

## R&D and Innovation in Industry

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### HIGHLIGHTS

- The last two years have seen less growth in R&D investment by U.S. industry, with 2002 showing barely more spending than 2001 in current dollars and slightly less in constant dollars (see Table I-11). Spending is likely to be no more vigorous in 2003 and we can expect to see a second year of spending that does not keep pace with inflation. There will again be wide variation depending on industry, with pharmaceuticals, biotech, and genomics companies on the high end, telecommunications, networking equipment manufacturers, computer makers, chemical and process-related industries on the low end.
- Internally generated business growth opportunities, either within existing product lines or based upon newly-employed platforms, will command the largest proportion of R&D budgets. Directed basic research will continue to diminish in its proportion of overall spending. Unlike last year there will be much increased support for customer-focused technical service work. Savings in R&D expenditures will be achieved by continued reductions in technical work force, movement of technical development to Asia, and leveraging scarce resources through alliances and joint ventures—including federal laboratories and, to a lesser extent, universities.
- Building a national innovation capacity has become a top priority for regions and nations as well as companies, in order to stimulate economic development and strengthen competitiveness.

- Retention of R&D during hard times is seen by most companies as a key growth strategy by firms in most parts of the world but not practiced by many of the same companies.

## INTRODUCTION

This chapter reviews the R&D investment made by industrial firms in recent years, indicates the projection for industrial R&D investment in 2003, describes recent initiatives by other countries to stimulate innovation, and summarizes results of the Industrial Research Institute's (IRI) annual R&D trends forecast for 2003.

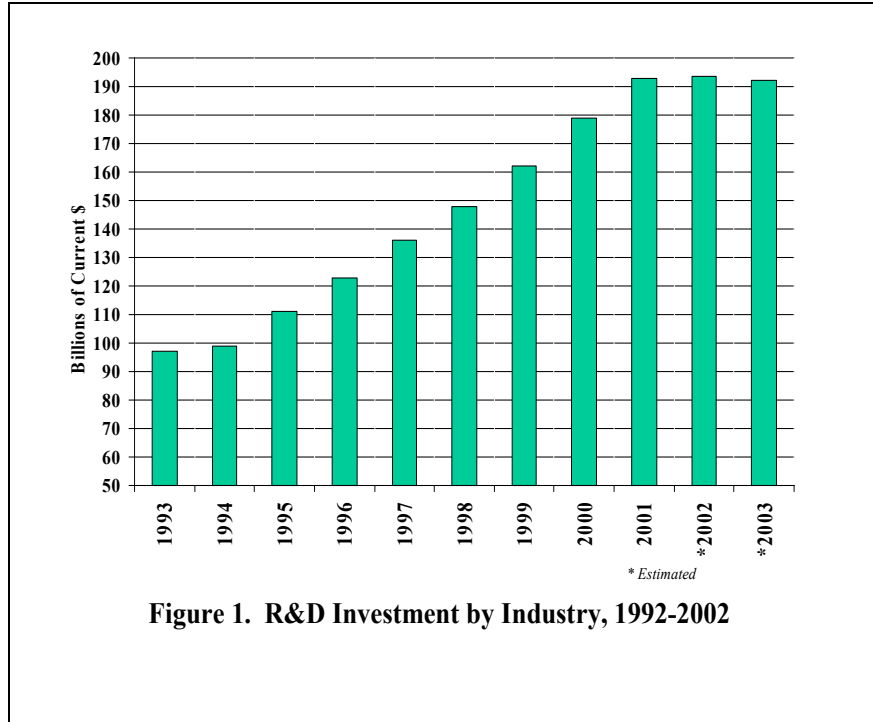
## R&D INVESTMENT

R&D funding by industry remained essentially steady in 2002 after more than ten years of growth, with half of those years recording near or above double-digit percentage increases. The Battelle R&D Magazine<sup>1</sup> study has estimated that the increase for 2002 was 0.26 percent over 2001, taking industry's R&D investment to \$193.4 billion last year (see Table I-11). Battelle projects an increase in industry R&D funding of only 0.16 percent for 2003, to \$193.7 billion. IRI's Trends Forecast for 2003 shows most companies reporting zero to less than 2.5 percent increase in spending year-to-year. Comparing previous forecasts to actual, this data indicates a contraction in spending to about \$192 billion. Indeed, the number of companies forecasting reduced spending rose significantly. This estimate is supported by anecdotal evidence gathered more recently in meetings with industrial research leaders and the advantage of seeing actual business performance and employment trends for a number of months. The prospect of another year of a sluggish economy, exacerbated by the lingering threat of war with two adversaries, also suggests why predictions made earlier may be too optimistic. It is quite possible that 2003 will be the first year of decreased investment in industrial R&D in current dollars in more than 10 years. These revised estimates are reflected in Figure 1, which tracks or predicts R&D investment by industry over 10 years through 2003. Year-to-year change percentage is shown in Figure 2.

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<sup>1</sup> Studt, Tim and Duga, Jules, *Federal R&D Offsetting Industrial Cutbacks*, R&D Magazine—January 2003, pp. F1-F13; and *Industrial Research Institute's R&D Trends Forecast for 2003*, RESEARCH-TECHNOLOGY MANAGEMENT, January-February 2003, pp. 17-20.

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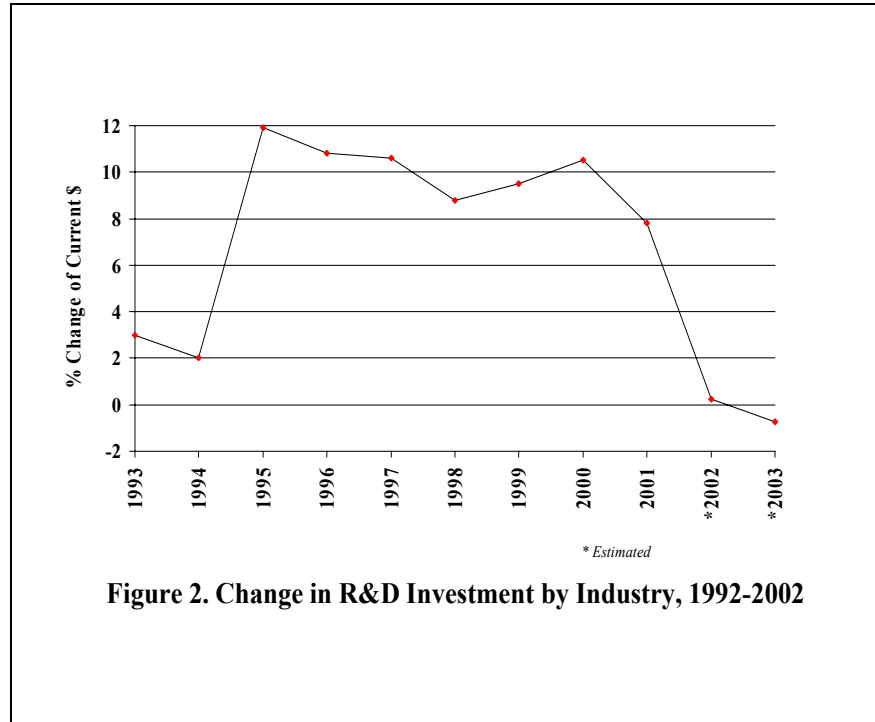


Industry's performance of R&D in 2002 was \$210.8 billion, up 1.3 percent from the \$208.0 billion in 2001 (see Table I-11). Battelle projects that this figure will increase 2.6 percent during 2003, bringing industry's total R&D effort to \$216.2 billion this year. Using the revised estimates for the proportion funded by industry, and recognizing that government and non-profit funding for industrial research are not as volatile, we estimate that this value of R&D performed by industry will be closer to \$214.5 billion or up only 1.8 percent. Thus, industry will *fund* more than 64 percent and will again *perform* some 72 percent of the total of \$300 billion we estimate will be invested in R&D in the U.S. during 2003.

### R&D TRENDS FOR 2003

The Industrial Research Institute (IRI) R&D Trends Forecast, based on replies from 95 IRI member companies during August and September 2001, forecasts a minor retreat from the historical pattern of continued growth in R&D. It clearly suggests a reduction in support of existing businesses and directed basic research. The forecast reduction in directed

basic research must be tempered by the understanding that this data set does not include an appropriate proportion of respondents from the emerging biotechnology and genomics enterprises, which invest significantly in this category. It does include traditional pharmaceutical companies, whose support of directed basic research is strong.



As with the 2002 data, there is an emerging recognition that internal R&D has the potential to create new businesses, possibly in a more cost-effective manner than acquisition, thus creating sustainable technological competitive advantage. Possibly in response to the recognized difficulty with initiating totally new businesses within an existing corporate structure (crossing the “valley of death”), more companies are suggesting they will spin out the new business ventures spawned by their technology platform development successes.

IRI’s forecast suggests that, in addition to support of new business growth, member companies will invest in partnerships and new ventures, at an increasing rate. Most industrial companies have been reducing staff for a number of years and are now at a point where further staff

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reductions will affect their ability to remain competitive. IRI companies, some of which fall into the category above, are indicating a much greater willingness to leverage this core staff with investments in partnerships with universities and the federal laboratories. This change indicates industry and these groups have learned to work together better. There is concern that growing support for university work by industry is skewing the academics' focus away from basic research toward more short-range efforts.

The drop in industrial R&D spending may not be a harbinger of reduced competitiveness. Major strides have been made in high-throughput methodologies of research and for information handling. This can mean more efficient research. It is also apparent that U.S.-based companies are increasingly outsourcing R&D to Asian companies. The reduced costs and abundance of talented scientists and engineers is appealing. The downside is a real potential to lose intellectual property and spinout opportunities as the Asian professionals start their own businesses with what they have learned in the U.S. companies. This is very similar to success stories of the last few decades in the U.S.

There has been no significant change in the forecast of capital spending for R&D over the past three years. However, the forecasts for professional staffing level and hiring of new graduates were somewhat more optimistic than the previous year.

## GLOBAL INNOVATION STRATEGIES

**United States:** Over the past ten years, a new innovation system evolved in the U.S., with support from government and industry for basic research in universities, nurtured by rapid growth in venture capital and implemented by industrial firms through strong investments in R&D, capital equipment, and information technology. This highly complex system of innovation is also based on closer collaborations and increasing alliances among industry, universities, and government labs.

The major discontinuity in venture capital funding has not been reversed. Many entrepreneurial businesses are waiting in the wings for seed capital to become available.

Within the government, major change is occurring with the projected demise of the Advanced Technology Program at the National Institutes

for Science and Technology (NIST; see Chapter 13). In spite of a congressional mandate to the national laboratories to partner with industry, funds for partnership programs and the offices to foster and manage such collaborations has been disappearing. Likewise, support for engineering centers and manufacturing extension programs is under severe pressure. On the positive side, funds for federal R&D continue to grow and the former imbalance toward life science funding has been ameliorated somewhat with support for the National Science Foundation (NSF).

The Department of Commerce is carrying out an extensive survey of industrial trends and stated needs in order to help prioritize existing and create new programs to maintain the U.S.'s international competitiveness. It will be imperative that this effort looks at the whole system of innovation in the U.S. and its competitiveness opposite increasingly attractive global venues for research.

**Europe:** The 6<sup>th</sup> Framework program, finally underway is designed to foster a culture of entrepreneurial risk taking; to improve the coordination of innovation policy across Europe; to improve the availability of venture capital; and to streamline the protection of intellectual-property rights in Europe. It is becoming apparent that the European Union investment goal of 3.0 percent of Gross Domestic Product (GDP) spent on R&D may someday be reached but it will not be met by R&D carried out in Europe. European industrial companies, like their U.S. counterparts, are increasingly turning to China, Singapore, and India to staff technical programs. This further widens the gap between Europe and the U.S. in the percentage of high-tech companies in the two market areas.

While there is no great pressure on industrial R&D budgets within the larger established companies in Europe, small high-tech companies are failing with the scarcity of venture capital.

**Latin America:** A movement is underway to initiate a "Framework for the Americas" based on the European model. Its purpose is to develop and nurture entrepreneurs at the grass roots. Many structural elements within the innovation and financial systems of the various countries will need to be addressed before or during such an ambitious initiative.

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**Asia:** China's political leadership continues to encourage investment in R&D by Chinese and foreign companies through tax credits, support of universities and institutes, establishing science/industry parks, and increasing funds to support small and medium enterprises. The "rule of law" in business and intellectual property matters still needs strengthening. In spite of the difficulties, U.S. companies continue to expand their Chinese laboratories to take advantage of the available highly skilled workforce with its 30 percent lower cost.

Japan continues to struggle with its economy. Nonetheless, it is supporting R&D at a level surpassed only by the United States and Europe.

Korean companies have made R&D a high priority for their firms even through these difficult times.

### CONCLUSIONS

2003 will be another difficult year for the U.S. industrial research establishment. The general economic malaise brought on by international threats and the growing deficit makes bold step-out efforts difficult to sell to management. The pressure of Wall Street for immediate gratification makes the term "patient capital" one which will disappear from our language. Only those organizations with talented scientists and engineers, strong technical leadership, and visionary business heads will thrive in this environment... as usual.