart attacks and fractures).[14] Ultimately, the system will also be used to perform comparative effectiveness studies.[15] However, many health authorities are already demanding evidence of comparative effectiveness – and conducting additional studies is very expensive.

Life sciences companies face increasing rules and regulations relating not only to development and manufacturing, but also their promotional activities.

Global harmonization of the regulatory requirements will compound these pressures. The International Conference on Harmonisation of Technical Requirements for Registration of Pharmaceuticals for Human Use deserves much of the credit for developing the common technical document and various quality guidelines.[16] But harmonization is a double-edged sword. Although it simplifies the process of testing and reporting and reduces duplication, it also means therapies that get spiked in one jurisdiction are more likely to get spiked in others, too. In September 2010, for example, the EMA banned one product, while the FDA imposed strict curbs on its use – and the two agencies not only compared notes, they synchronized the timing of their announcements.[17]

The slump in commercial productivity

The commercial model the industry has used for the past 50 years is facing a number of hurdles. It relies almost solely on face-to-face selling; it requires that a sales representative "intrude" on the healthcare professional; it's based on "push" marketing; and it's expensive. In the United States, for example, it costs about US$150,000 a year to employ a primary care sales representative and US$330,000 a year to employ a specialty sales representative.[18]

Even so, the model had been very effective when there was a clinical story to tell. But the stream of blockbusters has now dried up, and too many sales reps are competing for limited airtime using an outdated face-to-face model. More than 20 percent of U.S. physicians won't let any sales reps cross the threshold.[19] And those who still take sales calls typically limit them to less than three minutes.[20] The situation is similar in the United Kingdom and other developed countries.[21]

Most life sciences companies have therefore started exploring the potential of the Internet. But many still see it as an "alternative" channel and continue to rely on push marketing rather than creating a continuous dialogue with their customers about the issues those customers want to discuss. The content on hundreds of disconnected Web sites is sometimes static, outdated and unidirectional. Used in this fashion, the Web is not a particularly effective communication vehicle.

Big Pharma's promotional practices are concurrently coming under closer scrutiny. In March 2010, the U.S. government passed the Physician Payment Sunshine Act, which requires pharmaceuticals and medical device manufacturers to begin reporting any gifts or payments to physicians that are worth over US$10, with effect from January 2012. The data will be made public in a searchable online database from September 2013.[22] Meanwhile, various European trade bodies have established codes of practice regarding gifts to healthcare professionals, and members of the European Federation of Pharmaceutical Industries and Associations agreed to introduce strict limits on sampling.[23]

In the emerging markets, by contrast, sales reps still play an important role – and Big Pharma has been ramping up its presence. Witness the fact that Eli Lilly has doubled its Chinese sales force over the past five years; GlaxoSmithKline has increased the number of reps it employs in growth economies from about 8,500 to 13,000; and Sanofi expects its emerging-markets sales force to expand by 40 percent from 2009 and 2011.[24]

However, the growth countries are likely to adopt the same sort of controls the mature markets have implemented. Indeed, the Medical Council of India has already introduced a new rule banning physicians who accept costly gifts from pharma companies from practicing for up to a year.[25] So the industry's commercial model will soon come under pressure there, too.

In short, pharma can't rely on its products or its pipeline to save it. It can't promote its way out of the problems it faces. And, in general, it can't expect much sympathy from physicians, patients or the public at large.

Changes on every front

An over-stretched healthcare ecosystem

As if there weren't already enough issues to contend with, the healthcare ecosystem in which the industry operates is changing dramatically. Healthcare costs are soaring (see sidebar: Crunch time).[26] The level of complexity is rising, with more complex pricing, reimbursement and payment mechanisms and more complex regulations. Moreover, patients and consumers in general are becoming more demanding. They want more for their money – more and better care, delivered in more convenient settings, as well as medicines that work for them.

Crunch time

Various factors are driving up healthcare costs:

Demographic shifts – The global population is aging and getting fatter. By 2015, 12.3 percent of the populace will be 60 or older.[27] And the World Health Organization (WHO) estimates that more than 20 percent will be overweight.[28] Both these trends will increase the need for medical care.

The changing nature of disease – Chronic diseases now account for 60 percent of the 58 million deaths that occur each year, but the global incidence of chronic disease is predicted to rise by 17 percent over the next decade alone.[29] Infectious diseases are likewise pushing up healthcare costs. Some diseases have become drug-resistant (e.g., tuberculosis), while others can only be held in check (e.g., acquired immune deficiency syndrome – or AIDS). New infectious diseases are also emerging (e.g., severe acute respiratory syndrome – or SARS), and old ones are resurfacing (e.g., polio).

New technologies and treatments – Genomics, regenerative medicine and other such advances should help improve the quality of healthcare dramatically during the next 20 to 30 years, but they will also likely drive up costs. Targeted treatments for patients with specific disease subtypes are expensive, because the patient base is relatively small and some of these medicines extend life, turning acute diseases into chronic conditions.

The changing funding mix

Many governments have responded by introducing measures to curb spiraling costs while improving access to care. These initiatives have one common feature; they are shifting the funding mix.

Governments in countries with socialized systems are transferring a bigger share of the bill to individual citizens. In 2008, for example, the British government gave cancer patients permission to buy "top-up" medicines privately, without losing their right to free care under the National Health Service (NHS).[30] And in late 2010, the German government passed a law increasing premiums for the country's 72 million people with state health insurance.[31]

Conversely, governments in countries with market-based systems are digging into the public coffers. The United States is one such instance; the Affordable Care Act aims to expand insurance coverage and provide cheaper medications for the poor and elderly.[32] Many of the growth economies are also investing more heavily in healthcare and implementing major reforms (see Table 2).[33]

Struggling to curtail rising healthcare costs and increase access to care, many governments are slowly adopting more blended funding models.

Growth economy investment	
China	Has launched a US$125-billion program to extend access to health insurance to over 90 percent of the population.
Brazil	Healthcare spending (public and private) in Brazil as a percentage of GDP at 8.4 percent compares favorably with that in other Latin American countries; yet, healthcare indicators show that it is not garnering the necessary results.
India	Has invested about Rs 53,000 crore (US$11.67 billion) in provision of healthcare for the rural population and is now reported to be considering an extension of the scheme.
Mexico	Has almost finished enrolling the country's 51 million people in a national health insurance plan, although the quality of the care that's available is still uneven.
Russia	Recently pledged to spend 300 billion rubles (US$10 billion) modernizing its ill-equipped healthcare system and improving public access.
Turkey	Has extended the national health insurance scheme to cover 80-90 percent of the population.

Sources: See References, number 33.

Table 2: **The growth economies are investing more in healthcare.**

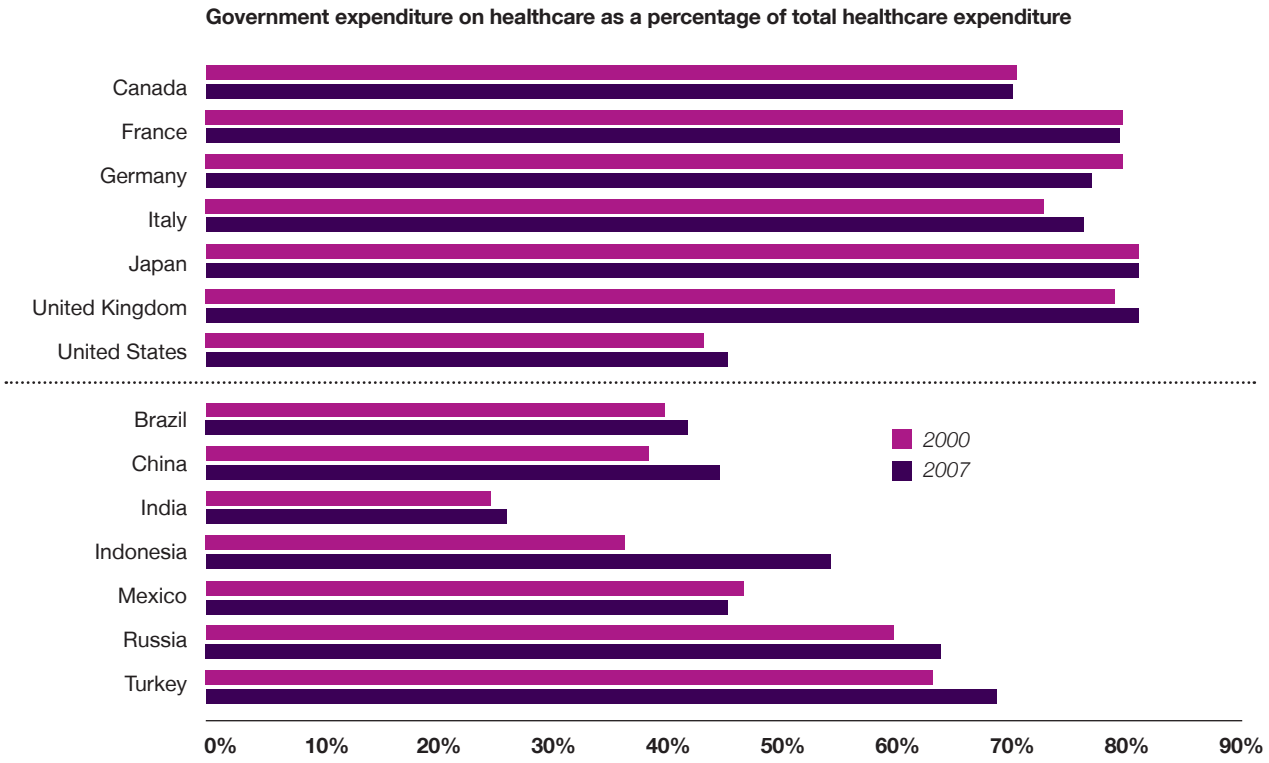
The net effect? People in the United States and emerging countries still pay more out of pocket for their personal healthcare costs than people in Canada and Western Europe.[34] But governments everywhere are slowly adopting more blended funding models, as they search for a sustainable economic balance (see Figure 4).

The spread of health information systems

Many governments and healthcare providers are also investing in electronic medical record (EMR) systems. Denmark has already made considerable headway. Nearly all primary care physicians and half of all hospitals in the country use electronic records, a move that is thought to have saved the Danish healthcare system up to US$120 million a year.[35]

The United Kingdom is currently building a national EMR system, while the U.S. government is promoting the construction of a national health information network with a number of measures, including grants for setting up health information exchanges.[36] But such initiatives aren't confined to the West. In 2007, South Korea launched a US$46 million National Healthcare Information Infrastructure Plan that includes the development of an EMR system. Singapore is also creating a countrywide EMR system and, in 2009, the Chinese government planned to do likewise, with the allocation of US$1.8 billion specifically for health IT.[37]

These systems will help healthcare payers and providers better share data, coordinate the treatment of patients and conduct longitudinal studies to identify how genetic variations, differences in treatment and the like have a bearing on disease.



Source: "World Health Statistics 2010." World Health Organization. 2010.

Figure 4: **The public/private funding mix is gradually changing.**

Several leading research centers are already using EMRs to perform such studies. For example, the Mayo Clinic is trawling over 8 million records to pinpoint the polymorphisms that make certain people more susceptible to peripheral artery disease.[38] And the Karolinska Institute headed an international project that has just unearthed 29 genetic variants associated with ulcerative colitis.[39]

New care delivery models

While governments focus on improving access to healthcare and the underlying technological infrastructure, the medical community has been pioneering new modes of delivery based on the continuous management of disease rather than expensive episodic care. As one instance, U.S. doctors are piloting the concept of the patient-centered medical home.

The core features of this model include a long-term relationship between the patient and a primary-care physician; the provision of proactive, integrated care via a team of healthcare professionals whose activities the physician orchestrates; multiple channels of communication (i.e., not just office visits); and payment based on outcomes instead of volume throughput.[40]

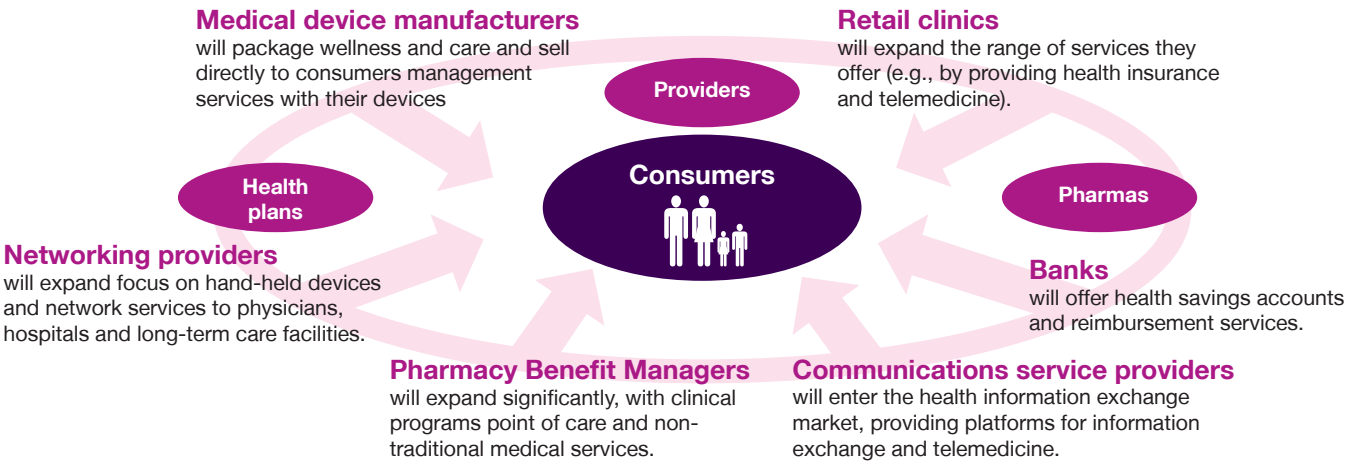
Greater scrutiny of outcomes

Many countries are also setting up agencies specifically to scrutinize outcomes. England and Wales were among the first to do so, with the establishment of the National Institute for Health and Clinical Excellence.[41] The United States recently followed suit, with the creation of the Patient-Centered Outcomes Research Institute to spearhead the collection of comparative effectiveness data.[42] And there are numerous other such organizations, including the Australian Pharmaceutical Benefits Advisory Committee, Finnish Office for Health Care Technology Assessment and New Zealand Pharmaceutical Management Agency.[43]

New players entering the field

Lastly, new entities – many of them from industries that haven't previously played a role in healthcare – are entering the healthcare ecosystem (see Figure 5). Some of these organizations, like 23andMe and BGI (formerly the Beijing Genomics Institute), could revolutionize the way in which diseases are identified and treated, providing opportunities to introduce wellness and health lifecycle management services.

Others are changing the way in which value is created by interacting via new, multi-nodal business models. Dossia, a not-for-profit consortium of top U.S. companies, is one such case. It aims to help employees make smarter decisions about their healthcare by using its collective influence to give them better access to health information and providing an electronic health record service where they can collate medical data from multiple sources, create their own records and share the information with selected healthcare providers.[44]



Source: IBM Institute for Business Value analysis.

Figure 5: **New entrants will transform the health ecosystem.**

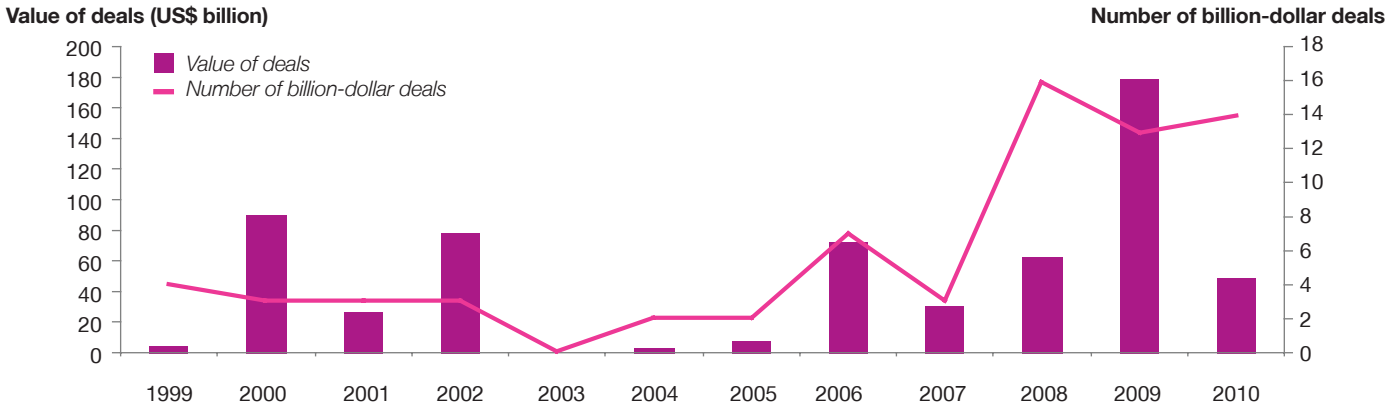
Choices past and present

So how has the life sciences industry responded to the challenges it faces and the transformation of the ecosystem in which it operates? It has been consolidating, repositioning itself both therapeutically and geographically, and cutting costs. However, not all these measures have proven successful.

The craze for consolidation

Between 1999 and 2010, 70 life sciences industry mergers and acquisitions (M&As) with a value of over US$1 billion apiece took place. A staggering US$607 billion changed hands, as 108 companies shrank to just 35 (see Figure 6).[45] There appear to be four main reasons for this deal making: to replenish empty pipelines, secure economies of scale, increase sales or pursue new opportunities. But what actually happened?

Sadly, there has been no big surge in scientific *or* commercial productivity. On the contrary, one recent study shows that 50 percent of mergers and 70 percent of acquisitions involving large companies have *reduced* the output of new molecular entities.[46] Restructuring costs have also eroded many of the savings on which the biggest deals were posted.[47] Nearly every mega-merger has delivered relatively flat sales growth, once the initial synergies have been realized.[48] So M&As, thus far, haven't been a panacea for Big Pharma's woes.



Sources: Capital IQ database. 2011; Company financial statements and IBM Institute for Business Value analysis.

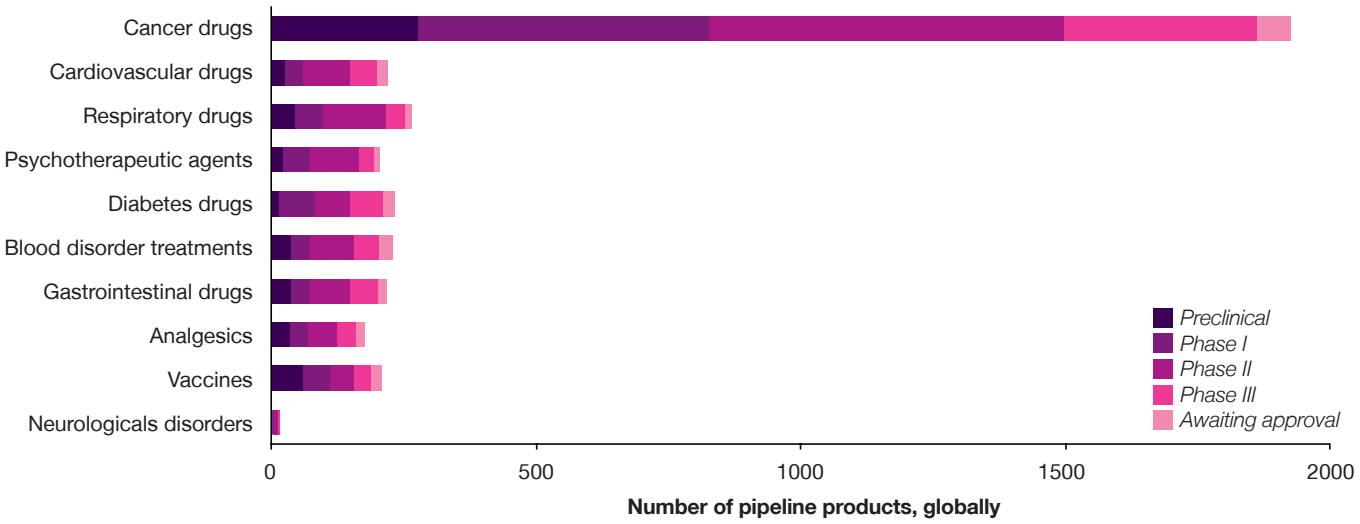
Figure 6: **M&As have rewritten the life sciences landscape.**

Eyes on the same therapeutic prize

Many pharma firms have also responded by investing more heavily in treatments for cancer and rare diseases. There are now over 1,900 cancer medicines in the pipeline (see Figure 7).[49] And in 2006-2008, Big Pharma produced over half the orphan drugs approved by the FDA – up from a third in 2000-2002.[50]

But this intense concentration on a few therapeutic areas presages other problems. In 2008, only 12.7 million people around the globe were diagnosed with cancer, for example.[51] So, if all the oncology treatments in earlier stages of development were to reach Phase III, the number of patients required to test them (at about 5,000 per trial) would account for 59 percent of the total market. There simply aren't enough patients to go round!

Moreover, therapies for very small patient populations cannot deliver the returns produced by mass-market medicines, unless they are sold for very high prices. And patients in many countries cannot afford such prices; indeed, even in relatively affluent markets, healthcare payers and patients are pushing back.[52]



Source: eKnowledgeBase (www.eknowledgbase.com). 2010.
Note: Numbers cover pipelines of top 50 pharma companies and top 50 biotech companies at the end of 2009.

Figure 7: **Oncology drugs account for the bulk of the industry's R&D efforts.**

Recognizing the limited commercial potential of highly specialized treatments, some traditional pharma companies have therefore hedged their bets by setting up generics subsidiaries. Novartis started this trend when it hived off its generics business to create Sandoz in 1993.[53] And many other industry giants have now followed suit (see Table 3).

Expanding into the emerging markets

However, many of these deals have served a dual purpose. Not only have they beefed up Big Pharma's generics capacity, they have also provided better access to the growth markets – whose greater affluence and changing disease patterns are rapidly rendering them more attractive.

Big Pharma	Generics Producer	Territories where products are sold	Date of deal
Abbott Laboratories	Solvay	Eastern Europe, Asia	2009
	Piramal	India	2010
	Zydus Cadila	Emerging markets	2010
AstraZeneca	Torrent	Emerging markets	2010
	Aurobindo Pharma	Emerging markets, United States, Europe	2010
Daiichi-Sankyo	Ranbaxy	Global	2008
GlaxoSmithKline	Dr Reddy's Laboratories	Africa, Middle East, Asia Pacific, Latin America	2009
	Aspen	South Africa	2010
	Phoenix	South America	2010
Novartis	Sandoz	Global	2003
	EBEWE Pharma	Global	2009
Pfizer	Greenstone	United States, Europe, Asia	2004
	Aurobindo Pharma	Emerging markets, United States, Europe	2009
	Claris Lifesciences	Latin America, Europe, Middle East, Africa, Central Asia, Asia Pacific	2009
	Strides Arolab	Europe, Canada, Australia, New Zealand, Japan, Korea	2010
Sanofi	Zentiva	Central and Eastern Europe	2008
	Medley	South America	2009
	Kendrick	Mexico	2009
	Nichi-iko	Japan	2010

Source: IBM Institute for Business Value analysis of publicly available information.
Note: The analysis includes mergers, acquisitions, licensing and other agreements.

Table 3: **Big Pharma is moving into the generics business.**

In 2008, the majority of the emerging world's inhabitants became middle class by the standards of the countries in which they live.[54] And chronic conditions are replacing the communicable diseases that once decimated these populations, boosting demand for "Western" medicines.[55] Just how much demand is rising is clear from the fact that IMS predicts sales in the 17 fastest-growing markets will increase by US$90 billion between 2009 and 2013.[56]

Taking the cleaver to costs

While pharma has been expanding on the one hand, it has been contracting on the other, as it tries to reduce its bloated costs. The sales force initially bore the brunt of these cuts. The number of U.S. sales reps declined from about 94,300 to about 78,800 between 2007 and the first quarter of 2010, and industry experts predict it will drop to 70,000 by 2012.[57] But the blade has fallen on other functions, too. For example, in the two years ending December 2010, pharma laid off some 111,277 people.[58]

The easy option

Rather than solve their challenges, many life sciences companies have quite possibly increased the risks they face. They have piled into the same therapeutic areas, although demand for cancer treatments can only sustain a few firms.

So the life sciences industry hasn't been very effective in addressing the problems it faces. Why? The primary reason is that the industry has seen itself as an independent product supplier to healthcare rather than as an integrated part of, and collaborator with, the other participants in the ecosystem. The life sciences industry can't fix everything in the ecosystem, but it certainly has a key role to play in optimizing health outcomes and lowering costs.

At the same time, the industry has not done a great deal to improve the safety and efficacy of its products. It has made little progress in developing diagnostics to identify which medicines work best for which patients, helping patients adhere to their medical regimens or reducing adverse events. In fact, between 2000 and 2009, the number of adverse events recorded by the FDA more than doubled.[59]

So the life sciences industry hasn't been very effective in addressing the problems it faces. Why? Primarily because every company has been trying to tackle its difficulties separately, rather than working with the other participants in the healthcare ecosystem to optimize the system as a whole. The life sciences industry can't fix everything in the ecosystem, but it certainly has a key role to play.

"I believe that if an organization is to meet the challenges of a changing world, it must be prepared to change everything about itself, except its beliefs."

Thomas J. Watson Jr., former IBM president (1952-1971)

Choices for the future

The key challenge for life sciences companies moving forward is to decide whether they will move away from their current silo thinking toward a systems thinking approach. Will they become true partners with peers and other healthcare stakeholders, helping to strip out waste within the healthcare ecosystem by maximizing outcomes and reducing healthcare costs while maximizing their profits? (See sidebar: From silos to systems.)

From silos to systems

Seen through the lens of systems thinking, the healthcare ecosystem is one of 11 core systems that collectively form a global system of systems representing 100 percent of the world's GDP.[60] Each system is an amalgam of public and private organizations spanning multiple industries. The life sciences and healthcare sectors are thus part of a single, interconnected ecosystem that includes all the parties that play a role in helping people manage their health.

However, the healthcare ecosystem is very bloated. IBM's research suggests that it has an economic value of about US$4.27 trillion and that about 42 percent of the money it absorbs is used very inefficiently.[61] In other words, US$1.79 trillion a year is wasted or lost.

We have stated emphatically that this paper is about choices. We see four fundamental questions driving the strategic direction for life sciences organizations over the next decade. Each question presents a set of choices that have implications for how successful they will be in meeting the challenges of a changing world. Each choice will define the transformational changes an organization will need to make to execute its strategy.

Key question 1: What will your organization's role be in the healthcare ecosystem?

The life sciences industry claims to be focused on health, with company vision statements and mottos often referring to driving better health or improving lives. But the public's perception of the industry is different and, frankly, sometimes dismal. Only 11 percent of the respondents in a recent Harris International poll thought that pharmaceutical companies were "generally honest and trustworthy."[62] Improving this perception is important because it creates the opportunity to interact with different players in the healthcare ecosystem in different ways. An organization will only be granted this permission if it is perceived as a willing and trusted partner that will add value and share resources.

To define a new role in the healthcare ecosystem and change perceptions, life sciences companies will need to rethink and refocus on strategies that are consistent with the larger healthcare ecosystem.

Choice 1: Is your company focused on patients or people?
How your company views the end users of its products will have significant implications.

- If seen as patients, they are viewed as someone with an illness filling a prescription that shows up as blinded data in a sales report. The company's obligation is limited to providing medication that is distributed and administered by someone else.

- If the end users are seen as people, then both the obligation and the opportunity change in scale. Providing the pill is still important, but your company and its partners may provide expanded offerings to address the needs of a person with the condition, the healthcare professionals and the family caregivers who constitute the care team.

Choice 2: Is your organization focused on disease or on health?

A focus on disease leads to efforts aimed at driving broader and earlier diagnosis of that disease, while a focus on the health of the person ultimately increases the opportunity to provide value beyond the medication.

- If products are focused on later stages of the diseases, then the company is likely focused on starting more advanced treatments sooner. For example, a company in the insulin business is probably interested in increasing diagnosis rates for diabetes and on driving earlier insulination.
- If a company is focused on health, its interest may still include diabetes. However, the focus is likely to be on prevention and wellness, as well as treatment. Such a company is likely as interested in the epidemic of childhood obesity and healthier lifestyles as it is about adherence and appropriate management of blood glucose levels.

Choice 3: Is your company a supplier or a partner?

A supplier of products to the healthcare ecosystem brings its products to market at a negotiated price. Partners offer solutions, and value is sought by both parties in the relationship.

- As a supplier, an organization has a vendor relationship with its customers. The bulk of conversation between payers, hospital providers and life sciences in this type of relationship revolves around formulary access and pricing levels. This is certainly the case today.
- If life sciences companies are truly partners in the healthcare ecosystem, the conversations will be broader and focused on how to address the needs of payers and providers and the needs of the patients they serve. The focus will be on outcomes and lowering overall healthcare costs. The value proposition of life sciences is higher and the opportunities to create and extract value are greater in this model.

The industry today is perceived as being focused on patients with diseases that fill prescriptions for products that the industry supplies. Life sciences companies are therefore viewed as suppliers of products – products that many perceive to be expensive, unsafe and ineffective. The historical position of the industry has limited its permissions and value proposition and, as a result, the industry is marginalized and maligned. However, the life sciences industry serves a noble cause. We challenge you to define your organizations in a way that broadens and unlocks the value of that cause.

Key question 2: What business will you be in?

This seems like a simple question – or is it? In the past, life sciences companies have clearly been in the business of developing innovative biopharmaceutical products. These products were proprietary and patent protected, and the margins on these innovative products provided sufficient return to justify the large research, development, and sales and marketing costs. This model had served the industry well for decades, but there is now compelling evidence that it is no longer sustainable on a broad scale.

The industry is faced with a set of choices that provide an opportunity to expand the definition of what it offers or to focus on fixing the existing business. This choice seems to be playing out through the recent merger and integration activities. Major companies are spinning off pieces of the business to "focus on the core," while others are acquiring new businesses to diversify. We again see three main choices.

Choice 1: Does your company focus on the "core" biopharmaceutical business but do it better? (the Pure Play approach)

This is a choice that seems to have been taken by Bristol Myers-Squibb with the recent spin-offs of the non-pharma businesses. Pfizer's recent statements indicate a move in this direction.[63] On the surface, "focus on the core" makes perfect sense: Focus on what you are good at and not get distracted by "adjacent" businesses that are already dominated by others.

Pharma companies must determine whether to focus on their "core" business, diversify into a broader set of products, or move into the services or solutions business.

The difficulty with this choice is that it requires the industry to solve a problem that no one has been able to crack for the last decade or so. What will be done differently to make the core business more productive than in the past? The arguments seem to be that the industry can move away from mass market blockbusters into smaller, more targeted treatments to smaller patient populations. This presumes that R&D can discover and develop these drugs, that smaller quantities can be manufactured and distributed efficiently, and that the commercial business can be transformed to effectively sell a portfolio of products utilizing multiple channels. There is little precedent for this happening.

Choice 2: Does your company diversify into a broader set of products? (the MegaCo approach)

Diversified business models have always been part of the life sciences landscape. Companies such as Abbott and Johnson & Johnson have device, diagnostics and/or consumer products businesses in addition to their pharmaceutical operations.[64] This model has proven beneficial as a hedge against risk as growth in one business can offset issues in another. In addition, the bringing together of these businesses can drive outcomes and lower overheads.

The historical issue with diversified business models is that the individual businesses have been sub-optimized. This can occur by being too closely controlled by headquarters or by being operated so autonomously that there is significant duplication and very little cross-company value creation. The challenge here is defining an operating model that allows the individual businesses to grow while creating value across the portfolio to show "one face to the customer" to drive health outcomes and lower costs.

As one example, the consumer healthcare market that encompasses personal care and over-the-counter (OTC) medications appears to be a good match for the traditional pharmaceutical business. The global personal care market is already worth over US$300 billion a year.[65] The OTC market is worth US$60 billion a year and is predicted to exceed US$70 billion by 2015, as more medicines get switched to non-prescription status and more people self medicate.[66]

Choice 3: Does your company move into services and/or solutions businesses? (the Solutions approach)

While the benefit of risk diversification is real and it is valuable to package a broader set of products, the real value lies in bringing these products together to offer solutions. The whole is greater than the sum when value is created that could not be achieved by buying the pieces separately. Tightly integrating the diverse businesses may only be justified if the organization can move beyond diversification to provide a broader set of products, services and solutions.

It is important to make a distinction between services and solutions. Services are targeted at a specific need or capability. Services can be provided as a stand alone fee-for-service business, as a "wrap around" to traditional products or as a "value add" to drive the use of products. While a significant services business would be new to most life sciences companies, in many ways, it is an extension of the product model.

Solutions are broader and more complex than services. Solutions are about bringing the appropriate products and parties together to solve a business, in this case healthcare, problem. Services are a key capability for solutions models as the pieces must be integrated and brought to market. Your company does not need to necessarily have a services business to offer solutions, but it will likely need to partner with an organization that does.

The implications of this choice are larger than they may appear on the surface. To be truly solutions focused, your company must be willing to provide services and solutions that benefit or even include competitors' products. For example, if a company is considering a remote monitoring solution for diabetics, is it just targeting people using its own products or all diabetics? For the solution to be valuable and, frankly, for it to have any chance of adoption by the healthcare system, it needs to be "product agnostic." Your company's solution will likely drive adherence to its competitors product as well as its own – a concept that can be difficult to accept.

The choice around what business or businesses to be in is clearly fundamental to future success. It is a unique time for the life sciences industry, as the current business model challenges and environmental changes provide an opportunity to change direction. The choices are not clear cut, and we see companies pursuing all three models presented to varying degrees. Most are either focusing on the core or diversifying, and everyone is dabbling with the idea of services and solutions in some way. A select few appear committed to making service and solutions a key part of their businesses going forward.

Our view is the solutions model has the greatest opportunity value. It is clearly the most difficult to implement, but provides the best chance for the life sciences industry to redefine itself and play a new and valuable role in improving care and lowering healthcare costs as it drives revenue and profit growth for shareholders.

Key question 3: How will you approach innovation to drive superior and more predictable results?

One of the great, unsolved challenges in life sciences is creating a more productive research and development function. As previously noted, R&D productivity is a significant contributor to bringing the traditional business model to its knees and represents billions in unproductive spend. What choices are there in solving this issue?

Choice 1: "Tighten the belt" or "Invest in growth."

One of the recurring themes in R&D has been reducing operating costs. While the merits of increased efficiency cannot be denied as having positive bottom-line, short-term impact, they certainly do not contribute to transformational R&D growth.

Historically, companies receiving the greatest benefit from R&D have increased research budgets, expanded R&D activities, and shifted to longer-term, higher-risk projects. Embracing this philosophy, Merck signaled in early 2011 its intention to reduce profit forecasts in the short term to increase R&D investment.[67]

Success of traditional investments was calculated based on predictability and short-term ROI. Future R&D investments must be measured against how effectively they enable R&D organizations to drive "planned" and "meaningful" innovation. For this to work, life sciences companies will need to find innovative approaches to improve productivity. Advanced analytics, in-silico research and transformed business models provide the promise for lowering the cost of research and increasing the probability of success.

Choice 2: Collaborative R&D or networked R&D collaboration models.

Becoming a systems player will require life sciences companies to collaborate with traditional and new healthcare stakeholders in a more flexible model built on transparency and shared responsibilities that focuses on achieving independent scientific-driven objectives. Companies will need to choose between the traditional "collaborative R&D" model tightly controlled by internal governance and metrics or the more open "networked R&D" model with shared control and objectives linked to scientific or health outcomes.

The "networked" R&D model will enable companies to conduct pre-competitive research collectively and to potentially pool and share disease, clinical and safety data with peers and other stakeholders to get insights that trials with a few thousand patients cannot provide. Making these changes will not be easy, but history provides several hints as to how to draw the boundaries between pre-competitive and competitive research. The Structural Genomics Consortium – a research alliance that includes Merck, Novartis and GlaxoSmithKline (GSK) alongside various academic and clinical institutions and government bodies – is one instance.[68] The Asian Cancer Research Group formed by Eli Lilly, Merck and Pfizer to promote research on cancers commonly found in Asia is another.[69] Examples of collaboration with other stakeholders can also be meaningful as illustrated in 2008, when GSK broke tradition to give government healthcare officials in Europe a say in deciding which compounds it should progress through its pipeline.[70] Together, industry leaders will build stronger, more integrated partnerships to coordinate research priorities more effectively. They could leverage these coalition models to develop treatments for particularly intransigent diseases and emerging market needs.

Integrating the lessons clinical experience has to offer presents a bigger challenge, since the industry doesn't own much of this data. But here, too, there are encouraging signs. Japan has established three clinical trial registries for collecting and publicizing trial data to promote patient recruitment and the re-use of negative data.[71] The U.S. Coalition against Major Diseases has also just launched a new alliance to pool data from failed clinical trials on treatments for Alzheimer's disease. Abbott Laboratories, AstraZeneca, GSK, Johnson & Johnson and Sanofi have made data from 11 trials publicly available. Data from other companies and the U.S. National Institutes of Health will eventually be added, and the scope of the scheme extended to cover other diseases.[72]

However, if the industry is to make real progress in developing useful new therapies and understanding why some treatments do not work in some patients, it will also need access to the medical data collected by doctors in daily practice. That, in turn, means healthcare payers and providers and patients must be willing to share their (blinded) data. True collaboration ultimately means unconstrained collaboration across all healthcare ecosystem stakeholders for the advancement of common goals.

Choice 3: Source innovation in-house or externally.
Increasingly, companies will seek external expertise for solving the traditional R&D challenges related to bringing novel products to market, making better decisions related to product attrition and better targeting the right medicines to the right patients. Even now, pharma is beginning to work with partners outside of the industry to apply new technology, products, analytical tools and research to solve these challenges. GSK is an example of a company that recognizes this need and has created a capability in Scinovo that provides scientific consulting and advisory support to GSK partners.[73]

Pharma will increasingly work with partners outside the industry in solving traditional R&D challenges.

Governments and health insurers might also become innovation partners by joining industry consortia to develop therapies for specific medical conditions. The European Commission's Seventh Framework Program is one example of how such arrangements could be managed. The Commission defines its priorities and brings research teams from different countries together, drawing on the public and private sectors alike.[74] Alternatively, some countries may set up government drug development centers, as the United States is doing. The National Center for Advancing Translational Sciences will perform as much research as is needed to attract industry investment.[75]

The overarching implication for any company adopting an open or "Networked R&D" model is that it will have to become far more transparent – something many executives may be uncomfortable with, given the industry's historical reluctance to share information about research targets, clinical and safety data, and the like. But the cost of developing new treatments has reached astronomical proportions, and the industry cannot carry on using conventional techniques and going it alone.

What would fixing the innovation model achieve? Putting a number on the potential savings is very tricky. But Thomas Lonngren, former head of the EMA, recently estimated that about 70 percent of global life sciences R&D expenditure – now some US$85 billion a year – is squandered.[76] If the industry could halve that, it would save almost US$30 billion a year.

Key Question 4: How will you organize to maximize growth in the emerging markets?

The mature life sciences markets in the United States, Europe and Japan are expected to grow in the low single digits for the foreseeable future. In addition, we see life sciences companies established within the emerging markets focusing their growth plans on these mature markets, which will put the existing players under even more pressure.[77] While mature markets still represent the bulk of the profits, there is general agreement that growth will come from the emerging markets.[78] It is less clear how best to capture that growth and create a sustainable global model that could potentially benefit both mature and emerging markets. We see two options:

Choice 1: Replicate your model all over the world.

The most obvious approach is to buy or set up local operations in these countries and give them significant autonomy to drive business results. The arguments for this approach are relatively straight forward: the need to act quickly, the relatively low cost of operations, and a desire to not get in the way of growth by slowing decision making by checking back with a head office that may not understand the market.

There is merit in this approach, and it may be the best way to capture the short-term opportunity. But the challenge is that you are likely to end up with a number of large, independent, redundant operations that are using different technology platforms, processes and metrics. In short, this approach is very difficult to manage and will generate suboptimal economies of scale.

Choice 2: Globally integrate the enterprise.

Another model to consider is what IBM calls the Globally Integrated Enterprise (GIE). The GIE model is defined as "operating seamlessly as a single organic entity by integrating internal operations horizontally and globally, collaborating with external partners, and operating at the best location in the world, to maximize value creation from a global point of view."

At its foundation, it is a shared services model for key back-office functions with common systems, processes and metrics. These back-office functions support local "front offices," where client-facing business takes place and key local market decisions are made. Global centers of excellence are established in the geography where the capability is most efficient and effective. This model results in a lower global cost structure that benefits both mature and emerging markets while enabling the organization to "think and act locally."

The need to operate globally and capture growth in the emerging markets is undisputed. The need to lower the cost structure in mature markets is also universally accepted. Our experience is that most life sciences companies see these as separate issues. We recognize the need for speed, and some of the short-term approaches that are being taken are necessary. That said, we believe the industry needs to take a longer, more strategic approach and move to a globally integrated model that serves the cost-cutting needs of the mature markets while supporting growth in emerging markets.

Conclusion: The path forward

The life sciences industry stands at a crossroads, and the road signs are clear. Global business leaders are expressing a view that the speed, immediacy, unpredictability and viral nature of change mean they can no longer expect to *manage* through this environment. Rather, success will depend on their ability to *innovate* through it. In essence, there is more than one way to successfully navigate today's challenges, and each company will choose its own path. The direction of this path will determine whether it will fade or flourish.

Regardless of the path your organization chooses, the appropriate enablers must be established to facilitate sustained market leadership. In short, the choices you make have distinct implications that must be addressed. The "pure play" approach will require the innovation gap to be solved, core processes be transformed to drive efficiencies, and creation of more meaningful relationships with healthcare providers beyond today's face-to-face driven detail model. Those who choose to engage more fully in the healthcare ecosystem and drive outcomes with solutions that extend "beyond the pill" will need to determine how to integrate with other constituents and bring the pieces together to create value for the ecosystem and themselves. In either case, companies will need to capture the opportunity in emerging markets.

As we look toward the future, we see five fundamental truths impacting your ability to succeed regardless of the choices you make. We predict that these truths will drive the industry toward a more integrated and collaborative model and reward those that choose to operate in that manner:

- **Loners will be losers.** Going it alone will not bring success in the twenty-first century. For example, R&D teams must find ways to collaborate and share intellectual property, compounds, data including clinical, safety and outcomes. Working more closely with the payer and provider community will be key to solving the enormous global healthcare challenge. It is no longer simply about how any one company can solve a given problem, but rather how it can best leverage those around to work together to find solutions and solve problems in a distinct and repeatable manner, i.e., sustained market leadership.
- **Outcomes will drive the dialogue.** The days of sample drops and the robotic delivery of canned messages from sales reps are gone. Relationships with healthcare providers, payors and patients (aka, people) will be based on trust, value and outcomes and will be managed through a variety of channels. Whichever business model your organization chooses, its success will become largely dependent on maximizing outcomes of the individuals who use its products and/or solutions. If your business is not able to consistently provide evidence that its products and/or solutions provide positive outcomes for the identified patients, it risks becoming a low-margin commodity business.
- **The data walls must come down.** In a highly interdependent healthcare ecosystem, it's essential to be able to share and analyze information. Combining and mining vast quantities of data uncovers clues that would otherwise be impossible to detect across discovery, development, marketing and the supply chain. The data walls must enable sharing of data (e.g., electronic medical records), as leveraging the same internally focused data elements that the industry has for decades will no longer be sufficient. Companies must also determine how to best gain true insights into the data they currently have, as many companies are currently data rich and insight poor.
- **Visibility is vital.** Integrated medical knowledge bases and real-time information will become the cornerstones of the new healthcare ecosystem. Medical insight will be driven by both longitudinal and real-time streaming data that will enable a shift to proactive care.
- **The individual is paramount.** Helping people stay well, get well, and/or manage illnesses efficiently and effectively is the goal. Life sciences companies must rethink their role in truly knowing and helping people.

Those that can innovate and reinvent what it means to be a life sciences company have a real chance to flourish and play a new and transformational role in the healthcare ecosystem. Those that cannot or will not change will be overwhelmed by the challenges facing the industry and will fade from the stage.

"I would argue that the first decade of the twenty-first century has been a series of wake-up calls, with a single subject: the reality of global integration. In business, global integration has changed the corporate model and the nature of work itself…Over the next couple of years, there will be winners, and there will be losers. And though it may not be easy to see now, I believe we will see new leaders emerge who win not by surviving the storm, but by changing the game."

Sam Palmisano, IBM chairman, president and chief executive officer [79]

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Notes and sources

1 For many years, the life sciences industry consisted of conventional pharmaceutical companies. It now encompasses biotechnology firms, generics producers, medical device manufacturers, medical services and supplies companies, medical distributors, animal health specialists, nutraceuticals manufacturers and consumer healthcare companies – a diversity that makes both the industry and its challenges more complex.

2 We identified many of these early signs of trouble in "Pharma 2010: The Threshold of Innovation." IBM. November 2002. http://www-07.ibm.com/services/pdf/pharma_es.pdf

3 Van Kralingen, Bridget. "IBM's Transformation – From Survival to Success." Forbes.com. July 7, 2010. http://www.forbes.com/2010/07/07/ibm-transformation-lessons-leadership-managing-change.html

4 "Pharmaceutical Industry Profile 2011." Pharmaceutical Research and Manufacturers of America. April 2011. http://www.phrma.org/sites/default/files/159/phrma_profile_2011_final.pdf

5 "Pharmaceutical R&D Factbook." CMR International. June 2010. http://science.thomsonreuters.com/m/pdfs/CMR-Factbook_Exec_Sum.pdf

6 Behnke, Nila and Norbert Hueltenschmidt. "Changing pharma's innovation DNA." Bain and Company. August 13, 2010. http://www.bain.com/publications/articles/changing-pharmas-innovation-dna.aspx; "Drug Firms Face Billions in Losses in '11 as Patents End." *New York Times*. March 6, 2011. http://www.nytimes.com/2011/03/07/business/07drug.html?pagewanted=all

7 Alazraki, Melly. "10 Popular Drugs Set to Lose Their Patents." *The Street*. March 3, 2011. http://www.thestreet.com/story/11027354/1/10-popular-drugs-set-to-lose-their-patents.html

8 Thomson Reuters database. 2011.

9 In the first half of 2010, the large-caps saw US$183 billion wiped off their market value, although they recovered somewhat in the second half. See "Big pharma continues to struggle in first half, Indian generics consolidate gains." EvaluatePharma. July 1, 2010.

10 "World Preview 2016." EvaluatePharma. May 2010. http://www.windhover.com/download/blog/EP0510worldpreview2016.pdf

11 Harman, Sarah. "Germany moves to end manufacturers' control of drug prices." *DW-World.De*. November 11, 2010. http://www.dw-world.de/dw/article/0,,6221497,00.html

12 "Health Reform: Prospering in a post-reform world." PricewaterhouseCoopers Health Research Institute. May 2010.

13 The EMA published EMEA CHMP Guideline on Risk Management Systems for Medicinal Products for Human Use in November 2005: http://www.pharmacoepi.org/riskmgmt/emea100505.pdf; The FDA adopted a similar policy in 2007, when it secured permission to require Risk Evaluation and Mitigation Strategies that may include monitoring of all adverse events, drug interactions and side effects: http://www.fda.gov/Drugs/DrugSafety/PostmarketDrugSafetyInformationforPatientsandProviders/ucm111350.htm

14 "The Sentinel Initiative." Food and Drug Administration. July 2010. http://www.fda.gov/downloads/Safety/FDAsSentinelInitiative/UCM233360.pdf

15 Racoosin, Judy. "Update on FDA's Sentinel Initiative." Presentation at Sentinel Workshop. Washington DC. January 12, 2011. http://www.brookings.edu/~/media/Files/events/2011/0112_sentinel_workshop/Racoosin.pdf

16 "The Value and Benefits of ICH to Drug Regulatory Authorities – Advancing Harmonization for Better Health." International Conference on Harmonization. 2010.

17 Stovall, Sten. "Europe's Drug Regulator Says Innovation Must Pick Up." *The Wall Street Journal*. December 15, 2010.

18 "Pharmaceutical Sales Management: Conquering the New Marketplace." Cutting Edge Information. December 2004. http://www.medicalnewstoday.com/articles/17155.php

19 Silverman, Ed. "Doctors to Sales Reps: Go Away and Stay There!" *Pharmalot*. October 13, 2010. http://www.pharmalot.com/2010/10/doctors-to-sales-reps-go-away-and-stay-there/

20 Rosenthal, Rick and Greta Roecker. "2008 Access Report: Finding Opportunity amid the Challenges." *Pharmaceutical Representative*. July 2008. http://www.healthstrategies.net/documents/published_articles/AccessReport_PharmaRep_July08.pdf

21 Jones, Paul and Nic Holladay. "Getting the Mix Right: New Roadblocks and New Routes to Market." *Pharmaceutical Executive Europe*. September 2006.

22 "Fact Sheet: Physician Payments Sunshine provisions in Health Care Reform." Pew Prescription Project. March 23, 2010. http://www.prescriptionproject.org/tools/sunshine_docs/files/Sunshine-fact-sheet-6.07.10.pdf

23 Jack, Andrew. "Drug groups to limit medicine 'sampling'." *Financial Times*. June 24, 2010. http://www.ft.com/cms/s/0/345d4c0c-7eed-11df-8398-00144feabdc0.html#axzz1SZg8U1Rh

24 Jarvis, Lisa. "Big Pharma Talks Emerging Markets Strategy." Central Science blog: The Haystack. Chemical & Engineering News. January 14, 2011. http://cenblog.org/the-haystack/2011/01/big-pharma-talks-emerging-markets-strategy/

25 Thacker, Teena. "Costly gifts could put doctors out of practice for up to a year." expressindia.com. March 15, 2010. http://www.indianexpress.com/news/costly-gifts-could-put-doctors-out-of-practice-for-up-to-a-year/590814/0

26 "Healthcare 2015: Win-win or lose-lose?" IBM Institute for Business Value. October 2006.

27 "World Population Prospects: The 2008 Revision." Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat. 2009. http://esa.un.org/unpp

28 "Preventing chronic disease: a vital investment." World Health Organization. Geneva. 2005. http://www.who.int/chp/chronic_disease_report/full_report.pdf

29 Ibid.

30 Templeton, Sarah-Kate. "10,000 set to pay for top-up cancer drugs." *The Sunday Times*. October 26, 2008.

31 Kirschbaum, Erik. "Germany passes unpopular healthcare reform." Reuters. November 12, 2010. http://www.reuters.com/article/idUSTRE6AB3TL20101112

32 The U.S. Congressional Budget Office estimates that the provisions outlined in the Health Care Patient Protection and Affordable Care Act of 2010, as modified by the Health Care and Education Reconciliation Act of 2010, will cost about US$938 billion over the next decade but should reduce the deficit by US$143 billion over the same period. See "H.R. 4872, Reconciliation Act of 2010 (Final Health Care Legislation)." U.S. Congressional Budget Office. March 20, 2010.

33 "Growth and collaboration: Embracing new challenges facing China's life sciences market." IBM Institute for Business Value. April 2010. http://www-935.ibm.com/services/us/gbs/bus/html/ibv-pharma-market-china.html; "Broadening healthcare access in Brazil through innovation." Economist Intelligence Unit. November 9, 2010. http://www.businessresearch.eiu.com/broadening-healthcare-access-brazil-through-innovation.html; "National Urban Health Mission in the making: Gulam." Andhra Headline.com January 12, 2011. http://www.andhraheadlines.com/state/national-urban-health-mission-in-the-making-gulam-4-77790.html; "Mexico's Universal Health Care Is Work in Progress." *New York Times*. January 12, 2011. http://www.nytimes.com/2011/01/30/world/americas/30mexico.html?pagewanted=all; "Russia & CIS: Health & Pharmaceuticals." AllBusiness.com. March 24, 2011. http://www.allbusiness.com/trade-development/trade-development-finance/15566391-1.html; "Country profile – Turkey." Library of Congress – Federal Research Division. August 2008. http://lcweb2.loc.gov/frd/cs/profiles/Turkey.pdf

34 "World Health Statistics 2010." World Health Organization. 2010.

35 Bhanoo, Sindya N. "Denmark Leads the Way in Digital Care." *The New York Times.* January 11, 2010. http://www.nytimes.com/2010/01/12/health/12denmark.html

36 The British system, which is part of a £12-billion (US$19.4 billion) IT upgrade within the NHS, should be virtually complete by 2014. The U.S. system should be finished by 2019; "Q&A: Electronic medical records." BBC News. March 10, 2010; Lohr, Steve. "Big Medical Groups Begin Patient Data-Sharing Project." *The New York Times*. April 6, 2011; "Electronic Medical Record/Electronic Health Record Systems of Office-based Physicians: United States, 2009 and Preliminary 2010 State Estimates." U.S. National Center for Health Statistics. December 8, 2010.

37 Suwinksi, Pawel. "Health Information Technologies: Market Overviews and Trends." Presentation at 2nd Annual Asia HER Conference, Singapore, 2010. http://www.slideshare.net/FrostandSullivan/health-information-technologies-market-trends

38 Versel, Neil. "Mayo Clinic using EMRs to reveal genetic predisposition to disease." FierceEMR. September 16, 2010. http://www.fierceemr.com/story/mayo-emr-abstraction-reveals-genetic-predisposition-disease/2010-09-16

39 "29 new gene variants linked to ulcerative colitis." Karolinska Institutet press release. February 7, 2011.

40 "Patient-centered medical home: What, why and how?" IBM Institute for Business Value. May 2009. http://www-935.ibm.com/services/us/gbs/bus/html/gbs-medical-home.html

41 Littlejohns, Peter. "The establishment of NICE." *Patients, the Public and Priorities in Healthcare*. Radcliffe Publishing. December 2009.

42 "Overview of the Patient-Centered Outcomes Research Institute." U.S. Center for Medical Technology Policy. http://www.cmtpnet.org/comparative-effectiveness/overview-of-the-patient-centered-outcomes-research-institute

43 Pharmaceutical Benefits Advisory Committee Web site. http://www.health.gov.au/internet/main/publishing.nsf/content/health-pbs-general-listing-committee3.htm; Finnish Office for Health Care Technology Assessment Web site. http://finohta.stakes.fi/EN/index.htm; Pharmaceutical Management Agency Web site: http://www.pharmac.govt.nz/

44 Dossia Web site. http://www.dossia.org/about-dossia/an-introduction-to-dossia

45 Capital IQ database. 2011.

46 Munos, Bernard. "Lessons from 60 years of pharmaceutical innovation." *Nature Reviews Drug Discovery*. December 2009. Vol. 8: 959-968.

47 For example, the net gain from combining Merck and Schering-Plough is expected to be about US$975 million by the end of 2011, after costs of over US$2.5 billion. For further information, see "Merck Announces Fourth-Quarter and Full-Year 2009 Financial Results." Merck press release. February 16, 2010.

48 Analysis by the IBM Institute for Business Value (based on company financial statements and other publicly available information) shows that, in most of the biggest deals, revenues from the target company have grown at a compound annual rate of 5 percent or less, five years after the deal was completed.

49 eKnowledgeBase (www.eknowledgbase.com). 2010.

50 Armstrong, Walter. "Pharma's Orphans." *Pharmaceutical Executive*. May 1, 2010.

51 "Incidence of most frequent cancers, men and women." Globocan 2008. http://globocan.iarc.fr/factsheets/populations/factsheet.asp?uno=900#BOTH

52 Mintz, Cliff. "Orphan Drugs: Big Pharma's Next Act?" *Life Science Leader*. October 2010.

53 "Novartis unifies generics products under Sandoz brand." ICIS.com. January 21, 2003. http://www.icis.com/Articles/2003/01/21/188417/novartis-unifies-generics-products-under-sandoz-brand.html; "Company history: 1996 to present." Novartis Web site. http://www.novartis.com/about-novartis/company-history/index.shtml

54 "Burgeoning bourgeoisie: New Middle Classes in Emerging Markets." *The Economist*. February 12, 2009.

55 "Life course perspectives on coronary heart disease, stroke and diabetes: key issues and implications for policy and research." World Health Organization. 2001; Kearney, P.M. et al. "Global burden of hypertension: analysis of worldwide data." *The Lancet*. 2005. Vol. 365: 217-223.

56 "IMS Announces 17 Countries Now Rank as High-Growth 'Pharmerging' Markets; Forecast to Contribute Nearly Half of Industry Growth by 2013." IMS Health press release. March 16, 2010. http://www.imshealth.com/portal/site/ims/menuitem.d248e29c86589c9c30e81c033208c22a/?vgnextoid=01624605b5367210VgnVCM100000ed152ca2RCRD

57 Barrett, Amy. "Pharmaceutical Companies Replace Sales Reps with Websites." *Daily Finance*. June 24, 2010.

58 Martino, Maureen. "2010 Pharma job cuts cross the 50K mark." FiercePharma. December 1, 2010. http://www.fiercepharma.com/story/2010-pharma-job-cuts-cross-50k-mark/2010-12-01

59 The total number of adverse event reports entered into the FDA's adverse event reporting system (as distinct from the number of reports received) rose from 200,352 in 2000 to 490,835 in 2009. "Reports Received and Reports Entered into AERS by Year." Food and Drug Administration. March 31, 2010. http://www.fda.gov/Drugs/GuidanceComplianceRegulatoryInformation/Surveillance/AdverseDrugEffects/ucm070434.htm

60 Korsten, Peter and Christian Seider. "The world's US$4 trillion challenge: Using a system-of-systems approach to build a smarter planet." IBM Institute for Business Value. January 2010. http://public.dhe.ibm.com/common/ssi/ecm/en/gbe03278usen/GBE03278USEN.PDF

61 In estimating the value of the healthcare ecosystem, we assumed that the 11 core systems that constitute the global system of systems are collectively worth US$54 trillion – the GDP generated worldwide in 2008. We calculated the value of each system by using OECD Input-Output Database tables to measure how much the core industries contribute to each system and how much of the production of other industries they rely on to produce each dollar of their own output.

62 "Oil, Pharmaceutical, Health Insurance, and Tobacco Top The List Of Industries That People Think Should Be More Regulated." Harris Interactive. December 2, 2010. http://www.harrisinteractive.com/NewsRoom/HarrisPolls/tabid/447/mid/1508/articleId/648/ctl/ReadCustom%20Default/Default.aspx

63 "Pfizer rises on talk it will sell-off huge chunk of non-core businesses." *The Pharma Letter*. March 15th, 2011 http://www.thepharmaletter.com/file/102799/pfizer-rises-on-talk-it-will-sell-off-huge-chunk-of-non-core-businesses.html

64 "Products by category." Abbott Web site, accessed July 2011. http://www.abbott.com/global/url/content/en_US/20.20:20/product/Products_By_Category.htm; "Our products." Johnson & Johnson Web site, accessed July 2011. http://www.jnj.com/connect/healthcare-products

65 "New opportunities drive ingredients market." *Personal Care Magazine.* March 2011. http://www.personalcaremagazine.com/Story.aspx?Story=7956

66 "The Global OTC Pharmaceutical Market 2010-2015." Visiongain. July 15, 2010. http://www.visiongain.com/Report/500/The-Global-OTC-Pharmaceutical-Market-2010-2025

67 "Merck & Co pulls long-term forecast, committed to R&D." PharmaTimes Online. February 04, 2011. http://www.pharmatimes.com/Article/11-02-04/Merck_Co_pulls_long-term_forecast_committed_to_R_D.aspx

68 Structural Genomics Consortium Web site. http://www.wellcome.ac.uk/Funding/Biomedical-science/Funded-projects/Major-initiatives/Structural-Genomics-Consortium/index.htm

69 Carroll, John. "Pharma giants join forces behind Asian cancer research group." *FierceBiotech Research*. February 23, 2010. http://www.fiercebiotechresearch.com/story/pharma-giants-join-forces-behind-asian-cancer-research-group/2010-02-23

70 Whalen, Jeanne. "Glaxo Seeks Guidance From Health Systems." *The Wall Street Journal*. July 7, 2008.

71 Shiokawa, Tomonori. "Background, introduction and activity of the Japan Primary Registries Network." *Journal of Evidence-Based Medicine.* Volume 2, Issue 1. March 5, 2009.

72 Wang, Shirley S. "Drug Makers Will Share Data From Failed Alzheimer's Trials." *The Wall Street Journal*. June 11, 2010; "Coalition against Major Diseses – fact Sheet." Critical Path Institute. June 11, 2010. http://www.c-path.org/pdf/Coalition-FactSheet.pdf

73 "Scinovo – innovation in collaborative drug development." Company Web site, accessed July 25, 2011: http://www.gsk.com/collaborations/scinovo-preclinical.htm

74 "FP7 in Brief." European Commission. 2007. http://ec.europa.eu/research/fp7/pdf/fp7-inbrief_en.pdf

75 Harris, Gardiner. "Federal Research Center Will Help Develop Medicines." *The New York Times*. January 22, 2011.

76 Stovall, Sten. "Europe's Drug Regulator Says Innovation Must Pick Up." *The Wall Street Journal.* December 15, 2010.

77 "Sun Pharma plans expansion in US and large emerging markets." *The Economic Times*. July 29, 2011. http://articles.economictimes.indiatimes.com/2011-07-29/news/29829259_1_managing-director-dilip-shanghvi-sun-pharmaceutical-industries-first-quarter

78 "Strength Emerging In The Health-Care Sector." istock analyst. July 5th, 2011.http://www.istockanalyst.com/finance/story/5272732/strength-emerging-in-the-health-care-sector

79 "A Smarter Planet: The next leadership agenda." ibm.com. November 6, 2008. http://www.ibm.com/ibm/ideasfromibm/us/smartplanet/20081106/sjp_speech.shtml

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