Federal Funds for Research and Development: Fiscal Years 2014–16

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Technical Notes

Survey Overview

Purpose. The annual Survey of Federal Funds for Research and Development (Federal Funds Survey) is the primary source of information about federal funding for R&D in the United States. The results of the survey are used to implement four federal programs: the Federal Laboratory Consortium for Technology Transfer, Small Business Innovation Research, Small Business Technology Transfer, and Experimental Program to Stimulate Competitive Research.

Data collection authority. The information is solicited under the authority of the National Science Foundation Act of 1950, as amended, and the America COMPETES Reauthorization Act of 2010.

Survey contractor. Synectics for Management Decisions, Inc.

Survey sponsor. The National Center for Science and Engineering Statistics (NCSES) within the National Science Foundation (NSF).

Key Survey Information

Frequency. Annual.

Initial survey year. 1951.

Reference period. FYs 2014–16.

Response unit. Federal agencies.

Sample or census. Census.

Population size. In the survey cycle for data collection on FYs 2014–16, a total of 28 federal agencies reported R&D data. Five federal departments were surveyed at the agency level; 10 federal departments were surveyed at the subdivision level, with a total 54 subdivisions; 13 independent agencies were surveyed at the agency level.

Sample size. Not applicable; the survey is a census of all federal agencies that conduct R&D programs, except the CIA.

Survey Design

Target population. The Federal Funds Survey target population consists of the federal agencies that conduct R&D programs, except the CIA. For the FYs 2014-16 cycle, 28 federal agencies (15

federal departments and 13 independent agencies) reported R&D data. Because multiple subdivisions of a federal department were in some cases requested to complete the survey, there were 72 individual respondents. (Five of the 15 federal departments were surveyed at the department level, and 10 were surveyed at the subdivision level, with 54 subdivisions surveyed. All 13 independent agencies were surveyed at the agency level.)

Sample frame. The survey is a census of all federal agencies that conduct R&D programs, which are identified from information in the president's budget submitted to Congress. The CIA is excluded. The Analytical Perspectives volume and the "Detailed Budget Estimates by Agency" section of the appendix to the president's budget identify agencies that receive R&D funding. In addition, the Federal Yellow Book and the U.S. Government Manual are consulted.

Sample design. Not applicable.

Data Collection and Processing Methods

Data collection. Data for FYs 2014–16 (volume 64) were collected by Synectics for Management Decisions, Inc. (Synectics) under contract to NCSES. Data collection began with an e-mail to each agency to verify the name, address, fax and phone numbers, and e-mail address of each survey respondent. A Web-based data collection system is used to collect the Federal Funds Survey data.

The Web data collection system is part of NCSES's effort to enhance survey reporting and reduce data collection and processing costs by offering respondents direct online reporting and editing; however, some agencies submit their data in alternative formats.

Information was collected for 3 federal government fiscal years (e.g., 1 October 2013 through 30 September 2014): the fiscal year just completed (FY 2014), the current fiscal year (FY 2015), and the president's budget year (FY 2016). FY 2014 data are completed transactions. FY 2015 data are estimates of congressional appropriation actions and apportionment and reprogramming decisions. FY 2016 data are estimates of administration budget proposals not yet acted on.

Data collection began 18 February 2015, and the requested due date for data submissions was 22 April 2015. Data collection was extended until all of the surveyed agencies provided complete and final survey data.

Mode. The Federal Funds Survey uses a Web-based data collection system. The Web system consists of a data collection component that allows survey respondents to enter their data online and a monitoring component that allows the data collection contractor to monitor support requests, data entry, and data issues. The Web system's two components are password protected so that only authorized respondents and staff can access them. All data imports, data editing, and trend checking are accomplished using the Web system.

Response rate. 100%.

Data editing. Federal Funds Survey data errors are flagged automatically by the Web data collection system: respondents cannot submit their data to NCSES until all required fields have been completed without errors. Once data are submitted, each agency's narrative statement, 2-

year difference report, and $100-million difference report are reviewed. Respondents are contacted to resolve potential reporting errors that cannot be reconciled by the narratives. Explanations of questionable data are noted.

Imputation. None.

Weighting. None.

Variance estimation. Not applicable.

Survey Quality Measures

Sampling error. Not applicable.

Coverage error. Because identifying relevant federal agencies is a straightforward task, coverage is assumed to be complete as of the time of identification, excluding the activities of the Central Intelligence Agency.

Nonresponse error. Agencies are encouraged to estimate informally when actual data are unavailable. The survey instrument allows respondents to enter data or skip data fields. NCSES assumes a blank field is zero for estimation purposes.

Measurement error. Some measurement problems are known to exist in the Federal Funds Survey data. Some agencies cannot report the full costs of R&D. For example, the Department of Defense (DOD) does not include headquarters costs of planning and administering R&D programs, which are estimated at a fraction of 1% of its total cost. DOD has stated that identification of amounts at this level is impracticable.

The National Institutes of Health (NIH) in the Department of Health and Human Services currently has many of its awards in its financial system without any field of science code. Therefore, NIH uses an alternate source to estimate its research dollars by field of science. NIH uses scientific class codes (based upon past history of grant, content of the title, and the name of the awarding institute or center) as an approximation for field of science codes.

The National Aeronautics and Space Administration (NASA) does not include any field of science codes in its financial database. Consequently, NASA must estimate what percentage of the agency's research dollars are allocated into the fields of science.

Also, agencies are required to report the ultimate performer of R&D. However, through past workshops, NCSES has learned that some agencies do not always track their R&D dollars to the ultimate performer of R&D. This leads to some degree of misclassification of performers of R&D, but NCSES has not determined the extent of the errors in performer misclassification by the reporting agencies.

R&D plant data are underreported to some extent because of the difficulty some agencies, particularly DOD and NASA, encounter in identifying and reporting these data. DOD's respondents report obligations for R&D plant funded under the agency's appropriation for construction, but they are able to identify only a small portion of the R&D plant support that is within R&D contracts funded from DOD's appropriation for research, development, testing, and

evaluation. Similarly, NASA respondents cannot separately identify the portions of industrial R&D contracts that apply to R&D plant, since these data are subsumed in the R&D data covering industrial performance. NASA R&D plant data for other performing sectors are reported separately.

Data Comparability (Changes)

Data revisions. When completing the current year's survey, agencies naturally revise their estimates for the latest 2 years of the previous report—in this case, FYs 2014 and 2015. Sometimes, survey submissions also reflect reappraisals and revisions in classification of various aspects of agencies' R&D programs; in those instances NCSES requests that agencies provide revised prior-year data to maintain consistency and comparability with the most recent R&D concepts.

For trend comparisons, use only the historical data from the most recent publication, which incorporates changes agencies have made in prior-year data to reflect program reclassifications or other corrections. Do not use data published earlier.

Changes in survey coverage and population. This cycle, (volume 64, FYs 2014–16) the Department of Homeland Security's Domestic Nuclear Detection Office began reporting funds. In January 2014, all of the Department of Transportation's Research and Innovative Technology Administration programs were transferred to the Office of the Assistant Secretary for Research and Technology.

Changes in questionnaire.

- In volumes 59 (FYs 2009–11) and 60 (FYs 2010–12), questions relating to funding from the American Recovery and Reinvestment Act of 2009 (ARRA) were added to the data collection instruments. The survey collected separate outlays and obligations for ARRA and non-ARRA sources of funding, by performer and geography for FYs 2009 and 2010.

- Starting with volume 59 (FYs 2009–11), funds data were requested in actual dollars (instead of rounded in thousands, as was done through volume 58).

Changes in reporting procedures or classification.

- In FY 2013 NASA revamped their reporting process so that the final data for FYs 2012–14 forward are not directly comparable with totals reported in previous years.

- Starting with volume 62 (FYs 2012–14), an "undistributed" category was added to the geographic location tables to include DOD obligations for intramural and industry R&D where the location of performance could not be identified. This change was applied retroactively to FY 2011 data.

- Starting with volume 61 (FYs 2011–13), DOD subagencies other than the Defense Advanced Research Projects Agency were reported as an aggregate total under other defense agencies to enable complete reporting of DOD R&D (both unclassified and

classified). Consequently, DOD began reporting additional classified R&D not previously reported by its subagencies.

- FYs 2005–07. Before the volume 55 survey cycle, NSF updated the list of foreign performers in the Federal Funds Survey to match the list of countries and territories in the Department of State's Bureau of Intelligence and Research fact sheet of Independent States in the World and fact sheet of Dependencies and Areas of Special Sovereignty. Area and country lists in volume 55 data tables and later may differ from those in previous reports.

- November 2002. On 25 November, President Bush signed the Homeland Security Act of 2002, establishing the Department of Homeland Security.

- FYs 1996–98. The lines on the survey instrument for the special foreign currency program and for detailed field of science and engineering (S&E) were eliminated beginning with the volume 46 survey cycle. Two tables depicting data on foreign performers by region, country, and agency that were removed before publication of volume 43 were reinstated with volume 46.

- FYs 1994–96. During the volume 44 survey cycle, the Director for Defense Research and Engineering (DDR&E) at DOD requested that NSF further clarify the true character of DOD's R&D program, particularly as it compares with other federal agencies, by adding more detail to development obligations reported by DOD respondents. Specifically, DOD requested that NSF allow DOD agencies to report development obligations in two separate categories: advanced technology development and major systems development.

  An excerpt from a letter written by Robert V. Tuohy, Chief, Program Analysis and Integration at DDR&E, to John E. Jankowski, Program Director, Research and Development Statistics Program, Division of Science Resources Statistics, NSF, explains the reasoning behind the DDR&E request:

  > The DOD's R&D program is divided into two major pieces, Science and Technology (S&T) and Major Systems Development. The other federal agencies' entire R&D programs are equivalent in nature to DOD's S&T program, with the exception of the Department of Energy and possibly NASA. Comparing those other agency programs to DOD's program, including the development of weapons systems such as F-22 Fighter and the New Attack Submarine, is misleading.

- FYs 1990–92. Since volume 40, DOD has reported research obligations and development obligations separately. Tables reporting obligations for research, by state and performer, and obligations for development, by state and performer, were specifically created for DOD. Circumstances specific to DOD are (1) DOD funds the preponderance of federal development and (2) DOD development funded at institutions of higher education is typically performed at university-affiliated nonacademic laboratories, which are separate from universities' academic departments, where university research is typically performed.

Changes in reporting.

- FY 2014. In January 2014, all Research and Innovative Technology Administration programs were transferred into the Office of the Assistant Secretary for Research and Technology in the Office of the Secretary of Transportation.

- Starting this cycle (volume 64, FYs 2014–16), the Department of Homeland Security's Domestic Nuclear Detection Office began reporting.

- The Department of State's volume 64 (FYs 2014–16) data were excluded due to their poor quality.

- In FY 2013 NASA revamped their reporting process so that the final data for FYs 2012–14 forward are not directly comparable with totals reported in previous years.

- FY 2012. The National Aeronautics and Space Administration (NASA) began reporting International Space Station obligations as research rather than R&D plant.

- FYs 2011–13. To enable complete reporting of R&D (both unclassified and classified) from DOD, DOD subagencies other than the Defense Advanced Research Projects Agency are reported as an aggregate total under other defense agencies. Consequently, DOD began reporting additional classified R&D not previously reported by its subagencies.

- FY 2011. The Department of Agriculture's Economic Research Service revised its data for FY 2009.

- FY 2010. NASA resumed reporting International Space Station obligations as R&D plant.

- FYs 2000–09. Beginning in FY 2000, Air Force (AF) did not report Budget Activity (BA) 6.7 Operational Systems Development data because the agency misunderstood the reporting requirements. During the volume 57 data collection cycle, AF edited prior-year data for FYs 2000–07 to include BA 6.7 Operational Systems Development data. These data revisions were derived from FY 2007 distribution percentages that were then applied backward to revise data for FYs 2000–06.

- FY 2007. NASA's R&D obligations decreased by $1 billion between FYs 2006 and 2007. Of this amount, $850 million was accounted for by obligations for operational projects that NASA excluded in FY 2007 but reported in FY 2006. The remainder was from an overall decrease in obligations between FYs 2006 and 2007.

- FY 2006. NASA reclassified funding for the following items as operational costs: Space Operations, the Hubble Space Telescope, the Stratospheric Observatory for Infrared Astronomy, and the James Webb Space Telescope. This funding was previously reported as R&D plant.

- FYs 2004–06. NASA implemented a full-cost budget approach, which includes all of the direct and indirect costs for procurement, personnel, travel, and other infrastructure-related expenses relative to a particular program and project. NASA's data for FY 2004 and later years may not be directly comparable with its data for FY 2003 and earlier years.

- FY 2004. The National Institutes of Health (NIH) revised its financial database; beginning with FY 2004, NIH records no longer contain information on the field of S&E. Data for FY 2004 and later years are not directly comparable with data for FY 2003 and earlier years.

- FY 2003. The Substance Abuse and Mental Health Services Administration reclassified some of its funding categories as non-R&D that had been considered R&D in prior years.

- FY 2000. NASA reclassified the Space Station as a physical asset, reclassified Space Station Research as equipment, and transferred funding for the program from R&D to R&D plant. Also in FY 2000, NIH reclassified as research the activities that it had previously classified as development. For more information on the classification changes at NASA and NIH, refer to *Classification Revisions Reduce Reported Federal Development Obligations* (InfoBrief NSF 02-309), February 2002, available at http://www.nsf.gov/statistics/nsf02309/.

Definitions

Agency and subdivision. An agency is an organization of the federal government whose principal executive officer reports to the president. The Library of Congress is also included in the survey, even though its chief officer reports to Congress. Subdivision refers to any organizational unit of a reporting agency, such as a bureau, division, office, or service.

Development. Systematic application of knowledge or understanding that is directed toward the production of useful materials, devices, and systems or methods, including design, development, and improvement of prototypes and new processes to meet specific requirements.

- To better differentiate between the part of the federal R&D budget that supports science and key enabling technologies (including technologies for military and nondefense applications) and the part that primarily supports testing and evaluation (mostly of defense-related systems), NSF collects development dollars from DOD in two categories: advanced technology development and major systems development.

- DOD's Research, Development, Test, and Evaluation (RDT&E) budget activities are used to classify data into the survey categories. Within DOD's research categories, basic research is classified as budget activity 1, and applied research is classified as budget activity 2. Within DOD's development categories, advanced technology development is classified as budget activity 3. Major systems development covers budget activities 4–7 and includes advanced component development and prototypes (ACD&P), system development and demonstration (SDD), RDT&E management support, and operational systems development. Note: As a historical artifact from previous DOD budget authority

terminology, funds for budget activity categories 1 through 7 are sometimes referred to as 6.1 through 6.7 monies.

Fields of science and engineering. The Federal Funds Survey uses eight broad field categories, each comprising a number of detailed fields. A discipline under one detailed field may be classified under another detailed field when the major emphasis is elsewhere. Research in biochemistry, for example, might be reported as biological, agricultural, or medical, depending on the focus of the project. No double counting is intended or allowed. The fields are as follows:

- *Computer sciences and mathematics* employs logical reasoning with the aid of symbols and is concerned with the development of methods of operation using such symbols or with the application of such methods to automated information systems. Detailed fields: computer sciences, mathematics, and other computer sciences and mathematics.

- *Engineering* is concerned with developing engineering principles or making specific principles usable in engineering practice. Detailed fields: aeronautical, astronautical, chemical, civil, electrical, mechanical, metallurgy and materials engineering, and other engineering.

- *Environmental sciences* (terrestrial and extraterrestrial) is, with the exception of oceanography, concerned with the gross nonbiological properties of the areas of the solar system that directly or indirectly affect human survival and welfare. Obligations for studies pertaining to life in the sea or other bodies of water are reported as support of oceanography, not biology. Detailed fields: atmospheric sciences, geological sciences, oceanography, and other environmental sciences.

- *Life sciences* is concerned with the scientific study of living organisms and their systems. Detailed fields: agricultural sciences, biological sciences (excluding environmental biology), environmental biology, medical sciences, and other life sciences.

- *Physical sciences* is concerned with understanding of the material universe and its phenomena. Detailed fields: astronomy, chemistry, physics, and other physical sciences.

- *Psychology* deals with behavior, mental processes, and individual and group characteristics and abilities. Detailed fields: biological aspects, social aspects, and other psychological sciences.

- *Social sciences* is concerned with an understanding of the behavior of social institutions and groups and of individuals as members of a group. Detailed fields: anthropology, economics, political science, sociology, and other social sciences.

- *Other sciences not elsewhere classified (nec)* is used for multidisciplinary or interdisciplinary projects that cannot be classified within one of the broad fields of science already listed.

Federal obligations for research performed at universities and colleges, by detailed field of science. Seven agencies respond to this part of the survey: the Departments of Agriculture, Defense, Energy, Health and Human Services (HHS), and Homeland Security; NASA; and NSF.

Geographic distribution of FY 2014 R&D obligations. The 11 largest R&D funding agencies respond to this portion of the survey: the Departments of Agriculture, Commerce, Defense, Energy, HHS, Homeland Security, the Interior, and Transportation; the Environmental Protection Agency; NASA; and NSF. They are asked to provide the principal location (state or outlying area) of the work performed by the primary contractor, grantee, or intramural organization, assign the obligations to the location of the headquarters of the U.S. primary contractor, grantee, or intramural organization, or list the funds as undistributed.

Obligations and outlays. Obligations represent the amounts for orders placed, contracts awarded, services received, and similar transactions during a given period, regardless of when funds were appropriated and when future payment of money is required. Outlays represent the amounts for checks issued and cash payments made during a given period, regardless of when funds were appropriated.

Performer. An intramural group or organization carrying out an operational function or an extramural organization or a person receiving support or providing services under a contract or grant.

- *Intramural performers* are the agencies of the federal government. The work of these agencies is carried out directly by agency personnel. Obligations reported under this category are for activities performed or to be performed by the reporting agency itself or are for funds that the agency transfers to another federal agency for performance of work, as long as the ultimate performer is that agency or any federal agency. If the ultimate performer is not a federal agency, funds transferred are reported by the transferring agency under the appropriate extramural performer category (businesses, universities and colleges, other nonprofit institutions, FFRDCs, nonfederal government, and foreign).
    - Intramural activities cover not only actual intramural R&D performance but also the costs associated with planning and administration of both intramural and extramural programs by federal personnel. Intramural activities also include the costs of supplies and off-the-shelf equipment (equipment that has gone beyond the development or prototype stage) procured for use in intramural R&D. For example, an operational launch vehicle purchased from an extramural source by NASA and used for intramural performance of R&D is reported as a part of the cost of intramural R&D.
- *Extramural performers* are organizations outside the federal sector that perform R&D with federal funds under contract, grant, or cooperative agreement. Only costs associated with actual R&D performance are reported. Types of extramural performers:

    Industry—organizations that may legally distribute net earnings to individuals or to other organizations.

Universities and colleges—institutions of higher education in the United States that offer at least 1 year of college-level study leading toward a degree. Included are colleges of liberal arts; schools of arts and sciences; professional schools, such as schools of engineering and medicine, including affiliated hospitals and associated research institutes; and agricultural experiment stations.

Other nonprofit institutions—private organizations other than educational institutions whose net earnings in no part inure to the benefit of a private stockholder or individual and other private organizations organized for the exclusive purpose of turning over their entire net earnings to such nonprofit organizations.

Federally funded research and development centers (FFRDCs)—R&D-performing organizations that are exclusively or substantially financed by the federal government and are supported by the federal government either to meet a particular R&D objective or in some instances to provide major facilities at universities for research and associated training purposes. Each center is administered by an industrial firm, a university, or another nonprofit institution (see http://www.nsf.gov/statistics/ffrdclist/ for the Master List of FFRDCs maintained by NSF). In general, an organization included in the FFRDC category meets all the following criteria: (1) its primary activities include one or more of the following: basic research, applied research, development, or management of R&D (specifically excluded are organizations engaged primarily in routine quality control and testing, routine service activities, production, mapping and surveys, and information dissemination); (2) it is a separate operational unit within the parent organization or is organized as a separately incorporated organization; (3) it performs actual R&D or R&D management either upon direct request by the federal government or under a broad charter from the federal government but, in either case, under the direct monitoring by the federal government; (4) it receives its major financial support (70% or more) from the federal government (usually from one agency); (5) it has or is expected to have a long-term relationship with its sponsoring agency (about 5 years or more), as evidenced by specific obligations assumed by it and the agency; (6) most or all of its facilities are owned by or are funded under contract with the federal government; and (7) it has an average annual budget (operating and capital equipment) of at least $500,000.

State and local governments—state and local government agencies, excluding state or local universities and colleges, agricultural experiment stations, medical schools, and affiliated hospitals. (Federal R&D funds obligated directly to such state and local institutions are excluded in this category; however, they are included under the universities and colleges category in this report.) R&D activities under the state and local governments category are performed either by the state or local agencies themselves or by other organizations under grants or contracts from such agencies. Regardless of the ultimate performer, federal R&D funds directed to state and local governments are reported only under this sector.

Foreign performers—foreign citizens, foreign organizations, or foreign governments, as well as international organizations (such as the North Atlantic Treaty Organization; the United Nations Educational, Scientific, and Cultural Organization; and the World

Health Organization), performing R&D work abroad financed by the federal government. Excluded from the survey are U.S. agencies, organizations, or citizens performing R&D abroad for the federal government. The survey does not seek information on offshore payments. An exception in the past was made in the case of U.S. citizens performing R&D abroad under special foreign-currency funds; these activities were included under the foreign performers category but have not been collected since the mid-1990s.

Private individuals—When an R&D grant or contract is awarded directly to a private individual, obligations incurred are placed under the category industrial firms.

Research, development, and R&D plant. Amounts for R&D and R&D plant include all direct, incidental, or related costs resulting from, or necessary to, performance of R&D and costs of R&D plant as defined below, regardless of whether R&D is performed by a federal agency (intramurally) or by private individuals and organizations under grant or contract (extramurally). R&D excludes routine product testing, quality control, mapping and surveys, collection of general-purpose statistics, experimental production, and the training of scientific personnel.

- *Research* is defined as systematic study directed toward fuller scientific knowledge or understanding of the subject studied. Research is classified as either basic or applied, according to the objectives of the sponsoring agency.

  Basic research is defined as systematic study directed toward fuller knowledge or understanding of the fundamental aspects of phenomena and of observable facts without specific applications toward processes or products in mind.

  Applied research is defined as systematic study to gain knowledge or understanding necessary to determine the means by which a recognized and specific need may be met.

- *Development* is defined as systematic application of knowledge or understanding that is directed toward the production of useful materials, devices, and systems or methods, including design, development, and improvement of prototypes and new processes to meet specific requirements.

  To better differentiate between the part of the federal R&D budget that supports science and key enabling technologies (including technologies for military and nondefense applications) and the part that primarily supports testing and evaluation (mostly of defense-related systems), NSF collects development dollars from DOD in two categories: advanced technology development and major systems development.

  DOD uses service codes 6.1–6.7 to classify data into the survey categories. Within DOD's research categories, basic research is classified as 6.1, and applied research is classified as 6.2. Within DOD's development categories, advanced technology development is classified as 6.3. Major systems development is classified as 6.4–6.7 and includes component developmental prototypes, demonstration and development of management support, and operational systems development.

- *Demonstration* includes amounts for activities that are part of R&D (i.e., that are intended to prove or to test whether a technology or method does in fact work). Demonstrations intended primarily to make information available about new technologies or methods are excluded.

- *R&D plant* is defined as R&D facilities and fixed equipment, such as reactors, wind tunnels, and particle accelerators. Amounts include acquisition of, construction of, major repairs to, or alterations in structures, works, equipment, facilities, or land for use in R&D activities at federal or nonfederal installations. Excluded from the R&D plant category are costs of expendable or movable equipment (e.g., spectrometers, microscopes) and office furniture and equipment. Also excluded are the costs of predesign studies (e.g., those undertaken before commitment to a specific facility). These excluded costs are reported under "total conduct of research and development." Obligations for foreign R&D plant are limited to federal funds for facilities that are located abroad and used in support of foreign R&D.