



Two NSF Surveys on R&D Document Varied Relationships between Businesses and Academia

by Ronda Britt and Brandon Shackelford¹

Universities reported that 4.9%, or \$3.2 billion, of their \$65 billion total in research and development expenditures in FY 2011 was funded by businesses, according to the National Science Foundation's (NSF's) Higher Education Research and Development (HERD) Survey. This percentage has remained very stable since the late 1970s (between 5% and 7% of total R&D expenditures).²

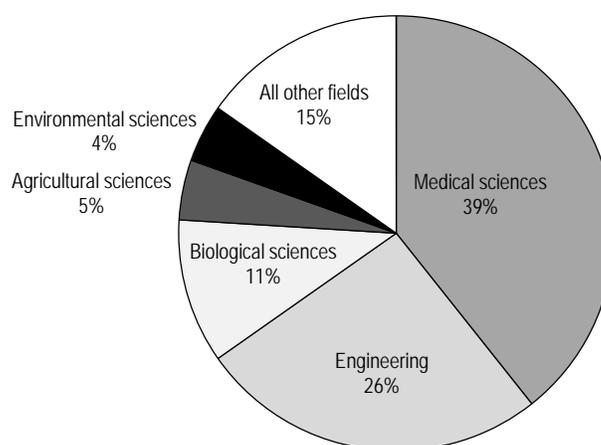
Overall, the share of academic R&D funded by businesses did not differ much between private institutions (5.2%) and public institutions (4.7%). Relatively large shares of the R&D funding provided by businesses went toward two fields: the medical sciences (39%) and engineering (26%) (figure 1). The remainder of business-funded academic R&D was divided between biological sciences, agricultural sciences, environmental sciences, and other fields. Compared with academic R&D funded by businesses, the academic sector's overall R&D expenditures were less concentrated in the fields of medical sciences and engineering (31% and 15%, respectively, of the \$65 billion total).

This InfoBrief looks at findings from two NSF surveys—the FY 2011 HERD Survey of universities and the 2010 Business R&D and Innovation Survey (BRDIS) of companies—to examine businesses' R&D collaborations with academic institutions, as well as relationships between businesses and academia.

Academic R&D Funding from Businesses

The 2011 HERD Survey found that overall, 67% of the universities surveyed reported some level of R&D funding from business, with 38% of those reporting business-funded expenditures in excess of \$1 million.

FIGURE 1. Higher education R&D expenditures funded by businesses, by R&D field: FY 2011



SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Higher Education Research and Development Survey, FY 2011.

The top 15 academic institutions that received business funding accounted for 37% of the \$3.2 billion total (table 1). Duke University reported over \$200 million in business-funded expenditures (86% within the field of medical sciences), and Massachusetts Institute of Technology (MIT) and Ohio State University (OSU) reported over \$100 million each. MIT's business funding was spent primarily in engineering, computer science, and multidisciplinary fields. OSU's funding was concentrated in mechanical engineering and medical sciences. On average, business-funded R&D accounted for 8.9% of the total R&D for the top 15 academic institutions that received business funding.

Many of the institutions reporting the highest proportion of their R&D expenditures funded by businesses were relatively smaller R&D performers. For example, Wichita State University and the University of Tulsa reported the largest proportions of business funding for their R&D expenditures (47% and 38%, respectively), but their total R&D expenditures were \$50 million and \$23 million, respectively (table 2). Wichita State University houses the National Institute for Aviation Research, which works closely with the aviation manufacturing industry on research projects. The University of Tulsa operates 13 different research consortia and joint industry projects within engineering fields. All but three of the institutions reporting the largest proportions of business funding had total R&D expenditures of less than \$70 million, most ranking well below the top 150 in total R&D expenditures.

Business Purchases of Academic R&D Services and Collaborative R&D Projects

Payments to U.S. colleges and universities for collaborative R&D projects or purchased R&D services make up a

TABLE 1. The 15 higher education institutions reporting the largest R&D expenditures funded by business: FY 2011
(Dollars in thousands)

Rank	Institution	Total R&D expenditures	Business-funded R&D expenditures	% of total
	All institutions	65,073,411	3,162,464	4.9
	Top 15 institutions	13,256,958	1,174,380	8.9
1	Duke U.	1,022,207	215,366	21.1
2	MA Institute of Technology	723,610	110,006	15.2
3	OH State U.	832,126	103,564	12.4
4	U. CA, Berkeley	707,945	86,769	12.3
5	SUNY, U. Albany, C. of Nanoscale Science and Engineering	248,778	80,797	32.5
6	U. TX, Austin	632,171	68,479	10.8
7	U. CA, San Diego	1,009,378	67,139	6.7
8	PA State U., U. Park and Hershey Medical Ctr.	794,846	64,650	8.1
9	U. TX, M. D. Anderson Cancer Ctr.	663,279	59,582	9.0
10	Johns Hopkins U.	2,145,308	59,048	2.8
11	Stanford U.	907,971	58,014	6.4
12	TX A&M U., College Station	705,720	54,880	7.8
13	U. CA, San Francisco	995,226	53,607	5.4
14	U. CA, Los Angeles	982,357	48,961	5.0
15	U. PA	886,036	43,518	4.9

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Higher Education Research and Development Survey, FY 2011.

very small share of overall domestic business R&D spending, according to NSF's BRDIS. Companies estimated to have performed at least \$7 million of R&D in the United States in any of the 4 years preceding 2010 (hereafter referred to as large-R&D companies) were asked to detail the types of organizations to which they made collaborative R&D payments or from which they purchased R&D services. Of the \$25.3 billion of such expenditures estimated for large-R&D companies, only \$829 million were reported as going to U.S. universities and colleges. Consistent with the field-of-science data from HERD presented in figure 1, 60% of these payments were reported by companies classified in the pharmaceutical manufacturing industry. By way of comparison, in 2010, companies spent \$251 billion of their own funds on R&D in the United States—most of which supported the companies' own R&D performance.

Relationships Between Large-R&D Companies and Academia

Although payments to colleges and universities represent less than 1% of company R&D spending, 29% of large-R&D companies reported making these payments or they reported initiating new R&D collaborations with academia in 2010.³ Despite accounting for the majority of payments to academia, the pharmaceutical manufacturing industry represented only 21% of the large-R&D companies reporting R&D payments to academia or new collaborations with academia. Other well-represented industries reporting these activities included computer and electronic products manufacturers, transportation equipment manufacturers, and food manufacturers.

The large-R&D companies reporting such university involvement discussed above differ from other large-R&D

TABLE 2. Higher education institutions reporting over 15% of total R&D expenditures funded by business, ranked by percent funded: FY 2011
(Dollars in thousands)

Rank	Institution	Total R&D expenditures	Business-funded R&D expenditures	% of total
1	Wichita State U.	50,194	23,766	47.3
2	U. Tulsa	23,320	8,808	37.8
3	SUNY, U. Albany, C. of Nanoscale Science and Engineering	248,778	80,797	32.5
4	Columbia U., Teachers C.	18,406	5,925	32.2
5	Ball State U.	18,765	4,402	23.5
6	Mercer U.	29,039	6,662	22.9
7	CO School of Mines	48,704	10,290	21.1
8	Duke U.	1,022,207	215,366	21.1
9	Polytechnic Institute of NY U.	13,222	2,618	19.8
10	U. LA, Lafayette	69,978	13,538	19.3
11	Clarkson U.	17,951	3,321	18.5
12	Creighton U.	31,443	5,638	17.9
13	MA Institute of Technology	723,610	110,006	15.2

NOTE: Includes only institutions spending over \$10 million in FY 2011.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Higher Education Research and Development Survey, FY 2011.

companies in a number of ways (figure 2). These companies are on average much larger in terms of employment, sales, and R&D expenditures. On average, these companies are also more likely than other companies to report introducing manufacturing process innovations and report more revenue from first-to-the-market innovations. These companies also perform more research overall and as a share of their total domestic R&D performance.

Incidence of Companies Reporting Other Activities with Academia

Apart from the data discussed earlier, all companies surveyed by BRDIS were asked several yes or no questions about their activities with academia that were not necessarily tied to their own R&D. These questions asked whether companies had done the following:

- Hired academic consultants
- Hosted student interns in science or engineering programs

- Hosted postdoctoral fellows in science or engineering
- Had company employees serve as visiting scientists or engineers at a university
- Made monetary gifts to universities that were restricted to supporting R&D

In 2010, hosting student interns in science and engineering was the most common activity reported, estimated at 14% of companies with R&D activity (defined as having either R&D expense or R&D costs paid for by others) (table 3). The next most common activity with academia involved hiring academic consultants (6% of companies with R&D activity). The remaining activities were much less common, with 2% of these companies estimated to have made monetary gifts restricted to supporting R&D. Only 1% of companies with R&D activity are estimated to have hosted postdoctoral fellows in S&E fields, and 1% had company employees serve as visiting scientists or engineers at universities in 2010.⁴

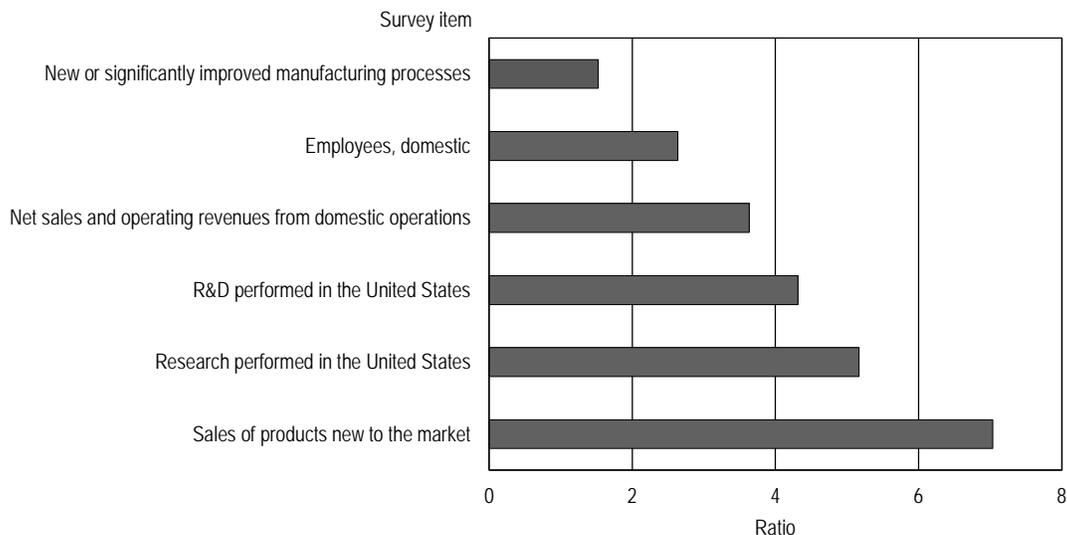
Of nearly 57,000 companies estimated to have R&D activity in 2010, 18% were estimated to have at least one of the activities listed above. The prevalence of companies reporting activities with academia varied considerably by industry (figure 3). Industries that reported higher rates of activities with academia than the overall average included biotechnology (North American Industry Classification System [NAICS] code 541711), utilities (NAICS 22), and semiconductor and other electronic components (NAICS 3344).⁵ The industry that accounts for the largest share of U.S. R&D spending (pharmaceuticals and medicines; NAICS 3254) also had above-average rates of activity with academia. Industries least likely to report activities with academia included textile, apparel, and leather manufacturers (NAICS 313–16) and finance and insurance (NAICS 52).

Data Sources and Limitations

The HERD fiscal year referred to throughout this report is the academic fiscal year; for most institutions FY 2011 represents the period 1 July 2010 through 30 June 2011. The HERD Survey data presented in this InfoBrief were obtained from 912 universities and colleges that grant bachelor's or higher degrees and expended at least \$150,000 in R&D during the survey period. The business-funded expenditures reported represent grants and contracts from the companies themselves; the total does not include funding received from a company's nonprofit foundation.

The sample for BRDIS was selected to represent all for-profit companies with five or more domestic employees that are publicly or privately held. Although the focus of the survey is on companies that perform or fund R&D (i.e., R&D active), it also collects information from companies with no R&D activity. For 2010 a total of 42,965 companies were

FIGURE 2. Ratios of average values of survey items for companies with university involvement to those without such involvement: 2010



NOTES: Data representative of companies responding to Form BRDI-1 where the worldwide R&D expense plus worldwide R&D costs funded by others is greater than 0. Companies classified as having university involvement include those reporting payments to colleges and universities for R&D or new R&D collaborations with academia in 2010. Ratios represent average values of variables for companies reporting R&D payments to or new R&D collaborations with colleges and universities divided by the average values of companies of companies reporting none. A ratio of 2 means the average for companies with university involvement is twice as large as the average for the companies without university involvement.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Business R&D and Innovation Survey: 2010.

sampled for BRDIS, representing over 2 million companies in the population. Because the statistics from the survey are based on a sample, they are subject to both sampling and nonsampling errors.

For this InfoBrief, BRDIS statistics for business activities with academia based

on yes or no questions represent only the weighted amounts for companies responding to the item. Estimates were not adjusted for item or unit nonresponse.

BRDIS estimates of payments from companies to academia for collaborative R&D and R&D services differ

from HERD estimates of academic R&D expenditures funded by the business sector. Some possible reasons for these differences include the following:

- Gifts to universities are not accounted for as an R&D expense by companies, but rather as charitable giving. Companies may opt to account for payments to universities as a gift if the research agreement does not give full rights to any resulting intellectual property to the company.
- BRDIS estimates are derived from U.S. R&D expenditures only and does not include payments to academia from foreign research units.
- Interviews with BRDIS respondents indicate that details on purchased R&D services are among the more difficult items on BRDIS for compa-

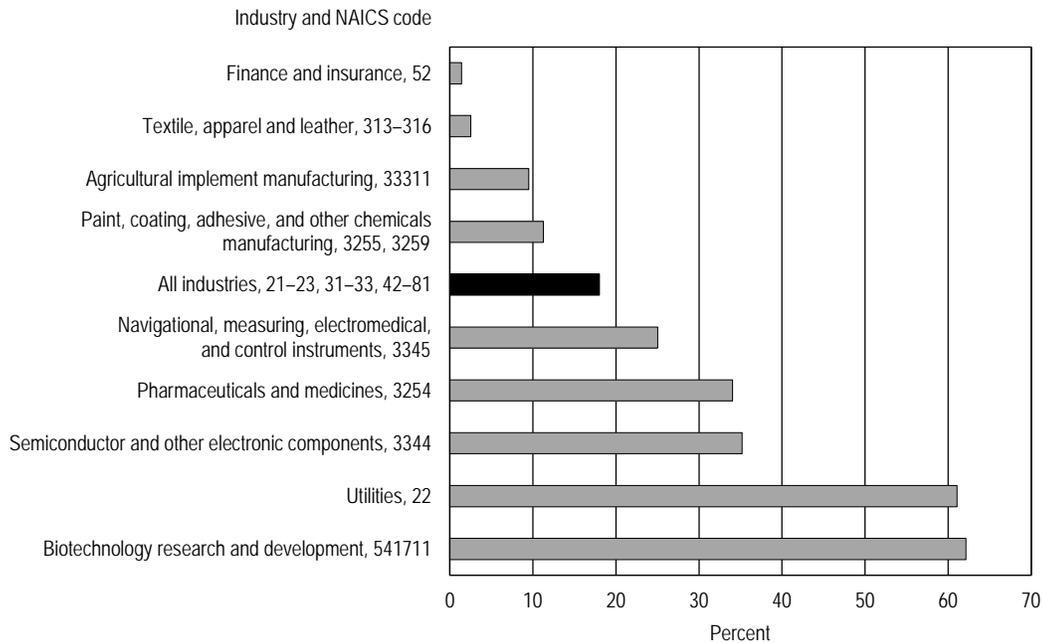
TABLE 3. R&D-active companies in the United States that reported activities with academia: 2010

Activity with academia	Yes	No	No response
Hosted student interns in science or engineering programs	7,709	45,604	3,256
Hired academic consultants	3,397	49,931	3,241
Made monetary gifts to universities restricted to supporting R&D	1,213	51,896	3,461
Had company employees serve as visiting scientists at a university	782	52,458	3,329
Hosted postdoctoral fellows in science or engineering	626	52,643	3,300
Any of the above activities	9,632	43,805	3,132

NOTE: Counts are weighted totals for companies that reported to the survey and had positive R&D expense or R&D paid for by others.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics and U.S. Census Bureau, Business R&D and Innovation Survey, 2010.

FIGURE 3. R&D-active companies in the United States that reported activities with academia in 2010, by select industry



NAICS = North American Industry Classification System.

NOTES: Data representative of companies responding to Form BRDI-1 where the worldwide R&D expense plus worldwide R&D costs funded by others is greater than 0. Industry classification was based on dominant business code for domestic R&D performance where available. For companies that did not report business codes, classification used for sampling was assigned. Percentages based only on companies responding to the question on activities with academia (Question 4-19). Six percent of R&D-active companies did not respond to this question.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Business R&D and Innovation Survey: 2010.

nies to report. These payments may not meet the threshold of materiality to merit tracking separately from an accounting perspective.

- Funding from foreign operations of foreign corporations is not included in BRDIS estimates.

The full set of detailed tables from HERD are available in the report Higher Education Research and Development: Fiscal Year 2011 at <http://www.nsf.gov/statistics/herd/>. Detailed tables for the 2010 BRDIS are forthcoming and will be available at <http://www.nsf.gov/statistics/industry/>. Individual tables from the 2010 survey may be available in advance of publication of the full report. For more information about HERD, please contact Ronda

Britt. For questions related to BRDIS, please contact Raymond Wolfe.

Notes

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2. See table 1 in National Science Foundation, National Center for Science and Engineering Statistics. 2013. *Higher Education Research and Development: Fiscal Year 2011*. Detailed Statistical Tables NSF 13-325. Arlington, VA. Available at <http://www.nsf.gov/statistics/nsf13325/>.

3. Of the 2,572 companies that received Form BRDI-1, unit responses were received from 1,924. Of these responses, 367 reported payments to universities, colleges, and academic researchers in Question 2-23 or reported entering into a new R&D agreement with universities, colleges, and academic researchers in Question 4-7; 893 reported no such activity; and 665 did not answer either question (item nonresponse). Cases with item

nonresponse are not included when calculating ratios.

4. The incidence figures reported are the percentages of companies (weighted totals) responding yes to the various questions on activities with academia. Also, these figures reflect the sample-weighted responses of the sample companies that responded to the survey and do not include data for

those who were fully nonresponsive to the survey. Those responding to the survey and whose R&D status could be determined represent approximately 1.5 million companies, weighted; the nonrespondents represent about 327,300 companies, weighted.

5. In the 2010 BRDIS statistics, the biotechnology R&D industry included

many pre-commercial start-up companies as well as contract research organizations. Companies classified in the utilities industry tend to be large in terms of sales with low R&D spending relative to their size. The utilities industry allocates a larger share of its total R&D expenditures to payments to R&D contractors and collaborators than any other industry tabulated by BRDIS.

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