

2016 R&D Trends Forecast

Results from the Industrial Research Institute's Annual Survey

IRI's 2015 trends survey results reveal growing optimism for 2016.

The Industrial Research Institute

Since 1982, the Industrial Research Institute (IRI) has undertaken an annual survey of R&D spending expectations among R&D- and innovation-focused companies. Typically, the survey asks R&D leaders about their actual activity and budgets in the past year and their expectations and projections for the coming year. The publication of those results in the January issue of *RTM* has become an annual event.

This year, IRI partnered with *R&D Magazine*, combining the Trends Survey with *R&D Magazine's* Global R&D Funding Forecast (GFF) survey to extend the reach of the survey and expand its scope while preserving historic trends data relevant to IRI's members. Three separate surveys were distributed in mid-2015, each receiving a different number of responses. On average, approximately 222 companies from 37 countries, mostly from North America and Europe responded to each survey. The bulk of respondents (60–85 percent, depending on the survey) came from organizations spending less than \$50 million on R&D each year.

The full 2016 GFF report can be found at <http://www.rdmag.com/articles/2015/11/2016-global-r-d-funding-forecast>. Below, we've excerpted that full report to focus on elements of particular interest to *RTM's* readership and appended IRI's unique sea-change index analyses, not found elsewhere.

Global R&D Funding Forecast

Research and development (R&D) is defined as the process of creating new products, processes, and technologies that can be used and marketed for mankind's benefit in the future. The R&D processes and their costs vary from industry to industry, from country to country, and from year to year. Since January 1959, the editors of *R&D Magazine* have

The Industrial Research Institute (IRI) brings together companies and laboratories from around the world to seek, share, learn, and create best practices and policies in R&D and innovation. IRI is the only cross-industry association of R&D experts in the United States and has been publishing this trends survey for over 30 years, one of the longest running and most reliable forecasts of its type. In 2015, for the first time, IRI has partnered with *R&D Magazine* to gather data and carry out analyses for the forecast. For more information about IRI, visit www.iriweb.org.

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created an annual R&D Funding Forecast (U.S.–focused from 1959 to 2004 and global since 2005) which provides a summary and future outlook for those costs. The 2016 Global R&D Funding Forecast, this year sponsored by the Industrial Research Institute (IRI), reveals that global R&D investments will increase by 3.1% in 2016 to a total of \$1.942 trillion in purchasing power parity (PPP) values for the more than 110 countries having significant R&D investments (more than \$100 million).

As in previous years, the growth in global R&D investments is being driven by spending in Asian countries, and in particular, China. Asian countries (including China, Japan, India, and South Korea) now account for more than 40% of all global R&D investments, with North American investments now less than 30%, and European R&D only slightly more than 20%. China's R&D investments, until recently, had annual growth figures of more than 10% since the 1990s, but these have slowed to less than 7% for 2016. This slower growth, however, is still several times the growth rates of both the U.S. and Europe, whose annual growth rates are in the 2% to 3% range. The rest of the world accounts for a combined 8.8% of global R&D investments with combined average growth of only about 1.5% per year.

Actual Results

R&D investments, especially those for upcoming years, are based on budgets prepared by R&D managers, directors, and executive committees. They're based on what these planners expect to spend, their long-term R&D and product development goals, and what resources they have available to them. Based upon surveys created by *R&D Magazine* and IRI, most global survey respondents (77%) noted that their R&D budgets and expenditures had improved over the past three years (Figure 1) with relatively few (8%) seeing a decline in their budgets/expenditures. Many of the survey respondents (56%) also noted that their R&D budgets increased from 2014 to 2015 (Figure 2), while some respondents (15%) had experienced reductions in their budgets/expenditures. Nearly a third (29%) stated that they had no changes in their R&D support from 2014 to 2015.

The long-term outlook for these researchers was not as positive as you might expect, with only slightly more

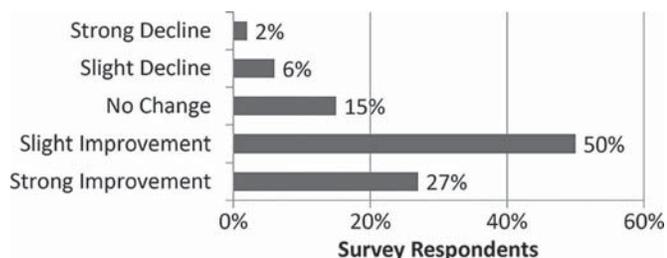


FIGURE 1. Changes in R&D budgets since 2012

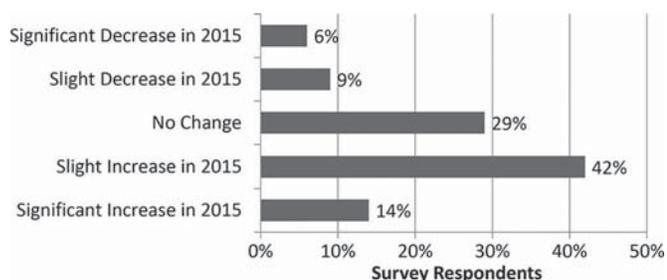


FIGURE 2. 2015 R&D budgets compared to 2014

than half (57%) expecting to see their R&D budgets improve over the next five years (Figure 3). The remaining survey respondents expect to see their R&D budgets decline (11%) or stay the same (31%) as they have in 2015.

Most survey respondents (75%) stated that they basically held to their formal R&D budgets in 2014, while some (15%) overspent their budgets and a few (10%) underspent their R&D budgets. Similar results were obtained from the researchers when they were asked about their current 2015 R&D budgets. These research budgets however were noted as being restricted, since nearly two thirds of the researchers stated they were limited in what research they could perform by their tight budgets—no one stated that they had excess funds, even though they might have underspent their budgets. Despite their budgets, or lack thereof, most researchers we surveyed indicated that their R&D was successful in 2014. Only a handful (6%) noted that their R&D was unsuccessful.

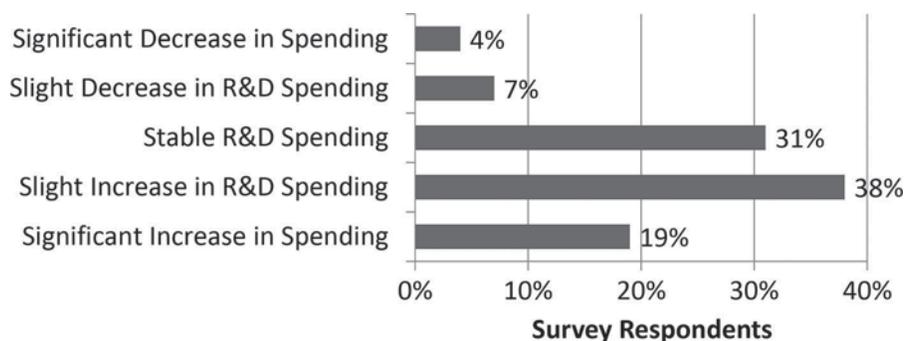


FIGURE 3. Outlook for R&D spending by 2020

U.S. R&D Improves, But with Limitations

U.S. researchers—all those in government, industry, and academic labs—struggled throughout 2015 with a host of uncertainties to understand how to plan for their 2016 R&D budgets. And as we close out 2015, many of those uncertainties have not been allayed. The overriding factor in 2015 was the global economy and its effects on all areas of the R&D environment, what measures might be employed to support it, and how effective those measures might be. All types of factors that bear upon the R&D arena have become involved—politics, economics, technologies, global trade, regulatory, and more.

For 2016, total U.S. R&D spending is expected to increase by 3.5% to \$507.8 billion or a 2.0% increase after accounting for 2016's expected 1.5% inflation rate. This is the third consecutive year of positive increases following flat R&D growth in the recession-recovery years. *[Still, a number of factors combined to create a weaker than expected environment for strong fiscal growth.]* However, the U.S. fares better than most other overseas economies. This strength . . . can be attributed to the U.S.'s strong energy resources and the potential for both short- and long-term improvements.

[One large source of continuing uncertainty is fluctuating federal funding levels. As this report goes to press, the US Congress has yet to finalize a budget for FY2016. Just how the budget and negotiations around it will affect R&D spending remains to be seen, although federal R&D allocations are likely to be larger than was initially anticipated in the drafting of this report.]

The Global Researcher

Effective research and development has many different aspects and components, including innovation, funding, technologies, and the scientists and engineers that make up the R&D staff. How those researchers feel about their work and their R&D environment makes up this section of the 2016 Global R&D Funding Forecast.

Innovation is considered one of those key aspects that drives the development of new and successful product development. In the various surveys that we performed to create this report, one of the questions we asked researchers was if the level of innovation within their organization was adequate. Surprisingly, more than half (56%) stated that the level of innovation within their organization was NOT adequate.

When the researchers were asked about the innovativeness of their own personal work, their company, industry, and country, more than 40% of the survey respondents stated that they were personally very innovative, while only ranking their group, organization, organization's R&D, competitors' R&D, industry's, and country's innovativeness in the 18% to 26% range for being very competitive. Looking at a composite

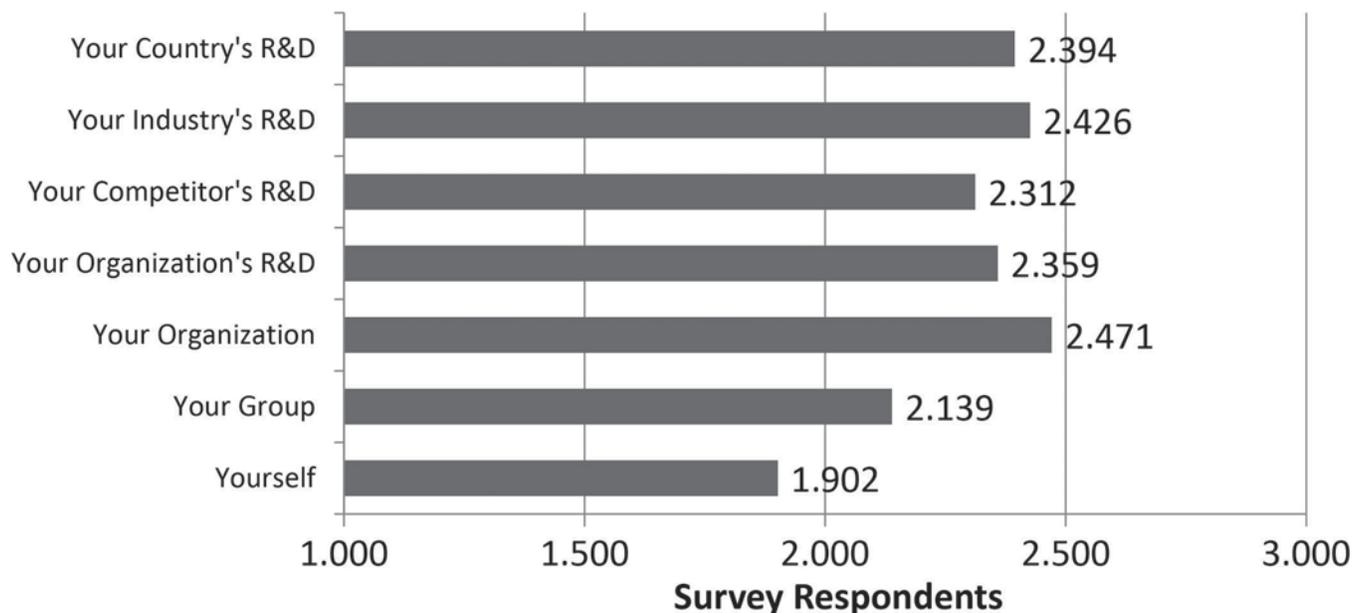


FIGURE 4. How do you rate your innovation?

of these rankings, with 1.0 being very innovative and 5.0 being not innovative at all, the average rankings reveal the disparities between the different groups (Figure 4).

The R&D Budget

Nearly two-thirds of the researchers we surveyed stated that they had larger R&D budgets in 2014 than they did in 2013 by an average of about 7%. About 20% stated they had similar budgets and the remaining researchers (16%) stated they had smaller budgets in 2014 than they had in 2013, again by about 7%. Most of those researchers (75%) stated that they held to their budgets, while about 15% overspent their budgets and the remaining 10% underspent their budgets.

While the majority of these researchers had larger budgets in 2014 than they had in 2013, they still stated that they were limited in what they could do by a shortage of R&D funds. Most of the researchers (74%) stated that their R&D in 2014 was successful. Only 6% of the survey respondents stated that their R&D was unsuccessful—only 2% said it was extremely unsuccessful, while the other 4% said it was only slightly unsuccessful.

The ratios were quite similar when looking at the researchers' 2015 versus 2014 R&D budgets. Again, nearly two-thirds (62%) said they had larger R&D budgets in 2015 than they had in 2014, 20% had similar budgets and 15% had smaller R&D budgets in 2015 than they had in 2014. The larger R&D budgets for 2015 averaged about 6% larger, while the reduced R&D budgets for 2015 were about 5% smaller. Very few researchers (3%) had budgets that were more than 10% smaller than in 2014 while a considerable number of researchers (12%) stated that their 2015 R&D budgets were more than 10% larger than in 2014.

Looking at how researchers distribute their R&D budgets, the largest portion of the R&D pie is dedicated to staff salaries (33%) (Figure 5). This is consistent with R&D funding reports

we've created in the past. Capital spending takes up the next largest share at 18%, and this accounts for new research lab designs, construction and renovations; new large instrumentation and equipment purchases; and the creation of specialized testing structures and systems. Often, the capital expenditures assigned to the organization's R&D budget are of a lower scale, while larger structures and systems are assigned to capital budgets in the operational side of the organization. In that regard, the cost for a new NMR system might be allocated to the R&D budget, while the cost of a relatively massive structure for housing that same NMR would be allocated to the organization's operations budget. The bulk of the remaining R&D budget is comprised of materials (15%), supplies and consumables (11%), overhead including utilities, maintenance, and support (12%), and outsourcing (6%). A 5% "other" category for the R&D budget can accommodate things like licensing, legal fees, transportation, training, recruitment, and emergency activities and systems.

Finding the Money

Researchers... get funding for their work from a variety of areas (Figure 6). The largest fraction of researchers get funding for their research operations from internal sources, be that

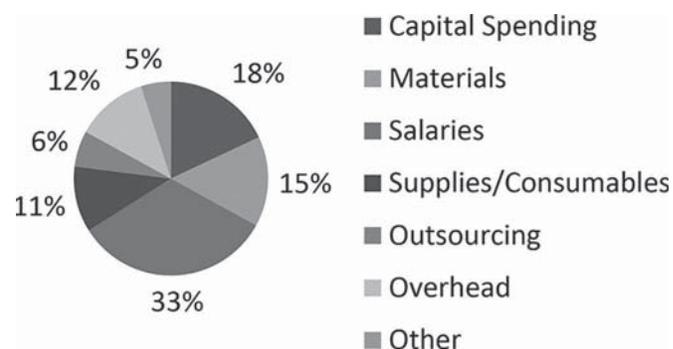


FIGURE 5. Distribution of R&D investments

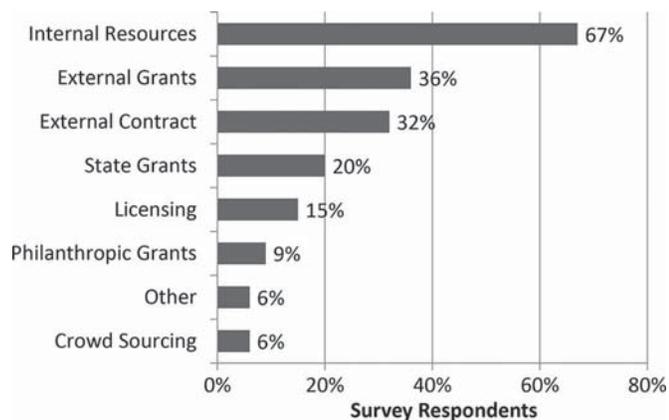


FIGURE 6. What are the funding sources for your R&D?

for industrial, government, or academic types of operations. The second largest source of funds (36%) comes from external grants, such as those that might come from the NIH or NSF for academics or biopharmaceutical researchers, or from the DOD or National Institute of Standards and Technology (NIST) for industrial or aerospace organizations.

R&D funding from external contracts (32% of the survey responses) is the third largest source of funds for R&D organizations. These contracts include the work funded by the federal government to industrial R&D organizations and between industrial companies for contract research work. Crowd sourcing is a popular method of obtaining research funding, but still the smallest category of funding sources (6%).

Finding the money for R&D is important for creating a strong, innovative R&D environment. The largest component of an organization's R&D budget is that part dedicated to scientists/engineers salaries (33% of the overall budget). The highest importance within the R&D environment, according to our survey, is that component responsible for attracting and maintaining an adequate R&D staff—nearly two-thirds of the researchers surveyed indicated this component as having the highest importance for their R&D. Money is obviously just one component for maintaining and attracting researchers, but it is likely the most important component. Tied closely to creating a strong research staff is the creating of an innovation culture within the R&D organization, according to our survey results.

As a carry-over from the lessons learned in the Great Recession of 2008–2009, many R&D organizations still run a lean operation. “Our biggest concern for our 2016 R&D budget is a decreased R&D budget due to limited or declining sales,” says one researcher. “Our biggest concern for our 2016 R&D budget is our business performance, which is driven by currency exchange rates and soft industrial markets,” says another researcher. Economics (as applied to funding R&D operations) and, to a much lesser degree, R&D staffing dominated the concerns of our survey respondents.

IRI's Sea Change Index and Historical Trends

This portion of the analysis was conducted exclusively by IRI and does not appear in other editions of the GFF study.

The collaboration between IRI and *R&D Magazine* involved distributing three separate surveys over a period of several months in mid-2015, each survey focusing on a different aspect of R&D spending and timeframes. The historic data reported in this portion of the report was gathered from the third and final survey and included 191 responses, of which 100 were from organizations that typically spend \$0.5 million or more on R&D each year, the population from which IRI's historical data has been drawn (Table 1). As a result of the different mix of respondents accessed by the collaboration, this year's survey is heavily biased towards companies spending between \$0.5 million and \$50 million on R&D in the coming year (Table 2), with 80 of the 100 responding companies investing in R&D in this range.

TABLE 1. Respondents spending >\$0.5 million on R&D, by industry

Industry	Responses
Academia	15
Healthcare, Medical Products & Pharma	11
Aerospace & Defense	8
Chemicals, Gasses and Advanced Materials	8
Electronics/Semiconductors	7
R&D Services	7
Biotech, Biological, Genomics	5
Federal Lab, Government, Nonprofit	5
Food, Tobacco & Related Products/Services	5
Automotive	4
Computer, Software and Related Products	4
Energy, Utilities	4
Industrial Machinery, Equipment & Products	4
Consumer Products	3
Paper & Allied Products	3
Construction	2
Instrumentation	2
Legal/Financial	2
Petroleum & Related Products	1
Textiles, Apparel	0
Total Responses	100

TABLE 2. 2015 R&D spending among respondents investing >\$0.5 million

2015 R&D spending (in \$ millions)	Responses
>1,000	5
501–1,000	4
101–500	6
51–100	5
11–50	11
6–10	17
1–5	33
0.5–1	19
No Response	0
Total	100

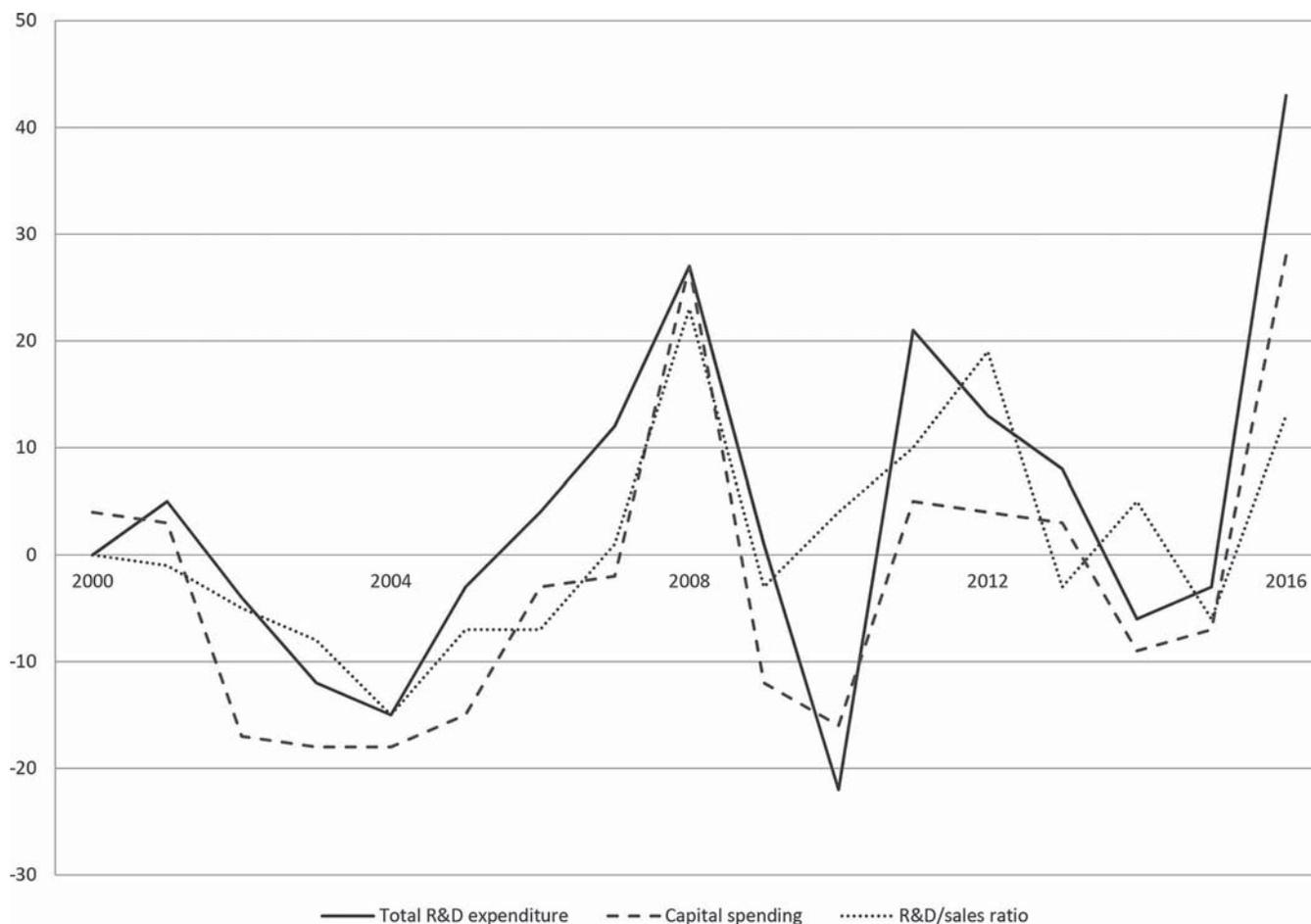


FIGURE 7. Sea change index for overall R&D spending, 2000–2016

Historic Data

Historic data is invaluable as it allows the ability to visualize trends over time that may reveal more about R&D spending expectations than that provided by a one-year snapshot. To maintain the historic data typically gathered by IRI, responses were analyzed through the lens of IRI's proprietary Sea Change Index. This index is calculated by subtracting the number of respondents who anticipate a negative change from the number who anticipate a positive change in spending for each category and then normalizing the data to a 100-point scale by dividing the difference by the number of responses. The range of the index varies from -100 to $+100$ percent. It should be noted that the index does not measure actual growth rates; it measures sentiment (optimism vs. pessimism). Survey responses indicating zero expectations of change are not considered a part of the analysis; only those expecting an increase or a decrease are included. Likewise, it should be understood that sentiment, both positive and negative, can be moderated when the bulk of responses report expectations of little to no change. In this year's report, respondents expecting little to no change accounted for approximately 40–60 percent of responses, depending on the question, allowing the sentiment obtained by this analysis to be considered relevant and reliable.

Data for this year's R&D spending expectations reveals a strong upswing in positive sentiment regarding next year's investment levels (Figure 7). Respondents show the most growth in positive expectations for total R&D spending of any IRI survey in the last 15 years. This year's sea change score for total R&D investment expectations revealed a reading of $+43$ percent, up from last year's reading of -3 percent. While this does not represent the percentage of growth to be expected, it does indicate that there is high optimism regarding total R&D spending. Other categories showed similar, though less startling gains. Capital spending moved from -7 to $+28$ percent, and the R&D/sales ratio shifted from -6 to $+13$.

The data also show optimism across spending categories, the most significant change coming from the historically negative categories of Support of Existing Businesses (labeled "Technical Service" in the survey) and Directed Basic Research, both of which moved significantly upward from last year's pessimistic reading to one showing moderate optimism moving into 2016 (Figure 8). Support for new business projects (labeled "Development" in the survey), showed one of the highest readings ($+41$ percent) in the survey's history, topped only by 2001's surge to $+44$ percent.

This optimism seems to be more moderated, however, in several collaboration categories. While sentiment regarding investment in overall R&D is on the rise, and

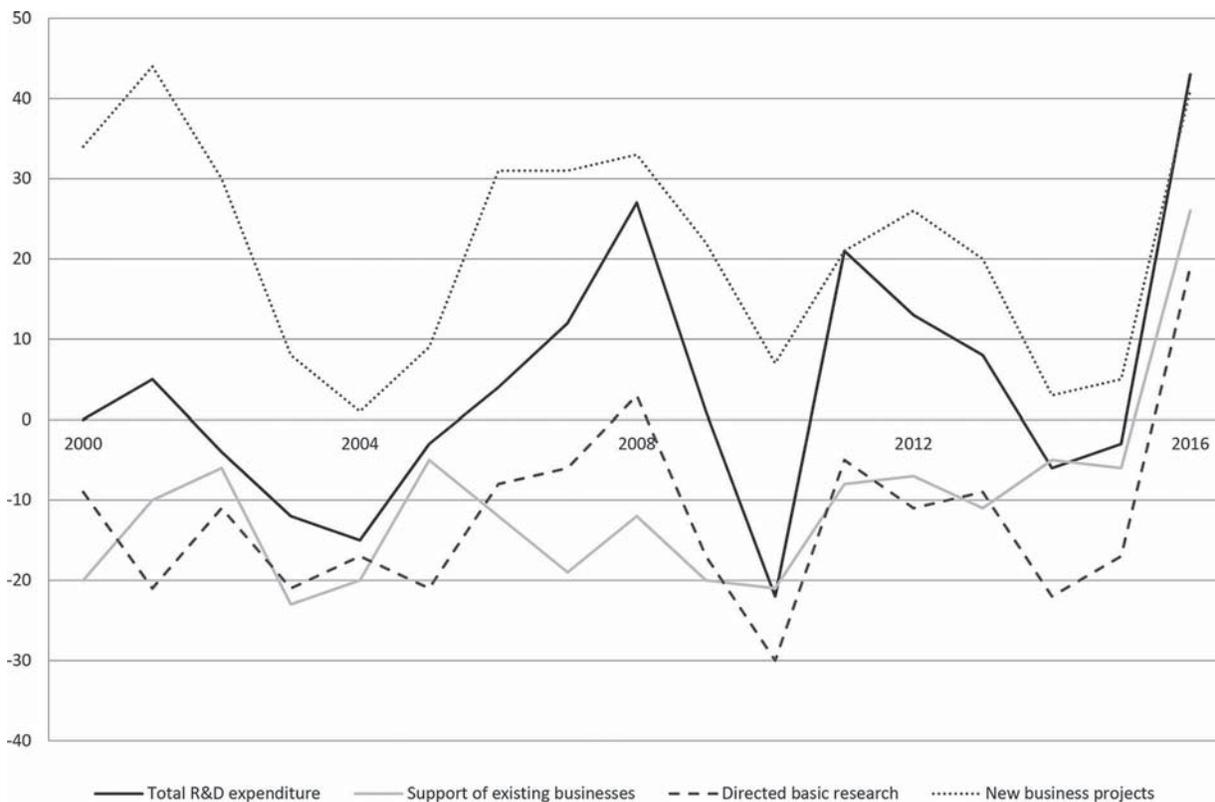


FIGURE 8. Sea change index for R&D spending by type, 2000–2016

companies appear to be shifting funds toward directed basic research, collaboration between industries is showing a weaker tendency than last year (Figure 9). Expectations for Participation in Alliances and Joint Ventures

and Acquisition of Technology through M&A both declined mildly, but this may not be cause for concern. Participants are moderately more optimistic about collaborations between industry and universities and between industry

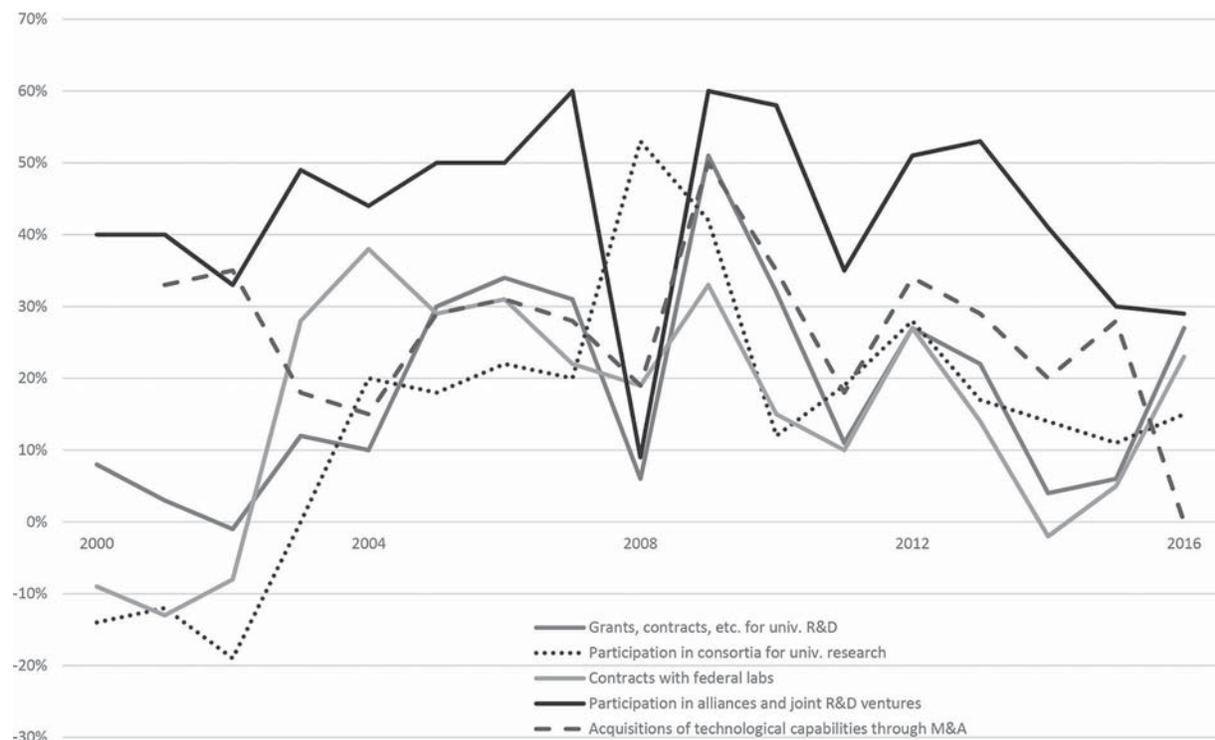


FIGURE 9. Collaboration spending expectations for 2016

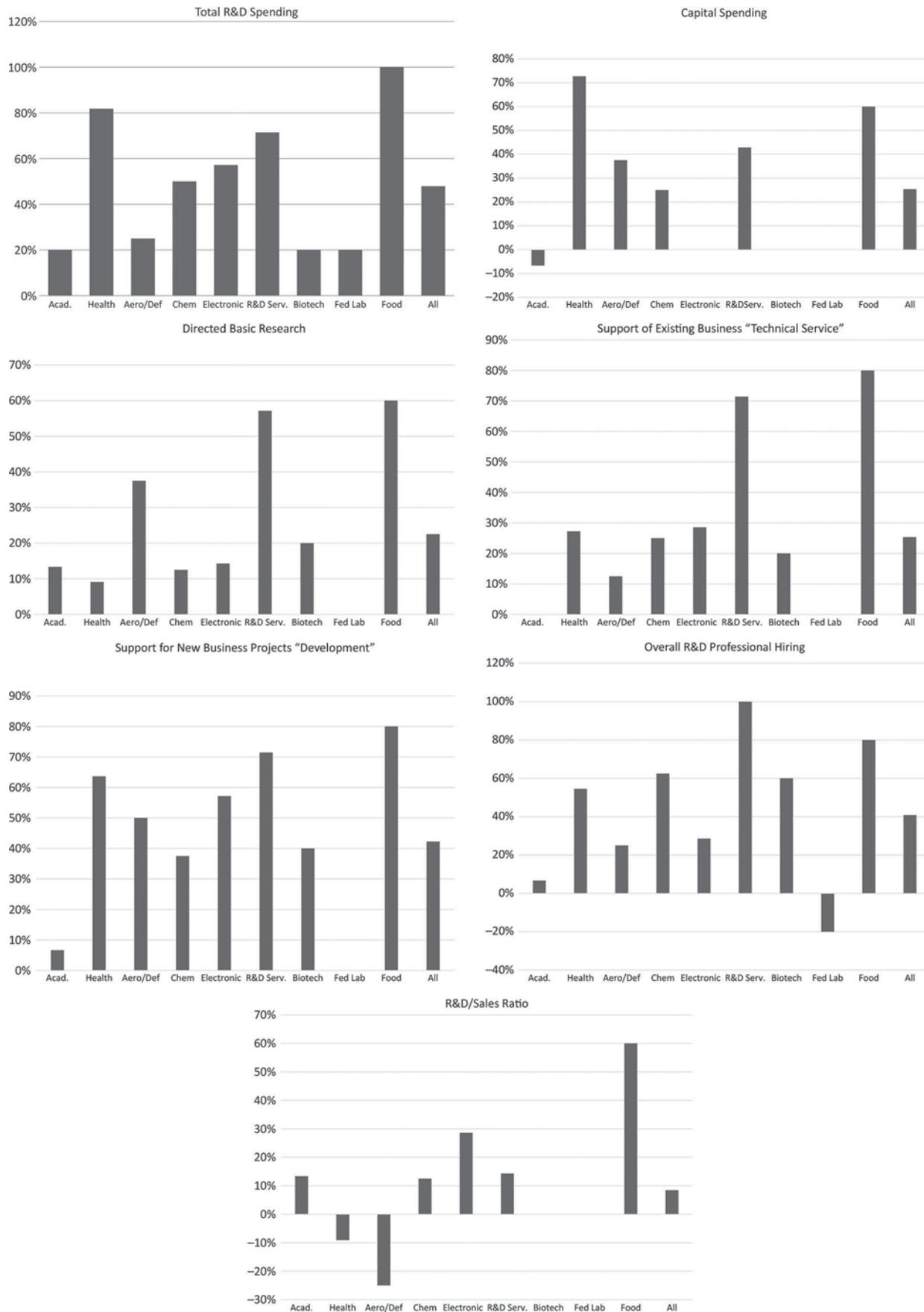


FIGURE 10. Total R&D spending by industry

and federal laboratories, with moderate increases in these indexes from last year's somewhat pessimistic assessments.

Industry Sector Trends

In an effort to capture R&D spending expectations in more detail, the survey asks for information about participants' industry segment; the data are then analyzed by industry segment to examine where the biggest changes are taking

place and which factors are most affecting particular industries. To be included in the segmentation data, an industry sector must be represented by at least five respondents. In this year's instance, inclusion in the segmentation analysis requires five or more responses in the third survey, the specific source of the data for this analysis. This year, there were nine qualifying industrial segments: academia, healthcare/medical devices, aerospace/defense, chemicals, electronics, R&D services, biotech, federal laboratories, food, and all.

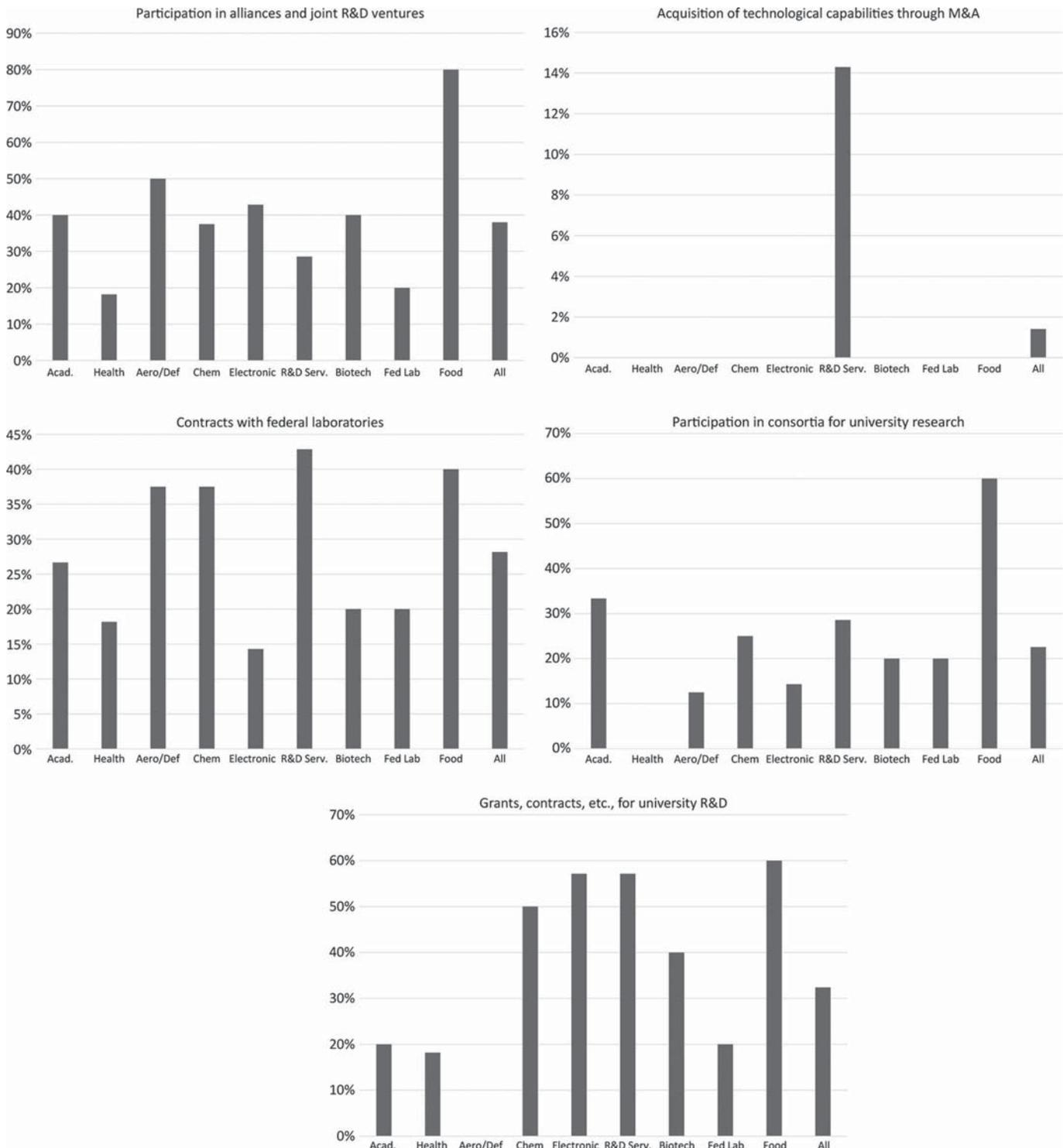


FIGURE 11. Spending on R&D collaboration by industry

electronics, R&D services, biotech, federal labs, and food. The data on spending across these industrial segments largely align with the overall survey results, with a few exceptions (Figure 10).

Across spending categories, trends for individual industries are in accord with the overall data, except for capital spending in academia and federal laboratories, which show negative and neutral tendencies, respectively. The targeted R&D/sales ratio overall was only slightly optimistic in the aggregated data, but in the segmentation data, aerospace/defense and healthcare companies show negative sentiment in this category. Two categories stood out in the full data as significantly more optimistic than previous iterations of this survey, Support of Existing Business and Directed Basic Research. This analysis holds true in the segmentation data, as well, for all sectors except academia and federal labs. Academia shows neutral sentiment (0 percent tendency) for the former category and a mildly optimistic tendency (+10 percent) for the latter. Federal lab respondents are neutral on both categories.

In the collaboration categories (Figure 11), analysis across industrial segments largely aligns with the overall view, with only two minor exceptions. Healthcare/medical device companies reported neutral sentiment towards participation in consortia for university research, a slight improvement in sentiment from last year. Aerospace/defense companies were also neutral toward grants/contracts for university R&D, the category that exhibited the most dramatic upswing on the overall sea change index.

Segmentation can offer some interesting perspectives on the overall data. Some trends appear to make a stronger showing when data are segmented by industry, skewing more strongly either positive or negative in the industries analyzed. For instance, sentiment regarding capital

spending is highly optimistic in the overall data, but three of the nine segmented industries expect no change in this area, and one (academia) expects a decline. Sometimes the data can reveal a weak spot in a major trend. One example is overall professional hiring, which is strongly rising in the overall view but shows a decline for US federal labs (in this case, for the second year running). Likewise, participants are increasingly optimistic about support for new business projects overall, but federal labs show a mild decline in sentiment for this category. One remarkable standout in the data is the very strong showing of food companies, which reported expectations of moderate to strong growth in every category except one (Acquisitions of Technology through M&A).

Summary

Overall, R&D managers are much more optimistic about R&D investment growth going into 2016 than they were in last year's survey. New business projects remain a key driver of investment, but collaboration activities, which had been strong, are this year a small weak spot, but still positive overall; this year, all categories reported a sea change index reading above 0.

Hiring expectations for R&D professionals appear to be continuing their growth across almost every industry segment with the exception of federal labs, whose budgets were uncertain at the time surveys were distributed. Global investment patterns also appear to be stable. In stark contrast to last year's neutral to pessimistic outlook, this year's respondents expressed record optimism regarding R&D spending. However, economic fundamentals remain ambivalent and, with the federal budget still to be negotiated, it remains to be seen whether that optimism will be supported by events.

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