



InfoBrief

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One in Five U.S. Businesses with R&D Applied for a U.S. Patent in 2008

by Brandon Shackelford¹

According to the Business R&D and Innovation Survey (BRDIS), one out of five U.S. companies with research and development applied for a patent from the U.S. Patent and Trademark Office (USPTO) in 2008.² These companies applied for at least 136,751 U.S. patents and were issued at least 65,879 patents in 2008. Patents are a legal means used by inventors to exclude others from using their invention and are commonly used by economists as a proxy measure for one type of innovation output or success.³ Because of the interest in measuring the output of R&D and other innovation-related activities, a number of questions pertaining to patents and other forms of intellectual property (IP) protection were included on BRDIS. This InfoBrief presents summary findings from the 2008 BRDIS pilot survey on the patenting activity of U.S. businesses with R&D.

Patent Applications by Subsector, Industry, and Size of Company

Companies classified in two North American Industrial Classification System (NAICS) subsectors and one industry group accounted for 56% of the patent applications reported to

BRDIS by companies with R&D in 2008: computer and electronic products (NAICS 334), software publishing (NAICS 5112), and chemicals (NAICS 325) (table 1). These three industries accounted for a similarly large share (59%) of the BRDIS total worldwide R&D expense estimate, but the relationship between R&D spending and patenting varied widely among their respective industries.⁴ For example, compared with companies in the pharmaceutical industry (NAICS 3254), companies in the software publishing industry had less than half the worldwide R&D expense but about twice as many patent applications.

Because patent applications are often outputs of the R&D process, it is common to analyze the ratio of R&D spending to patent applications. Overall there was \$2.4 million of worldwide R&D expense per patent application in 2008. This ratio varies widely from industry to industry, but these differences may reflect the relative importance placed on patenting among industries.⁵ For example, the fact that the ratio of \$6.3 million per patent application for the food manufacturing industry (NAICS 311) is much higher than most other industries may simply

reflect that food companies apply for patents less frequently than companies in other industries.

Both small companies (5–499 domestic employees) and the largest companies (25,000 or more domestic employees) had a higher share of patent applications than worldwide R&D expense in 2008 (table 2). Early research into the relationship between R&D and patenting also found that small R&D firms tended to have more patents per dollar of R&D than larger R&D firms, excepting the very largest companies.⁶ This early research, and much of the later research in the field, relied on R&D data from publicly traded companies matched to public patent data and carried the caveat that findings related to small firms were possibly subject to selection bias. BRDIS data are not subject to this limitation and are well suited for further microeconomic research into the relationship between R&D and patenting and productivity.⁷

Propensity to Patent and Distribution of Patent Applications

BRDIS data indicate that industries vary widely in terms of their propensity to patent as illustrated in figure 1. Overall,

TABLE 1. U.S. patent applications, patents issued, and worldwide R&D expense, by selected industry: 2008

Industry and NAICS code	Patent applications (number)	Patents issued (number)	Worldwide R&D expense (US\$millions)
All industries, 21–33, 42–81	136,751	65,879	328,040
Manufacturing industries, 31–33	95,106	47,880	239,162
Food, 311	453	165	2,860
Chemicals, 325	17,819	7,357	88,141
Basic chemicals, 3251	4,017	1,169	5,386
Pharmaceuticals and medicines, 3254	8,481	3,621	74,356
Other 325	5,321	2,567	8,399
Plastics and rubber products, 326	1,550	1,191	2,187
Fabricated metal products, 332	2,191	643	2,631
Machinery, 333	6,569	3,598	12,250
Computer and electronic products, 334	40,845	22,135	70,815
Communications equipment, 3342	2,858	2,798	15,130
Semiconductor and other electronic components, 3344	12,197	10,000	29,329
Navigational/measuring/electromedical/control instruments, 3345	20,062	5,078	13,307
Computer equipment/other electronic products, 3341, 3343, 3346	5,728	4,258	13,048
Electrical equipment/appliances/components, 335	3,987	2,110	4,275
Automobiles/bodies/trailers/parts, 3361–3363	3,367	2,321	24,314
Aerospace products and parts, 3364	5,049	2,486	12,875
Medical equipment and supplies, 3391	5,303	2,061	6,669
Manufacturing nec, other 31–33	7,973	3,813	12,145
Nonmanufacturing industries, 21–23, 42–81	41,645	17,999	88,877
Construction, 21	144	97	1,450
Wholesale trade, 42	3,074	2,489	2,849
Information, 51	21,618	9,243	47,064
Software publishers, 5112	17,602	7,828	35,562
Other information, other 51	4,016	1,415	11,502
Professional/scientific/technical services, 54	10,518	4,442	28,351
Architectural/engineering/related services, 5413	475	968	1,841
Computer systems design and related services, 5415	1,639	1,173	11,112
Scientific research and development services, 5417	7,072	2,037	13,095
Other 54	1,332	265	2,303
Nonmanufacturing nec, other 21–23, 42–81	6,291	1,728	9,163

NAICS = North American Industry Classification System; nec = not elsewhere classified.

NOTES: Data are representative of companies where worldwide R&D expense plus worldwide R&D costs funded by others is greater than zero. Detail may not add to total because of rounding. 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. Patent counts are lower-bound estimates because no adjustment was made to correct for survey nonresponse.

SOURCE: National Science Foundation/National Center for Science and Engineering Statistics, Business R&D and Innovation Survey: 2008.

21% of companies with R&D reported patent applications in 2008. Companies in industries such as food manufacturing and software publishing, where patents are less likely to be an important form of IP protection, were less likely to report patent applications on average. In contrast, in industries where patents are considered very important to protecting IP, such as basic chemi-

cals manufacturing (NAICS 3251) and semiconductor manufacturing (NAICS 3344), companies were much more likely to report patent applications.

Because both R&D and patenting are dominated by a relatively small number of large companies, industry-level ratios such as those discussed earlier may not be representative of

the average company in each industry. One way to overcome this concern is to analyze the means and medians of data items across the surveyed companies. Table 3 presents the mean and median values for the number of patent applications for the subset of BRDIS companies with both R&D and patent applications. The mean number of patent applications for these companies

TABLE 2. U.S. patent applications, patents issued, and worldwide R&D expense, by size of company: 2008

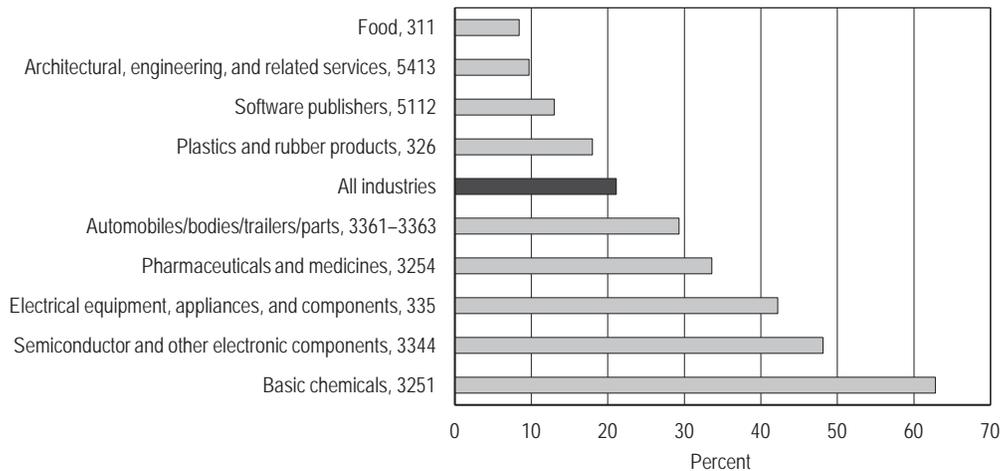
Company size (domestic employees)	Patent applications (number)	Patents issued (number)	Worldwide R&D expense (US\$millions)
All companies	136,751	65,879	328,040
Small companies ^a			
5-499	34,611	13,147	59,255
5-99	21,738	8,451	31,792
5-49	17,130	6,715	22,187
5-24	9,174	3,881	12,983
25-49	7,955	2,833	9,203
50-99	4,609	1,736	9,605
100-249	7,377	2,436	16,489
250-499	5,496	2,260	10,975
Medium and large companies			
500-999	5,069	2,580	12,928
1,000-4,999	18,229	11,867	55,156
5,000-9,999	8,905	4,088	28,379
10,000-24,999	18,877	12,533	62,814
25,000 or more	51,060	21,664	109,507

^a Upper bound based on U.S. Small Business Administration's definition of small business; Business R&D and Innovation Survey does not include companies with fewer than five domestic employees.

NOTES: Data are representative of companies where worldwide R&D expense plus worldwide R&D costs funded by others is greater than zero. Detail may not add to total because of rounding. Patent counts are lower-bound estimates because no adjustment was made to correct for survey nonresponse.

SOURCE: National Science Foundation/National Center for Science and Engineering Statistics, Business R&D and Innovation Survey: 2008.

FIGURE 1. Companies with R&D reporting U.S. patent applications in 2008, by selected industry and NAICS code



NAICS = North American Industry Classification System.

NOTES: Data are representative of companies where worldwide R&D expense plus worldwide R&D costs funded by others is greater than zero. 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. Patent propensity based only on companies responding to patent application question.

SOURCE: National Science Foundation/National Center for Science and Engineering Statistics, Business R&D and Innovation Survey: 2008.

TABLE 3. U.S. patent applications for companies reporting R&D and patent applications, by selected industry: 2008

Industry and NAICS code	Mean	Median
All industries, 21–33, 42–81	14.6	2
Mining, extraction, and support activities, 21	95.0	6
Aircraft, aircraft engine, and aircraft parts, 336411–336413	53.6	2
Software publishers, 5112	50.0	2
Electromedical, electrotherapeutic, and irradiation apparatus, 334510, 334517	40.6	5
Computer equipment/other electronic products, 3341, 3343, 3346	34.2	2
Semiconductor and other electronic components, 3344	34.0	4
Soap, cleaning compound, and toilet preparations, 3256	28.2	2
Telecommunications, 517	27.2	3
Paper, 322	25.7	4
Pesticide, fertilizer, and other agricultural chemicals, 3253	21.7	1
Automobiles/bodies/trailers/parts, 3361–3363	21.2	1
Basic chemicals, 3251	20.7	1
Communications equipment, 3342	18.6	2
Pharmaceuticals and medicines, 3254	18.3	3
Internet service providers/web search portals/data processing services, 518	13.1	2
Medical equipment and supplies, 3391	12.7	3
Scientific research and development services, 5417	10.6	4
Electrical equipment/appliances/components, 335	10.1	3
Primary metals, 331	6.9	3
Plastics and rubber products, 326	6.7	2
Health care services, 621–623	6.1	6
Food, 311	4.8	1
Fabricated metal products, 332	4.7	3
Architectural, engineering, and related services, 5413	3.9	1
Computer systems design and related services, 5415	3.7	2

NAICS = North American Industry Classification System.

NOTES: Data are representative of companies where worldwide R&D expense plus worldwide R&D costs funded by others is greater than zero. 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.

SOURCE: National Science Foundation/National Center for Science and Engineering Statistics, Business R&D and Innovation Survey: 2008.

(14.6) exceeds the median (2), indicating that a minority of these companies apply for a far greater number of patents than the average company. The difference between the median and mean number of patent applications is more pronounced in industries such as software publishing, where the mean number of patent applications for companies with both R&D and patents is 50.0 and the median is 2. In contrast, the gap is narrower in industries such as food manufacturing and computer

systems design and related services (NAICS 5415), indicating that these are less dominated by a minority of high-patenting outliers.

With few exceptions, companies in industries with a high propensity to patent tended to apply for more patents than the average company (figure 1 and table 3). For example, companies classified in the semiconductor manufacturing industry were more likely than the average company to apply for

patents in 2008. And among companies with R&D that applied for patents in 2008, companies classified in the semiconductor manufacturing industry applied for more than twice as many patents as the average company (34.0 versus 14.6 mean patent applications).

Patenting Outside the United States

Patent laws differ from country to country, so companies that want to protect their intellectual property in markets outside the United States must apply for patents in other jurisdictions. Because the cost required to file for and enforce patents in multiple jurisdictions can be high, economists often consider the act of applying for patents in multiple jurisdictions as an indicator of high-value inventions (or at least ones in which the company believes to have value outside of a local market). BRDIS asked companies to report the percentage of their U.S. patent applications for which they have corresponding applications (or plans for applications) in foreign jurisdictions. Among companies with R&D and U.S. patent applications, the mean value for this question was 37.7% and its median was 0% (table 4). Although most of the companies reporting patent activity to BRDIS did not apply for patent protection in foreign jurisdictions in 2008, some industries reported very high rates of foreign patenting. Nine industries tracked by BRDIS had median values of 100% for the foreign patenting question. All but one of these industries were in the manufacturing sector. The one nonmanufacturing industry in this group was scientific R&D services (NAICS 5417), which includes many biotechnology companies. These biotechnology companies are more similar to pharmaceutical manufacturers than to other nonmanufacturing companies in terms of their patenting strategies.

TABLE 4. U.S. patent applications with corresponding applications in foreign jurisdictions for companies reporting R&D and patent applications, by selected industry: 2008 (Percent)

Industry and NAICS code	Mean	Median
All industries, 21–33, 42–81	37.7	0
Pesticide, fertilizer, and other agricultural chemicals, 3253	76.4	100
Electromedical, electrotherapeutic, and irradiation apparatus, 334510, 334517	72.3	100
Soap, cleaning compound, and toilet preparations, 3256	69.7	100
Primary metals, 331	66.9	100
Health care services, 621–623	66.9	67
Pharmaceuticals and medicines, 3254	65.6	100
Scientific research and development services, 5417	65.2	100
Medical equipment and supplies, 3391	64.2	100
Aircraft, aircraft engine, and aircraft parts, 336411–336413	63.2	100
Mining, extraction, and support activities, 21	61.9	80
Basic chemicals, 3251	61.2	100
Fabricated metal products, 332	53.7	60
Paper, 322	51.4	50
Semiconductor and other electronic components, 3344	49.2	50
Architectural, engineering, and related services, 5413	49.2	25
Telecommunications, 517	49.1	33
Electrical equipment/appliances/components, 335	40.8	24
Plastics and rubber products, 326	37.0	0
Computer equipment/other electronic products, 3341, 3343, 3346	31.0	0
Computer systems design and related services, 5415	28.0	0
Food, 311	27.9	0
Automobiles/bodies/trailers/parts, 3361–3363	25.4	0
Communications equipment, 3342	22.6	0
Software publishers, 5112	21.5	0
Internet service providers/web search portals/data processing services, 518	10.2	0

NAICS = North American Industry Classification System.

NOTES: Data are representative of companies where worldwide R&D expense plus worldwide R&D costs funded by others is greater than zero. 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.

SOURCE: National Science Foundation/National Center for Science and Engineering Statistics, Business R&D and Innovation Survey: 2008.

Patent Licensing Revenue

Although patents are most commonly used by companies to prevent competitors from using certain inventions, companies may also choose to grant licenses so that others may use the patented technology in exchange for a fee or royalties. BRDIS asked companies to report their revenue from licensing patents to others. Results from this question indicate that U.S. companies with R&D earned at least \$42.1 billion in patent licensing revenue in 2008, or 0.4% of the total worldwide

revenue estimated for these companies (table 5).⁸ Patent licensing revenue is concentrated in a few industries, with medical equipment and supplies (NAICS 3391), pharmaceutical manufacturing, and computer and electronic products accounting for more than half of the total estimate.

Data Sources and Limitations

The sample for BRDIS was selected to represent all for-profit companies with five or more domestic employees,

publicly or privately held, that perform or fund R&D or engage in innovative activities in the United States. For 2008, a total of 39,553 companies were sampled, representing 1,926,012 companies in the population. Because the statistics from the survey are based on a sample, they are subject to both sampling and nonsampling errors.

Counts of patent applications and issued patents produced by BRDIS are lower-bound estimates and differ from the administrative patent data

TABLE 5. Worldwide sales and patent licensing revenue, by selected industry: 2008

(Millions of US dollars)

Industry and NAICS code	Worldwide sales	Patent licensing revenue
All industries, 21–33, 42–81	10,976,518	42,054
Manufacturing industries, 31–33	7,091,291	37,407
Chemicals, 325	1,394,686	8,876
Basic chemicals, 3251	319,731	1,686
Pharmaceuticals and medicines, 3254	551,734	5,557
Other 325	523,221	1,633
Computer and electronic products, 334	903,181	5,068
Medical equipment and supplies, 3391	181,611	13,341
Manufacturing nec, other 31–33	4,611,813	10,122
Nonmanufacturing industries, 21–23, 42–81	3,885,226	4,647
Information, 51	989,653	2,067
Software publishers, 5112	401,283	967
Telecommunications, 517	357,810	33
Other information, other 51	230,560	1,067
Real estate and rental and leasing, 53	21,222	512
Professional/scientific/technical services, 54	551,839	1,304
Architectural/engineering/related services, 5413	59,350	96
Computer systems design and related services, 5415	252,143	244
Scientific research and development services, 5417	144,899	821
Other 54	95,447	143
Nonmanufacturing nec, other 21–23, 42–81	2,322,512	764

NAICS = North American Industry Classification System; nec = not elsewhere classified.

NOTES: Data are representative of companies where worldwide R&D expense plus worldwide R&D costs funded by others is greater than zero. Detail may not add to total because of rounding. 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. Patent licensing revenue is lower-bound estimate because no adjustment was made to correct for survey nonresponse.

SOURCE: National Science Foundation/National Center for Science and Engineering Statistics, Business R&D and Innovation Survey: 2008.

published by the USPTO in a number of ways. USPTO data include all patent data, whereas BRDIS estimates provided here are only for companies that have R&D and have five or more U.S. employees. In addition, foreign-owned companies are instructed by BRDIS to report for only the portion of their company domiciled in the United States (and its subsidiaries). At the time BRDIS data were tabulated, there was no basis for imputing patent applications.

For an overview of worldwide R&D data collected by BRDIS see NCSES InfoBrief, *Business R&D Performed in the United States Cost \$291 Billion in 2008 and \$282 Billion in 2009* (NSF 12-309) at <http://www.nsf.gov/statistics/>

[infbrief/nsf12309/](http://www.nsf.gov/statistics/industry/). The full set of detailed tables from the 2008 BRDIS will be available in the report *R&D and Innovation in Business: 2008* at <http://www.nsf.gov/statistics/industry/>. Individual detailed tables from the 2008 survey may be available in advance of publication of the full report. For further information, contact Raymond Wolfe.

Notes

1. Brandon Shackelford is principal consultant at Twin Ravens Consulting, Austin, TX. For further information, contact Raymond M. Wolfe, Research and Development Statistics Program, National Center for Science and Engineering Statistics, National Science

Foundation, 4201 Wilson Boulevard, Suite 965, Arlington, VA 22230 (rwolfe@nsf.gov; 703-292-7789).

2. Businesses with R&D are those that either pay for or perform R&D. Copy of 2008 BRDIS is available at <http://nsf.gov/statistics/question.cfm#13>. Questions relating to patenting are in section 6 of survey.

3. Not all patents are indications of innovation. Patenting may be obtained to block rivals, negotiate with competitors, or raise funding from investors. Hall BH. 2008. Patents. In Durlauf SN, Blume LE, editors, *The New Palgrave Dictionary of Economics*, 2nd ed. Palgrave Macmillan. Available

at http://www.dictionaryofeconomics.com/article?id=pde2008_P000039. Accessed 9 March 2012.

4. Although BRDIS also collected information on business R&D that is paid for by others, such as customers, these data are not included in this analysis. Ownership of IP produced from this type of R&D is often assigned to the party paying for the R&D.

5. Jankowski J. 2012. Business Use of Intellectual Property Protection Documented in NSF Survey. InfoBrief

NSF 12-307. Arlington, VA: National Science Foundation, National Center for Science and Engineering Statistics. Available at <http://nsf.gov/statistics/infbrief/nsf12307/>.

6. Bound J, et al. 1984. Who Does R&D and Who Patents? *In* Griliches Z, editor, R&D, Patents, and Productivity, pp. 21–54. Chicago, IL: University of Chicago Press. Available at <http://www.nber.org/chapters/c10043.pdf>.

7. Preliminary econometric analysis of BRDIS data indicates nonlinear

relationship between worldwide R&D expense and U.S. patent applications. An ordinary least square regression using just the logarithm of worldwide R&D expense and its square as explanatory variables accounts for more than one-third of the variation in the logarithm of U.S. patent applications.

8. Figures presented here for patent licensing revenue are lower-bound estimates because no adjustment was made to account for item nonresponse.

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