

2017 R&D Trends Forecast

Results from the Industrial Research Institute's Annual Survey

Slowing economies slow R&D investments and mute optimism.

The Industrial Research Institute

The Industrial Research Institute (IRI) has undertaken an annual survey of R&D expectations among R&D- and innovation-focused companies since 1982. This survey typically asks R&D leaders about their actual activity and budgets in the past year and their expectations and projections for the year ahead.

In 2016, for the second year, IRI combined its traditional R&D Trends survey with the annual Global R&D Funding Forecast, created by the editors of *R&D Magazine*, allowing for a larger dataset and, hence, a stronger analysis. Data were collected via three separate surveys distributed between June and August 2016. On average, each survey attracted just over 300 respondents; the bulk of participating companies (65–85 percent, depending on the survey) spent less than \$50 million a year on R&D in 2016.

The full 2017 Global R&D Funding Forecast report can be found at www.rdmag.com/2017GFFReport. Below, we've included the preliminary snapshot of the forecast data and appended IRI's unique sea-change index analyses, which are not included in any other versions of the report.

Global R&D Funding Forecast

R&D Magazine's 58th annual Global R&D Funding Forecast estimates that global R&D investments will increase by 3.4% in 2017 to \$2.066 trillion in purchasing power parity (PPP) values for the more than 115 countries having significant R&D investments (those countries with more than \$100 million in R&D investments). The growth rate on R&D investments has slowed for 2017 as the overall slowing global economy is being reflected in the amount of monies that are now available for R&D endeavors.

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, the only cross-industry association of R&D experts in the United States, has been publishing its trends survey for more than 30 years, making the IRI Trends Survey one of the longest-running and most reliable forecasts of its type. This year, again, IRI 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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The overall global R&D forecast is a combination of the industrial, government, and academic investments by each country. Much of the R&D investments are driven by the country's economic situation, which is characterized by its gross domestic product (GDP). Our forecast is based on a combination of specific country economic values, published relationships of the country's science and technology (S&T) to its economy, and the most recent economic forecasts by organizations such as the International Monetary Fund (IMF), the World Bank, the Organization for Economic Cooperation and Development (OECD), and the US's Central Intelligence Agency (CIA).

The Global Overview

As noted over the past 10 years in these forecasts, the overall growth in global R&D investments is being driven by substantial increases in Asian countries and especially in China, which for many years increased its R&D investments by more than 10% per year. Over that many years, the Chinese rate increases are basically unsustainable and its current R&D growth rate is now in the 7% growth rate range, which is still more than twice that of the US and most European countries. This year, Asia accounts for more than 42% of all global R&D investments (Table 1). Its share rate continues to increase each year at the expense of all the other countries investing in R&D.

The US continues to be the country with the largest investments in R&D, a title it has held for the past 50 years. The US share of the global R&D pie continues to shrink due to the higher growth rates in Asia, however, at a slowing rate over the past five years. Economic turmoil in many developing-world countries and countries with social strife are seeing stagnating R&D investment rates, which are not keeping pace with the advanced North American and European economies and the Asian high-growth economies.

Over the past 12 months, the recovery from the 2008–2010 global recession has slowed, with consecutive economic growth forecasts from the IMF that have reduced its overall outlook in a pattern of forecasts released approximately every three months. The most current IMF World Economic Outlook (October 2016) again reduced its growth

TABLE 1. Gross domestic expenditure on R&D (GERD) and share of total global R&D by region/country

Region/Country	GERD (in \$ billion)			Share of Total Global R&D		
	2015	2016	2017	2015	2016	2017
North America (12 countries)	538.4	555.9	571.9	27.9%	27.8%	27.7%
<i>United States</i>	496.8	512.5	527.5	25.8%	25.6%	25.5%
South America (10 countries)	52.0	50.0	50.0	2.7%	2.5%	2.4%
Europe (34 countries)	416.6	423.0	429.2	21.6%	21.2%	20.8%
<i>Germany</i>	112.2	112.5	112.5	5.8%	5.6%	5.4%
Asia (24 countries)	795.2	845.4	887.0	41.3%	42.3%	42.9%
<i>Japan</i>	164.6	172.3	173.4	8.5%	8.6%	8.4%
<i>China</i>	372.8	401.0	429.5	19.4%	20.1%	20.8%
<i>South Korea</i>	74.7	80.9	83.9	3.9%	4.0%	4.1%
<i>India</i>	67.7	72.8	77.5	3.5%	3.6%	3.8%
Africa (18 countries)	18.4	18.0	18.4	1.0%	0.9%	0.9%
Middle East (13 countries)	47.7	48.7	51.2	2.5%	2.4%	2.5%
Russia/CAS (5 countries)	58.2	57.8	58.4	3.0%	2.9%	2.8%
<i>Total (116 countries)</i>	<i>1,926.5</i>	<i>1,998.8</i>	<i>2,066.3</i>	<i>100.0%</i>	<i>100.0%</i>	<i>100.0%</i>

forecasts for most countries from the updated report it issued in July 2016, which itself revealed a lower growth rate from the IMF's official April 2016 report. This recovery is one of the longest recovery periods on record and has negatively affected the growth rates on emerging economies.

The US economy continues to outpace many other Western economies with strong programs in place for ensuring continued, albeit slow growth. Supporting this growth is a strong cadre of academic institutions, a strong organization of federal government research organizations and facilities and strong industrial organizations. Over the past two years, industrial investments in R&D appear to be increasing at a time when many federal organizations have frozen their R&D budgets and investments due to budgetary restrictions and constraints.

A number of technological trends, which include biopharmaceuticals, automation and robotics, artificial intelligence, cloud computing, autonomous transportation systems, unmanned aerial systems and advanced military and weapons systems, ensure that technology will continue to drive new advances for the next five years and beyond. Global warming, energy resources, and food production do not appear to represent insurmountable challenges.

Global demographics also appear to be driving technological demands, economic and R&D funding hurdles, and possible future research staffing issues, as well, on a global basis. Most countries, and especially Japan and China, are facing an increasing rate of aging populations that directly impact these challenges.

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.

R&D Magazine and IRI distributed three separate surveys over a period of several months in mid-2016, each survey focusing on a different aspect of R&D spending. The historic

trends data reported in this portion of the report was gathered from the third and final survey, which drew 315 total responses, of which 176 were from organizations that spend \$0.5 million or more on R&D each year, the population from which IRI's historical data has been drawn (Table 2). This year's survey is heavily biased toward companies that spend between \$0.5 million and \$50 million on R&D (Table 3),

TABLE 2. Respondents spending >\$0.5 million on R&D, by industry

Industry	Responses
Academia	25
Medical/Diagnostics	16
Government/Nonprofit	15
Biotech/Biological/Genomics	12
Automotive	11
Machinery/Equipment	10
R&D Services	10
Aerospace	9
Materials/Chemicals/Gases	9
Energy/Utilities	8
Pharmaceutical	8
Communications	7
Food/Beverage	7
Electronics/Semiconductor	7
Defense/Military/National Security	5
Federal Laboratories	4
Petroleum/Polymers	4
Computer/Software/Internet	3
Instrumentation	2
Agriculture	1
Construction	1
Mining	1
Processing	1
<i>Total Responses</i>	<i>176</i>

TABLE 3. 2016 R&D spending among respondents investing >\$0.5 million in R&D

2016 R&D Spending (in \$ million)	Responses
>1,000	12
501–1,000	6
101–500	11
51–100	11
11–50	21
6–10	16
1–5	48
0.5–1	46
No Response	5
<i>Total</i>	<i>176</i>

with 131 of the 176 responding companies reporting their 2016 R&D budgets in this range.

Historic Data

Historic data is invaluable as it allows the ability to visualize the direction over time of trends, which may reveal more about R&D spending expectations than the view 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 dampened by the data when the bulk of responses are expecting little to no change. In this year's report, respondents expecting little to no change returned approximately 30–50 percent of responses, depending on the question, allowing the sentiment obtained by this analysis to be relevant and reliable.

Data for this year's R&D spending expectations reveal a modest drawback from last year's positive upswing in expectations for total R&D spending in 2017 (Figure 1). Last year's data revealed a 15-year peak in R&D spending expectations, surging up to $+42$ from 2015's reading of -3 . This year's sea change score for total R&D investment expectations pulled back from that high to a reading of $+31$ percent. While this does not represent the percentage of growth to be expected, it does indicate that there is a level of pragmatism pulling back on last year's optimism towards total R&D spending. Other categories showed similar drawdowns. Capital spending moved from $+28$ to $+5$ percent, and the R&D/sales ratio shifted from $+9$ to $+3$.

The data also show a general tempering of optimism across spending categories. Support for new business (labeled "Development" in this survey) is expected to remain positive overall but down from last year's reading of $+43$ to this year's $+39$ percent (Figure 2). Support for existing business projects (labeled "Technical Service" in the survey) shows a counter movement to the general

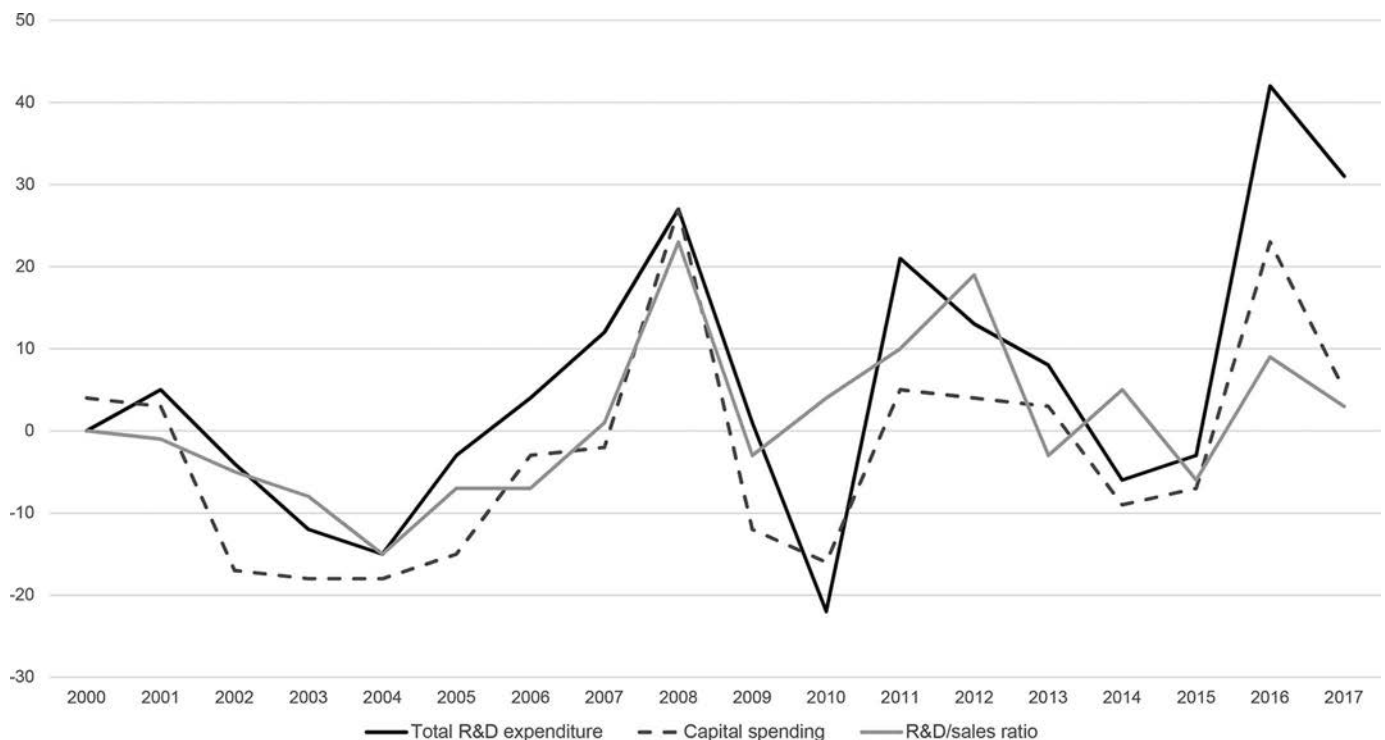


FIGURE 1. Sea Change Index: R&D expenditures

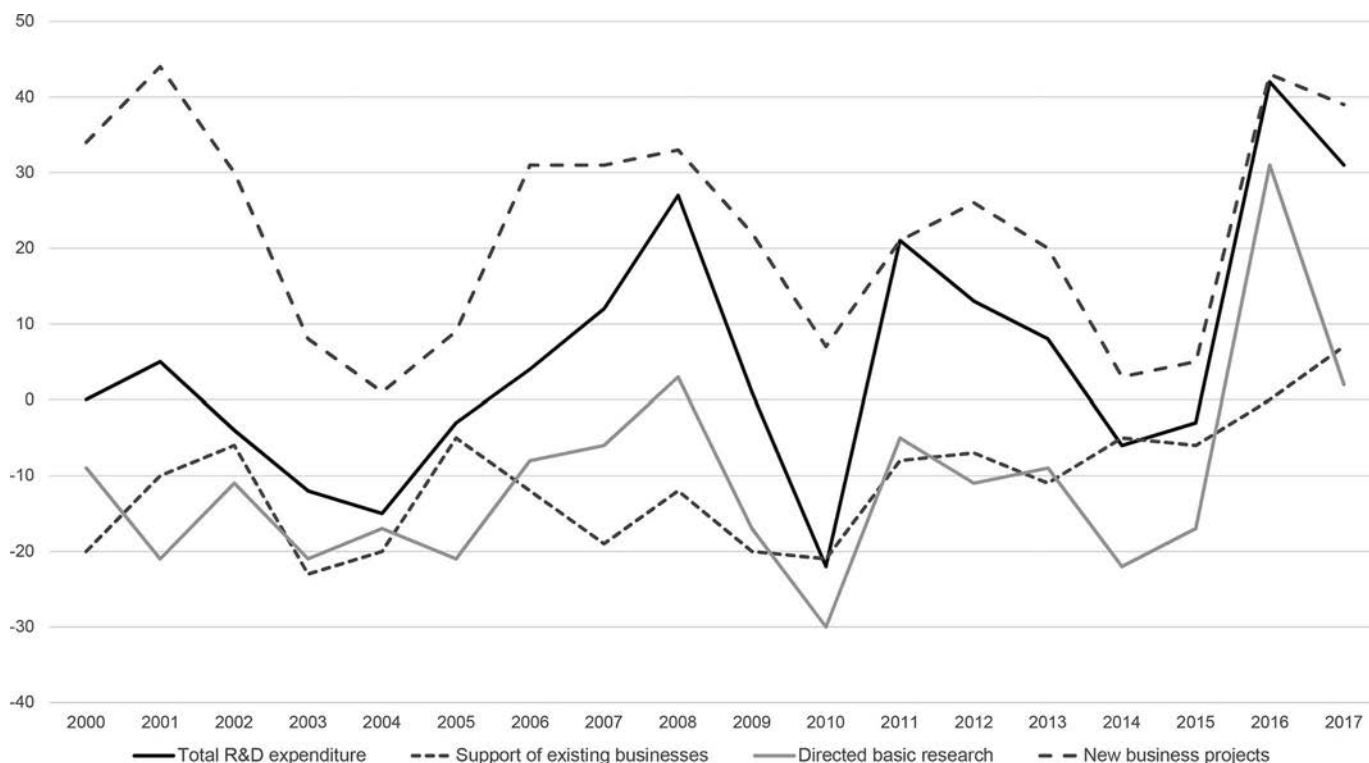


FIGURE 2. Sea Change Index: Expected R&D investments by type

sentiment seen in most of this year's sea change, revealing a strong movement into positive territory and reaching up to +7 from last year's reading of 0 percent. One surprising piece of data from last year's survey, the sudden and rapid climb of expected funding for directed basic research, has this year returned closer to its more historical realm of near-zero sentiment, falling to +2 from last year's +31.

While the data show trends over time that may represent a pull back from optimism to pragmatism, or even a rise in pessimism, it is important to note that all the data, regardless of diminished positive sentiment, remains positive. The data from this year's survey did not reveal any movement into pessimistic territory. This general optimism continues as the analysis shifts to collaboration. Similar to the sentiment regarding investment in overall R&D, collaboration between industries is showing a weaker tendency than last year (Figure 3). Expectations for participation in alliances and joint ventures declined mildly, as did sentiment towards expectations for grants and contracts with universities and federal labs. The remaining two categories, acquisition of technology through M&A and participation in consortia for university research, both reveal mild increases in sentiment. All five collaboration categories range between +5 and +18 percent on this year's sea change index.

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. Historically, to be included in the segmentation data, an industry sector must be represented by at least five respondents. In this year's survey, however, most sectors met this requirement; as a result, we're including only the 10 industries with the most respondents. The data on spending across these industrial segments may help explain why the drawback in sentiment is visible in this year's results (Figure 4).

Overall, the data across industry segments is largely positive, with a few exceptions. These exceptions are perhaps what explain this year's retreat from last year's surge. Not every industry is doing as well as some of the other top performers. Aerospace, for example, shows a pessimistic sentiment toward every major spending category except new business development, and even there the optimism isn't as high as it is in several other industry segments. Likewise, academia is showing mild optimism with regard to total R&D expenditures for 2017, but is showing pessimism in nearly every other category, with the exception of new business development. Academia is the industry segment with the most responses overall, making its impact felt more strongly in the index than other industries. This general pessimism in aerospace and academia, and the lack of optimism or pessimism in the government/nonprofit segment, may help explain why this year's data are not showing as much optimism.

The analysis for collaboration is quite different from that for R&D spending (Figure 5). Here, industries that appear to be experiencing a rise in pessimism toward

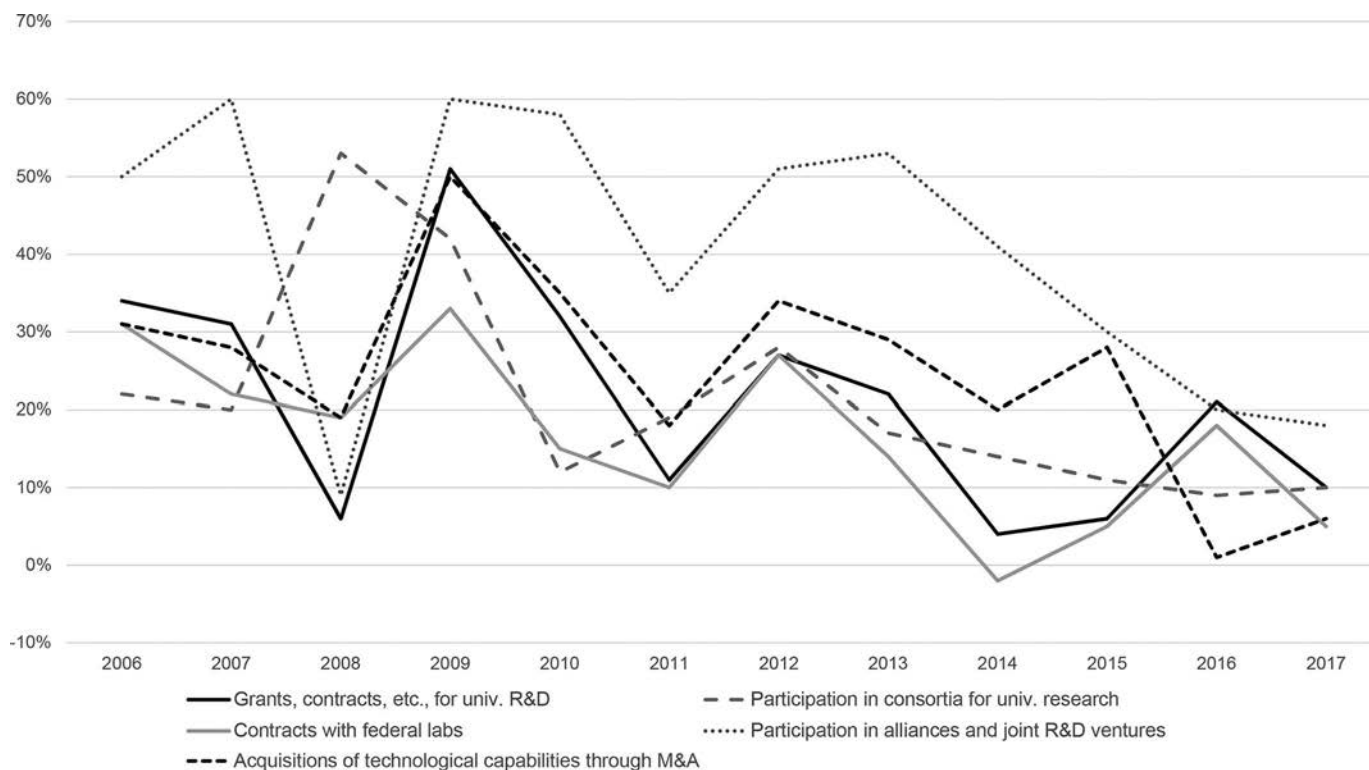


FIGURE 3. Sea Change Index: R&D collaborations

R&D spending show strong upswings in sentiment toward collaborations. Aerospace industries in particular report rising optimism around partnerships and alliances, as well as most other collaboration categories, with the exception of contracts for university R&D. Academia shows similar positive sentiment for every collaboration category but one: acquisition of technology through M&A (a category that may not be relevant for academia in the first place). Similarly, responses in the category of staffing requirements show building confidence in the current economic climate, with almost every industry segment represented exhibiting strong optimism about funding for future staffing needs. Aerospace once again is the exception, with a sea change index of 0 percent. The government/nonprofit segment also shows a small slide into pessimism regarding its future budget for staffing requirements, perhaps a reflection of political uncertainties as much as economic ones.

Segmentation offers some perspective on the overall data. Some trends 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 mildly optimistic in the overall data, but half of the segmented industries reveal pessimistic sentiment in this area, likely explaining why the overall view dipped from last year.

Sometimes the data can reveal a weak spot in a major trend. One example is support for new business ventures (business development), which is strongly optimistic in the overall view and in almost every industry segment. However, the automotive industry shows no sentiment in

either direction for this category. Scanning other areas of spending for the automotive segment may help explain why new business development seems less a priority for automotive companies going into 2017. Looking across spending categories, it can be seen that the automotive segment reports mild optimism about overall R&D budgets, but a big upswing in expectations for capital spending and staffing requirements, and even some mild optimism around availability of funds to support existing businesses, while the R&D/sales ratio and business development funding remain flat. Could it be that the automotive industry, in aggregate, is looking more at investing in new facilities that extend current lines of existing business units than in innovating new product lines? That is one possible explanation for this year's data.

One standout from this year's results is the very strong showing of energy/utilities companies, which reported moderate to strong optimism in every single spending and collaboration category heading into 2017. This is significant because it stands out as the exception, not the rule. Every other industry for which we performed segmentation analyses has a weak spot somewhere in its sentiment, but energy/utility companies reported optimism across the board, and in many areas we asked about, strong optimism—including about R&D budgets, capital spending, partnerships and alliances, and obtaining contracts for research, particularly from universities. This segment has the highest optimism among all of the industries examined around budgets for hiring new personnel. In a report showing mixed sentiment in almost every industry, the energy/utilities segment shines brightly.

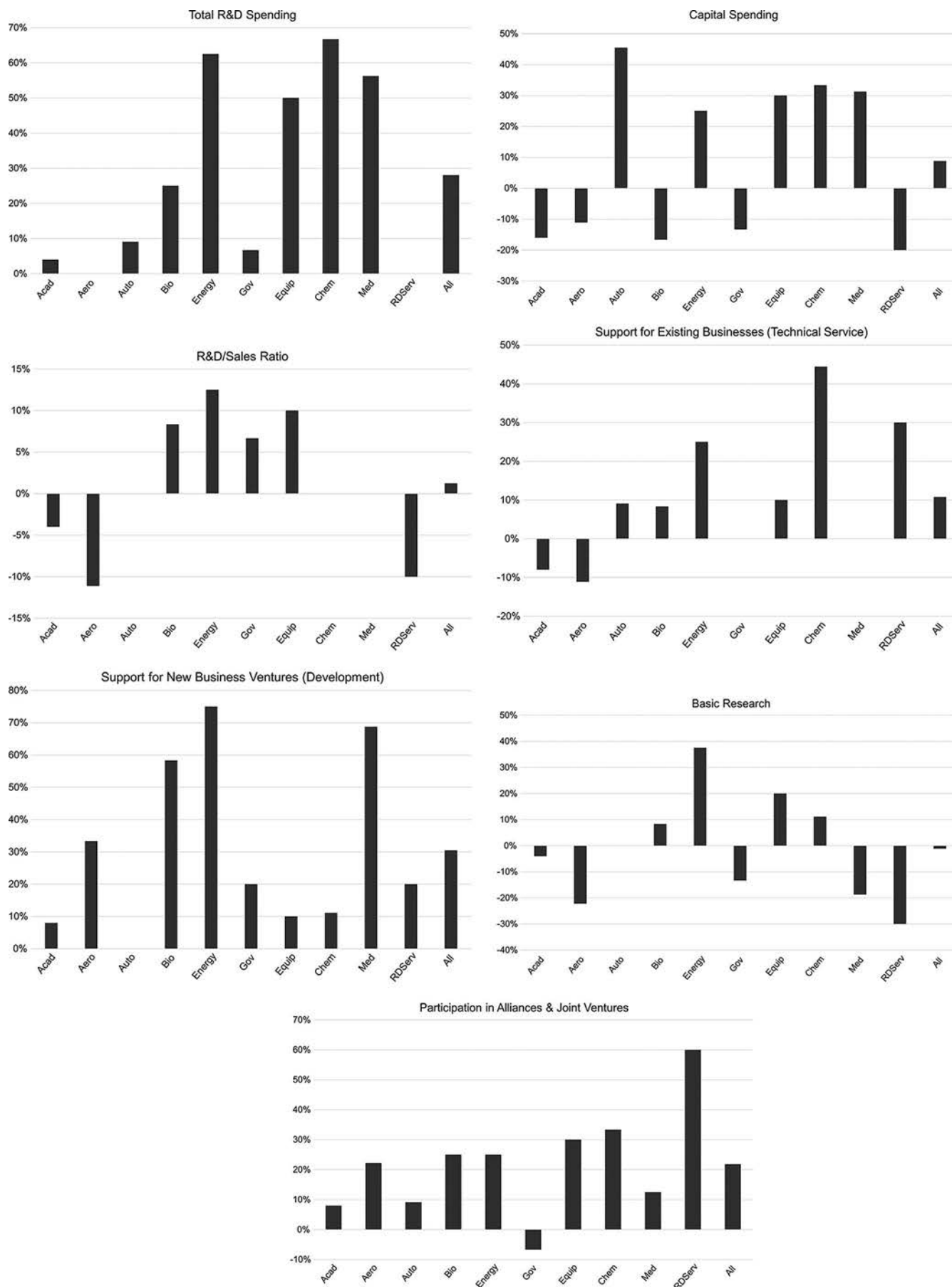


FIGURE 4. Industry segmentation data: R&D spending by type

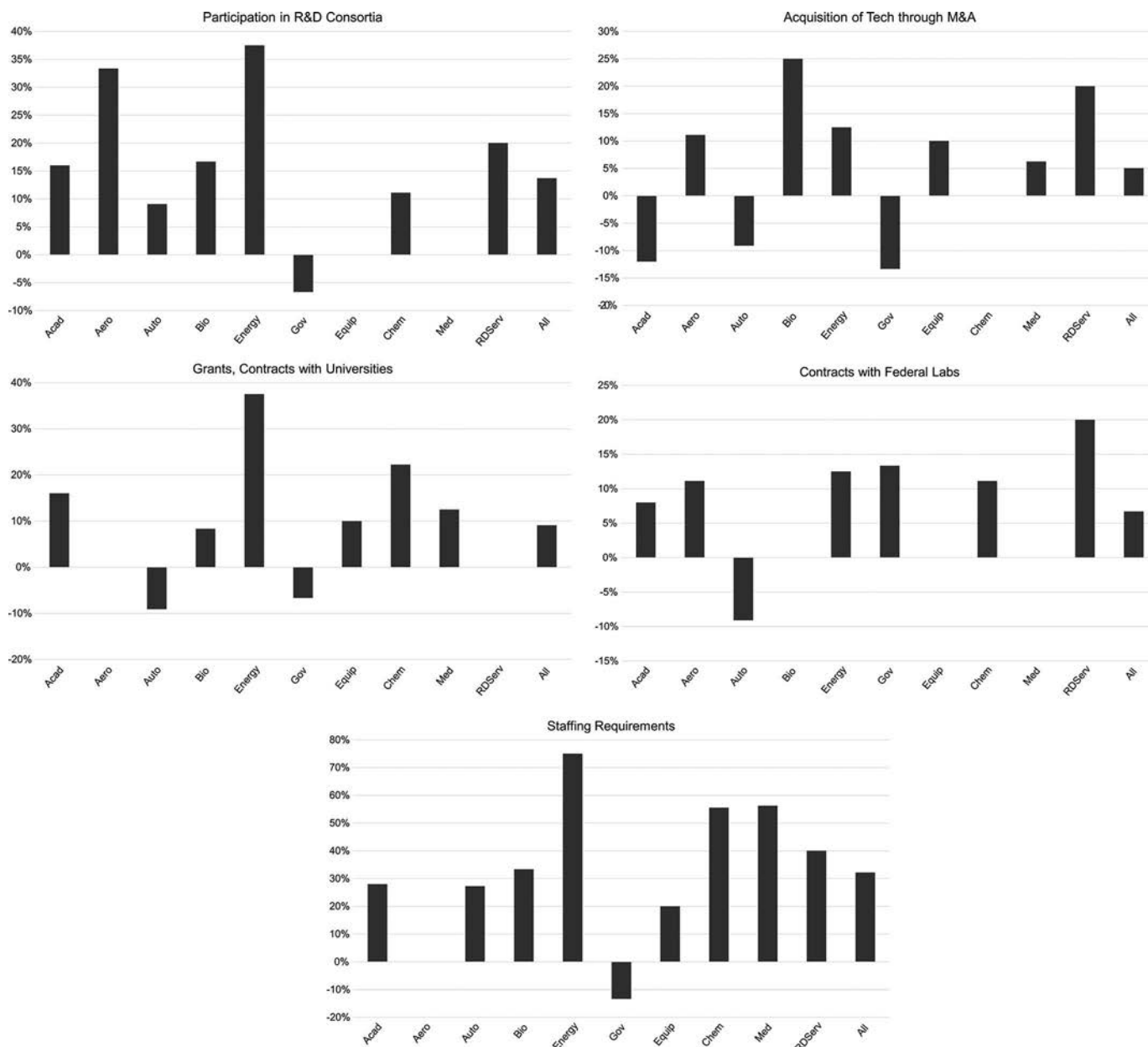


FIGURE 5. Industry segmentation data: R&D collaborations

Summary

Overall, R&D managers are slightly less optimistic about R&D investment growth going into 2017 than they were in last year's survey, but the general atmosphere of optimism remains. New business projects remain a key driver of investment, with all but one industry segment represented in the segmentation analysis reporting a rise in optimism regarding business development. Capital spending and R&D/sales ratio numbers remained positive, but the positive trend is flattened in this year's analysis, compared to 2016. Capital spending in particular shows mixed results, with half the segmented industries exhibiting a decline in sentiment about capital spending budgets next year.

Hiring expectations for R&D professionals appear to be continuing their growth across almost every industry

segment with the exception of aerospace and government/nonprofit, which show significantly less optimism than the other industry segments across the board. Global investment patterns also appear to be stable. Compared to last year's strongly optimistic outlook, this year's respondents expressed only mildly weaker optimism regarding R&D spending.

Conclusion

The Global R&D Funding report finds that growth rates in R&D spending began slowing in mid to late 2016. Likewise, the outlook for R&D investments in 2017 is for diminished growth, reflecting the current global economic climate. This slowdown has affected available funds for R&D and may help explain the dip in sentiment about R&D spending

across multiple categories heading into 2017, as captured in IRI's Sea Change Index. However, it should be highlighted that sentiment remains positive—although less positive than in the past—across every category of R&D spending and collaboration across industry, government, and academia. That some industries appear more affected than others by current conditions is typical fare, regardless of the economic climate. With limited global resources and

open competition, some industries will do better than others. The many bright points of data within this analysis—that some industries are expressing mostly positive sentiment, that hiring is universally going up or staying the same, and that optimism far outweighs pessimism across the board—suggest that the more negative analyses of the state of global R&D spending may be little more than fearmongering.

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