Splicing a cost squeeze into the **genomics** revolution

Observers and analysts are looking forward to a profusion of innovative drugs, but they have paid far less attention to the business challenge of the "new biology."

Last year's announcement that scientists had sequenced the human genome highlighted both the potential of genomics-related technologies and the speed with which they are evolving in the biopharmaceuticals industry. Most observers and analysts have been banking on the "new biology" to create innovative new drugs, and quickly. Yet far less attention has been paid to the enormous business challenges these new technologies pose for the industry. Recent research conducted jointly by McKinsey and Lehman Brothers suggests that over the next five years, the new biology could raise R&D costs substantially—in some cases to twice their current annual levels. Since pharmaceuticals companies spend as much as 20 percent of their annual sales on R&D, these potential budget increases may put substantial pressure on earnings.

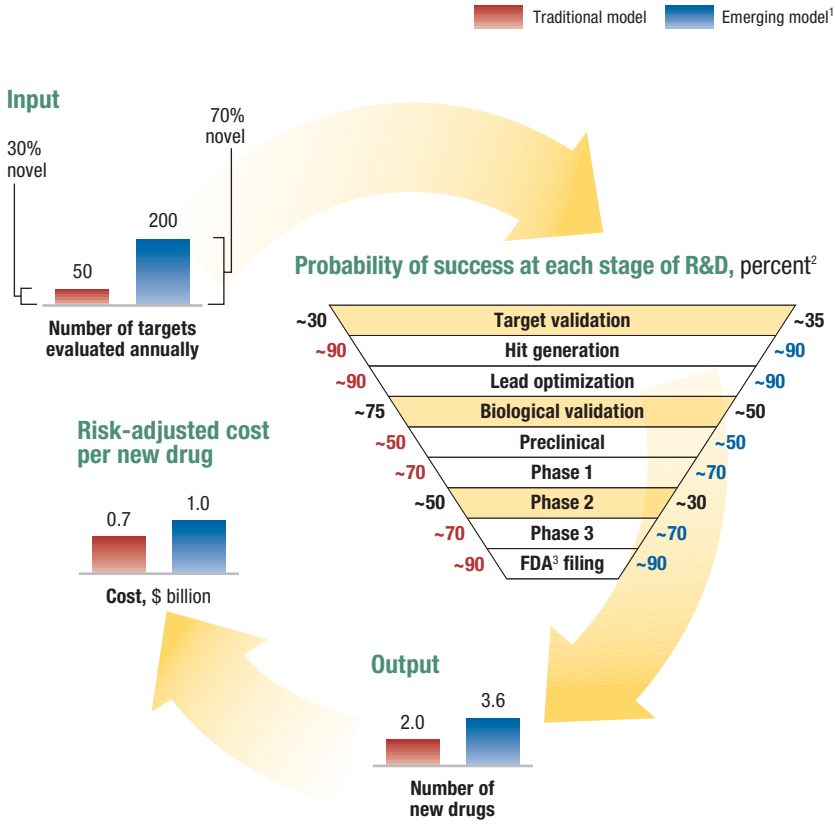
Why the coming cost squeeze? To put the problem simply, attempts to use today's relatively immature technology to explore the novel drug targets that genomics is uncovering will raise failure rates for drugs further down the development pipeline—during the most costly phase of the R&D process. These higher failure rates are also likely to stretch out the arrival timetable for the flood of new drugs that genomics is expected to yield.

Our perspective is rooted in exhaustive interviews with biopharmaceuticals executives and academic thinkers, as well as in-depth economic and benchmark analysis. From this foundation, we developed an industry-based productivity model of new-biology R&D strategies. At each step of the process, our model captures the cost of developing a drug and the probability that it can be developed successfully. The model represents the emerging worst-case scenario from an aggregate industry perspective; individual companies may actually find themselves in somewhat different situations.

Most biopharmaceuticals companies focus their R&D efforts on discovering novel targets: the biological mechanisms, usually receptors or enzymes in human cells, through which drugs work. As recently as five years ago, the research community knew of only 500 such targets. As the number of drugs

EXHIBIT 1

The future of genomics



[1]Assumes today's cost, performance, and technology levels.
[2]Target validation is first step in understanding role of target in disease path of physiology; hit generation identifies promising clinical compounds; lead optimization narrows selection of most promising clinical compounds; biological validation provides in-depth understanding of role of target in disease path of physiology; preclinical provides early information on drug's toxicology and effects on metabolism; phase 1 establishes drug's safety, effects on metabolism, and toxicology; phase 2 establishes effectiveness of drug and optimal dosage; phase 3 confirms efficacy, dosage regime, and safety profile of drug. Phases 1, 2, and 3 are often referred to as clinical development phases.
[3]US Food and Drug Administration.

oriented to the same targets increased, the opportunities they created began to dwindle. High-throughput genomics technologies are opening up vast new opportunities that will make it possible for researchers to find novel targets quickly, from a universe of as many as 10,000. Each year, a pharmaceuticals company using the new biology can now evaluate up to 200 targets, the majority of them new.

No doubt, the new biology has accelerated the process of discovering novel targets. But a fair degree of immaturity still characterizes many of the technologies—such as functional genomics, proteomics, and bioinformatics—that play critical roles in efforts to determine the biological functions of the targets and to translate that knowledge into drugs.

This problem complicates R&D in several ways. First, the biological functions of novel targets are less well understood than those of more traditional ones: the average number of academic citations in the published literature per target, for example, decreased from 100 in 1990 to 8 in 1999 because of the rapid pace of discovery. Most pharmaceuticals companies are therefore pushing drugs through the R&D pipeline without fully understanding the physiological consequences of their interactions with their intended targets.

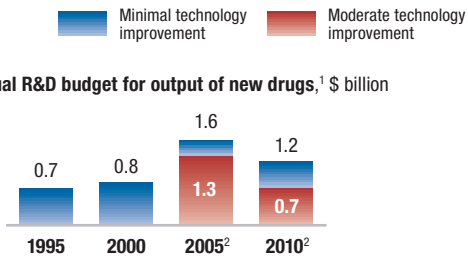
Moreover, traditional chemical technologies may not be sufficient to develop drugs that interact with novel targets. Pharmaceuticals companies will have to develop drugs with novel chemistries, which may have unpredictable pharmacological and toxicological effects. As a result, there will be far greater uncertainty during a drug's clinical development phases, historically the most expensive parts of research and development.

Our model of the new-biology pipeline begins in the year 2000, and it assumes current costs, performance levels, and technology. We estimate that during phase two, the probability of success for novel targets identified through the techniques of the new biology will range from 15 to 30 percent (for the purpose of modeling we assumed 30 percent). Under this model, a typical pharmaceuticals company could increase its yearly R&D output to 3.6 new drugs, up from 2, but would also have a higher attrition rate (Exhibit 1).

Higher attrition will push cost pressures for the industry up to their zenith within five years. These pressures will subside within a decade as critical technologies mature. We assumed that in the year 2000, the industry would adopt the new-biology strategy for the early stages of R&D and that products would progress through the pipeline over the next ten years. In a scenario with only a minimal improvement in technology, the average pharmaceuticals company's annual R&D budget for its output of new drugs should double, from $800 million in 2000 to $1.6 billion in 2005, and then decrease to $1.2 billion by 2010. In a scenario with a moderate improvement in technology, an average pharmaceuticals company's annual R&D budget for its output of new drugs would increase to $1.3 billion by 2005 and decrease to $700 million by 2010 (Exhibit 2).

EXHIBIT 2

Rise and fall of R&D costs



[1]In constant (2000) US dollars.
[2]Forecast.

The technologies that are expected to have the most substantial effect on productivity as they mature include proteomics, bioinformatics, predictive toxicology, and pharmacogenomics.[1] In the interim, however, the short-term cost pressures discussed in this article will create real challenges for the biopharmaceuticals industry. The winners and losers in this high-stakes game may be differentiated by strategic research and development choices, such as portfolio-management decisions and the mix of new targets—as well as by choices lying outside R&D, such as licensing deals and product-lifestyle management.

—Richard C. Edmunds III, Philip C. Ma, and Craig P. Tanio

[1] *See* Manish Bhandari, Rajesh Garg, Robert Glassman, Philip C. Ma, and Rodney W. Zemmel, "A genetic revolution in heath care," *The McKinsey Quarterly*, 1999 Number 4, pp. 58–67.

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