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NSF Releases New Statistics on Business Innovation

by Mark Boroush[1]

Preliminary data from the National Science Foundation's 2008 Business R&D and Innovation Survey (BRDIS) provide a map of the incidence of innovation by businesses located in the United States. These data are based on respondents to the survey and represent an estimated 1.5 million for-profit companies, publicly or privately held, with 5 or more employees, active in the United States in 2008.

The new data indicate that in the period 2006–08 about 22% of the manufacturing companies introduced product innovations (one or more new or significantly improved good or service) and about 22% introduced process innovations (one or more new or significantly improved method for manufacturing or production; logistics, delivery, or distribution; support activities).[2] In comparison, about 8% of companies in the nonmanufacturing sector were product innovators and 8% were process innovators. Nonetheless, much higher innovation incidences are observed in the manufacturing subsectors of chemicals, computer/electronic products, and electrical equipment/appliances/components, and in some parts of the nonmanufacturing sectors of information and professional/scientific/technical services. Further, the BRDIS data indicate that companies that perform and/or fund R&D have a far higher incidence of innovation than do companies without any R&D activity.

Incidence of Innovation across the U.S. Economy

Preliminary data indicate that overall about 9% of the estimated 1.5 million for-profit companies were active product innovators in 2006–08.[3] The corresponding figure for process innovators was also about 9%. Nevertheless, a wider range of innovation incidences is evident when more narrowly defined industry groups (manufacturing, nonmanufacturing, and their subsectors) are distinguished. These data, shown in detail in table 1, indicate that the incidence of U.S. innovation varies substantially by industry sector.

Manufacturing Industries

The manufacturing industries in aggregate (NAICS 31–33) exhibited a considerably higher overall incidence of innovation than did the population of companies as a whole. About 22% of all the companies in manufacturing industries reported one or more product innovations in the 2006–08 period and about 22% reported process innovations (table 1). (In 2008, manufacturing industries accounted for only about 8% of the 1.5 million companies in the survey's respondent population.)

"...incidence of U.S. innovation varies substantially by industry sector."

Higher incidences of innovation are evident in a number of more narrowly defined manufacturing subsectors. In the computer/electronic products subsector (NAICS 334), some 45% of the companies indicated product innovations in 2006–08 and 33% indicated process innovations. In the chemicals subsector

TABLE 1. Companies in the United States reporting innovation activities, by industry: 2006–08
(Percent)

Industry and NAICS code	Companies (thousands)[a]	New or significantly improved product: Any good/service Yes	Any good/service No	Goods Yes	Goods No	Services Yes	Services No	New or significantly improved process: Any process Yes	Any process No	Manufacturing/production methods Yes	Manufacturing/production methods No	Logistics/delivery/distribution methods Yes	Logistics/delivery/distribution methods No	Support activities Yes	Support activities No
All industries, 21–33, 42–81	1,545.1	9	86	5	91	7	88	9	86	4	91	3	92	7	88
Manufacturing industries, 31–33	127.1	22	74	18	77	10	85	22	72	18	77	7	88	13	82
Food, 311	9.1	17	75	16	77	5	87	17	75	13	80	6	86	7	85
Beverage/tobacco products, 312	1.2	17	77	13	81	6	87	15	75	9	81	6	84	8	81
Textile/apparel/leather and allied products, 313–16	6.1	19	77	15	81	9	87	18	78	13	83	7	89	12	84
Wood products, 321	6.1	9	88	6	91	5	92	16	81	13	84	3	95	6	91
Chemicals, 325	5.9	41	52	33	60	18	75	34	59	22	71	17	75	20	72
Pharmaceuticals/medicines, 3254	1.5	45	51	24	72	27	69	42	53	18	77	27	69	32	63
Other 325	4.4	40	52	36	56	15	77	31	60	23	69	14	78	16	75
Plastics/rubber products, 326	6.1	24	72	21	75	11	85	28	68	24	72	8	87	15	81
Nonmetallic mineral products, 327	5.4	13	84	11	85	5	91	14	83	11	85	4	92	8	88
Primary metals, 331	2.1	17	79	13	83	11	84	19	76	17	78	4	91	11	84
Fabricated metal products, 332	26.1	16	80	11	84	9	87	22	73	19	77	5	90	12	84
Machinery, 333	12.0	26	70	23	72	11	83	24	71	21	74	5	90	15	81
Computer/electronic products, 334	7.0	45	46	43	48	18	73	33	58	26	64	11	79	18	73
Computers/peripheral equipment, 3341	0.6	56	39	47	49	26	68	46	49	31	63	19	75	21	73
Communications equipment, 3342	0.8	51	41	51	42	21	72	33	58	25	67	7	85	17	75
Semiconductor/other electronic components, 3344	2.5	27	65	25	67	10	81	25	65	19	72	7	84	14	77
Navigational/measuring/electromedical/control instruments, 3345	2.6	59	30	58	31	24	64	40	48	36	53	16	72	22	66
Other 334	0.5	37	59	35	61	13	83	14	82	10	86	3	93	10	86
Electrical equipment/appliance/components, 335	2.8	37	60	36	60	11	85	28	67	24	72	12	84	21	75
Transportation equipment, 336	5.4	28	65	25	67	11	82	23	70	18	75	5	88	15	77
Motor vehicles/trailers/parts, 3361–63	3.3	24	67	22	69	8	83	22	69	19	71	3	87	14	77
Aerospace products/parts, 3364	0.9	32	60	29	63	19	74	25	67	16	76	7	86	20	72
Other 336	1.3	35	63	31	67	12	85	25	73	15	83	8	90	16	81
Furniture/related products, 337	7.8	14	81	13	82	6	88	19	75	12	83	5	90	12	83
Manufacturing nec, other 31–33	24.1	22	75	17	80	12	85	23	73	17	79	7	89	14	82
Nonmanufacturing industries, 21–23, 42–81	1,417.9	8	87	3	92	7	89	8	87	2	93	3	92	6	89
Information, 51	23.1	30	65	16	78	25	71	20	74	7	88	10	84	16	78
Software publishers, 5112	4.0	77	18	58	37	56	38	53	40	19	74	22	71	43	49
Telecommunications/Internet service providers/Web search portals/data processing services, 517–18	6.3	37	58	15	80	34	61	22	73	7	88	11	84	20	75
Other 51	12.9	12	83	4	91	11	85	10	86	4	92	7	88	6	89
Finance/insurance, 52	55.9	8	83	1	90	8	83	8	84	1	90	2	88	7	84
Real estate/rental/leasing, 53	49.0	7	90	6	91	5	92	6	90	2	95	2	95	6	91
Professional/scientific/technical services, 54	173.6	13	84	6	91	12	85	12	85	4	92	5	92	10	87
Computer systems design/related services, 5415	19.4	35	60	20	75	30	65	25	68	8	86	7	86	23	71
Scientific R&D services, 5417	3.1	33	59	24	69	22	71	26	67	15	77	6	86	14	78
Other 54	151.1	10	87	4	94	9	88	10	87	4	93	4	93	8	89
Health care services, 621–23	183.5	10	86	3	93	9	86	8	87	3	92	3	92	7	89
Nonmanufacturing nec, other 21–23, 42–81	932.8	6	89	3	92	5	90	7	88	2	93	2	93	5	90

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

[a] Weighted totals for companies that reported on the 2008 Business R&D and Innovation Survey whether they did or did not perform/fund R&D. Weighted totals do not include the estimated 327,300 nonresponding companies for whom an R&D status was not reported.

NOTES: Survey asked companies to identify innovations introduced in 2006 to 2008. Sum of yes plus no percentages may not add to 100% due to item nonresponse to some innovation question items. Figures are preliminary and may later be revised. Data may not be internationally comparable.

SOURCE: National Science Foundation/Division of Science Resources Statistics, Business R&D and Innovation Survey, 2008.

(NAICS 325), 41% of the companies were product innovators and 34% were process innovators. In the electrical equipment/appliances/components subsector (NAICS 335), 37% of the companies were product innovators and 28% were process innovators.

Further, several of the industry groups that constitute the computer/electronic products subsector (NAICS 334) exhibited incidences of innovation in goods or services in the 50%–60% range: computers and peripheral equipment (NAICS 3341), communications equipment (NAICS 3342), and navigational/measuring/electromedical/control instruments (NAICS 3345).

The other subsectors that constitute manufacturing exhibited innovation rates around or substantially below the overall incidence for manufacturing as a whole. The economically sizable manufacturing subsectors of transportation equipment (NAICS 336), machinery (NAICS 333), food (NAICS 311), and fabricated metal products (NAICS 332) fit this characterization.

Nonmanufacturing Industries

For nonmanufacturing industries (NAICS 21–23, 42–81), the overall incidence of innovation for the sector as a whole is relatively low compared with manufacturing: about 8% of nonmanufacturing companies reported product innovations (goods and/or services) in the 2006–08 period and about 8% reported process innovations. (In 2008, nonmanufacturing industries accounted for some 92% of the estimated 1.5 million for-profit companies.)

Even so, several more narrowly defined nonmanufacturing industry groups exhibited comparatively high incidences of innovation. The innovation standout in nonmanufacturing is the information sector (NAICS 51), where 30% of the companies indicated product innovations in 2006–08 and 20% indicated process innovations. Furthermore, two industry groups in this sector exhibited particularly high rates: software publishers (NAICS 5112), where 77% of the companies indicated product innovations and 53% indicated process innovations; and telecommunications/internet services (NAICS 517–18), where 37% of the companies indicated product innovations and 22% indicated process innovations.

The professional/scientific/technical services sector (NAICS 54) exhibited rates of innovation only somewhat above the 8% rate for the nonmanufacturing sector as a whole. But it includes two industry groups with relatively high innovation rates: computer systems design/related services (NAICS 5415), with 35% of companies indicating product and 25% indicating process innovations; and scientific R&D services (NAICS 5417), with innovation rates of 33% for products and 26% for processes.

In the finance/insurance industry (NAICS 52), the reported innovation rates for products and processes were each at about the same 8% level as the nonmanufacturing sector as a whole.

Note that a very large fraction of the nonmanufacturing companies (an estimated 0.9 million of 1.4 million nonmanufacturing companies) fall under the "not elsewhere classified" category, with overall innovation rates of 6% for products and 7% for processes. Included here are various wholesale/retail trade, hotel, entertainment, and personal services businesses. The comparatively low rates of innovation observed for these companies, given their large number, clearly affect the aggregate rates of innovation for nonmanufacturing – and, indeed, also for the all-industries totals.

Companies with R&D Activity

Finally, one of the clearest findings in the BRDIS data is the large difference in innovation incidence when companies with R&D activity are compared to those without any R&D activity. Companies with R&D (either performing R&D or funding others to perform R&D) exhibit far higher rates of innovation than do non-R&D companies.

Around 47,000 of the estimated 1.5 million for-profit companies (3%) performed and/or funded R&D in 2008 (table 2). According to the survey data, 66% of all these companies were product innovators in the 2006–08 period, and 51% were process innovators. There is also indication that the companies with the most R&D (those in the $50–$100 million and $100 million or more annual R&D categories) report the highest incidence of innovation: 76% and 81%, respectively, for products in 2006–08, and 69% and 71% for processes.

Companies without any R&D activity dominate the 1.5 million companies (about 97% of all companies), but their incidence of innovation is far lower: about 7% re-

TABLE 2. Innovation incidence of companies in the U.S. with and without R&D activity, by type of innovation: 2006–08
(Percent)

Company type	Companies (thousands)	New or significantly improved product: Any good/service Yes	Any good/service No	Goods Yes	Goods No	Services Yes	Services No	New or significantly improved process: Any process Yes	Any process No	Manufacturing/production methods Yes	Manufacturing/production methods No	Logistics/delivery/distribution methods Yes	Logistics/delivery/distribution methods No	Support activities Yes	Support activities No
All companies[a]	1,545.1	9	86	5	91	7	88	9	86	4	91	3	92	7	88
With R&D activity[b]	46.8	66	30	52	45	38	58	51	44	34	62	20	76	36	60
< $10 million	44.8	66	31	51	45	38	58	51	45	33	63	19	77	35	61
≥ $10 but < $50 million	1.3	70	25	64	31	42	52	56	38	44	50	30	64	43	51
≥ $50 but < $100 million	0.3	76	18	71	24	51	43	69	25	57	36	43	50	55	38
≥ $100 million	0.4	81	15	77	19	56	37	71	22	60	34	54	40	61	32
Without R&D activity	1,498.3	7	88	3	92	6	89	8	87	3	92	3	93	6	89

[a] Weighted totals for companies that reported on the 2008 Business R&D and Innovation Survey whether they did or did not perform/fund R&D. Weighted totals do not include the estimated 327,300 non-responding companies for whom an R&D status was not reported.

[b] Dollar ranges determined by total worldwide R&D expense plus total worldwide R&D cost funded by others.

NOTES: Survey asked companies to identify innovations introduced in 2006–08. Sum of yes and no percentages may not add to 100% due to item non-response to some innovation question items. Figures are preliminary and may later be revised.

SOURCE: National Science Foundation/Division of Science Resources Statistics, Business R&D and Innovation Survey, 2008.

ported being product innovators in 2006–08, and about 8%, process innovators.

Innovation Questions in Future Surveys

The scope of BRDIS questions about innovation will be expanded in future survey cycles as experience is gained in implementing the survey and analyzing its data. Indeed, several additional questions are included in the 2009 version of BRDIS, already in the field. First, companies reporting the introduction of goods or services innovation are being asked to indicate whether the innovation is new to the market in which the company is competing or just new to the company. Second, companies are asked to indicate the percentage of their total annual sales from: (a) goods and services innovations new to one of the company's markets, (b) goods and services innovations that are only new to the company, and/or (c) goods and services that were unchanged or only marginally modified.

Information about the Survey

BRDIS is a joint effort of NSF and the U.S. Census Bureau. BRDIS has been designed to collect a wide range of data on business R&D and innovation activities in the United States, including on topics that were not addressed by its predecessor, the Survey of Industrial Research and Development.[4]

The sample of companies for BRDIS is selected to represent all for-profit companies in the United States with five or more domestic employees, publicly or privately held.[5] The resulting sample provides statistical estimates for the population of companies that perform or fund R&D or engage in innovative activities in the United States. Because the statistics from the survey are derived from a sample, they are subject to both sampling and non-sampling errors.

For the 2008 BRDIS survey, 39,553 companies were sampled, representing 1,926,012 companies in the population. When these preliminary data were tabulated, the overall response rate was 77.4%, and the response rate for the top 500 domestic R&D-performing companies was 92.6%.

Industry classification is based on the dominant business activity for domestic R&D performance where available. For companies that did not report business activity codes for R&D, the classification used for sampling was assigned.

Measuring Business Innovation

Including questions on companies' innovation activities was a high priority of the industry survey redesign process. This reflected the considerable present interest by public policymakers, business leaders, and other ex-

perts and commentators in innovation as a key element of 21st century business strategy and a fertile venue for economic growth.

Definitions and guidelines for measuring innovation have been established over a number of years and are documented in the *Oslo Manual* (2005) prepared by the Organisation for Economic Co-operation and Development and Eurostat (the statistical office of the European Union). This discussion process has been multilateral in nature, involving extensive participation by the national statistical offices of OECD Member Countries, including the United States, and other relevant experts.

In the *Oslo* framework, "innovation is the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations."[6] Further, "The minimum requirement for an innovation is that the product, process, marketing method or organizational method must be new (or significantly improved) to the firm. This includes products, processes, and methods that firms are the first to develop and those that have been adopted from other firms or organizations." These *Oslo* concepts have been the foundation for the Community Innovation Surveys conducted by Eurostat periodically since the 1990s across the European Union's member states.[7]

BRDIS draws on the *Oslo* framework, with a focus on the product and process forms of innovation. In the 2008 survey, companies were directly asked (yes/no) if their business activities in 2006–08 included the introduction of (a) new or significantly improved products (either goods or services) or (b) new or significantly improved processes in one or more of three categories (methods for manufacturing or producing goods or services; methods for logistics, delivery, or distribution of inputs, goods or services; or support activities for processes, such as maintenance systems or operations for purchasing, accounting, or computing).[8] The incidences of innovation reported here reflect the answers to these questions in the 2008 BRDIS. These results are the government's first national estimates of U.S. innovative activity. Because of the complexity of the survey methodology and the potential for multiple survey respondents within a single company, comprehensive statistical and cognitive evaluations will be conducted to establish the robustness of the results presented.

More detailed information about the survey sample and methodology will be available in a forthcoming survey description at http://www.nsf.gov/statistics/survey.cfm. Copies of the BRDIS questionnaires and comparisons of BRDIS with the predecessor survey are available at http://www.nsf.gov/statistics/srvyindustry/about/brdis/. Standard errors and coefficients of variation for the statistics in this InfoBrief are available from the author.

Definitions

Company. A business organization of one or more establishments under common ownership or control. A company includes all subsidiaries and divisions in which there is more than 50% ownership, no matter where the subsidiary or division is located.

Industry. NAICS is the North American Industry Classification System, which uses a 6-digit code system to identify and organize types of industries, to aid the collection and publication of industry statistics. The first 2 digits in a code refer to the economic sector; the third, to the economic subsector. The fourth digit refers to the industry group, and the fifth and sixth to the industry. The statistics in this InfoBrief primarily reference codes at the 2-, 3-, and 4-digit levels.

United States. The 50 states and the District of Columbia.

Worldwide. All geographic locations, including the United States.

Data Availability

An initial BRDIS report on the 2008 worldwide R&D expenses of companies located in the United States was released in May 2010.[9] A second report discussing the BRDIS data on R&D employment was released in August 2010.[10] Detailed tables for 2008 will be available in the report *R&D and Innovation in Business: 2008* at http://www.nsf.gov/statistics/industry/ in early 2011. Individual tables may be available in advance of publication of the full report. For further information, please contact the author.

Notes

1. Mark Boroush, Research and Development Statistics Program, Division of Science Resources Statistics, National Science Foundation, 4201 Wilson Boulevard, Suite 965, Arlington, VA 22230 (mboroush@nsf.gov; 703-292-8726).

2. Figures for product and process innovations cited in this report are not additive. Companies indicating product innovations may also have process innovations, and vice versa.

3. The innovation incidence figures reported are the percentage of companies (weighted totals) responding "yes" to the various innovation questions as described in tables 1 and 2. The figures are not adjusted for item nonresponse to these questions. For the data in tables 1 and 2, the number of responses listed as "missing" range from 2% to 12%, but are 5% or less in most of the industry groups considered. Also, the innovation 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 non-respondents represent about 327,300 companies, weighted.

4. For information about the planning and preparation of BRDIS, see *NSF Announces New U.S. Business R&D and Innovation Survey* at http://www.nsf.gov/statistics/infbrief/nsf09304/.

5. Methodological work is underway to collect innovation-related data from companies with fewer than 5 employees (microbusinesses). The pilot NSF Microbusiness Innovation Science and Technology (MIST) Survey is expected to launch in 2012.

6. Organisation for Economic Co-operation and Development (OECD) and Eurostat. 2005. *Oslo Manual: Guidelines for Collecting and Interpreting Innovation Data.* Third edition, p. 46. Paris.

7. Eurostat (European Commission), "Innovation Statistics," http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Innovation_statistics. The most recent Community Innovation Survey data published by Eurostat covers the period 2004–06. In view of the preliminary nature of the NSF data published in this InfoBrief, there is no effort at this time to compare these new U.S. findings with the existing Eurostat statistics.

8. The 2006–08 window of time for the innovation questions follows the convention established in the Community Innovation Survey. This is done to recognize the intrinsically nonlinear features and timing of the processes involved in companies developing and adopting innovations. Future BRDIS surveys will carry forward a similar period of interest for the innovation questions, i.e., the 2009 survey will reference 2007–09, the 2010 survey, 2008–10, and so on.

9. Wolfe RM. 2010. *U.S. Businesses Report 2008 Worldwide R&D Expense of $330 Billion: Findings from New NSF Survey*. InfoBrief NSF 10-322. Arlington, VA: National Science Foundation. Available at http://www.nsf.gov/statistics/infbrief/nsf10322/.

10. Moris F, Kannankutty N. 2010. *New Employment Statistics from the 2008 Business R&D and Innovation Survey*. InfoBrief NSF 10-326. Arlington, VA: National Science Foundation. Available at http://www.nsf.gov/statistics/infbrief/nsf10326/.

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