



National Center for Science and
Engineering Statistics

InfoBrief

Measuring R&D Workers Using NCSES Statistics

NSF 21-335 | August 2021

Amy Burke, John Finamore, Daniel Foley, John Jankowski, and Francisco Moris

Workers engaged in basic research, applied research, and experimental development (R&D) as a primary work activity (RD1) is the new National Center for Science and Engineering Statistics (NCSES) headline measure for *R&D workers*, which more closely aligns with international guidance than the previous measure.¹ This InfoBrief reports on various measures of workers engaged in R&D activity (R&D workers) using data from the National Survey of College Graduates (NSCG), sponsored by NCSES within the National Science Foundation. The data shown in this report reflect an ability to take a broad approach in measuring workers engaged in R&D work activity. However, this broad approach diverges from international guidance and is no longer the NCSES-recommended measurement for estimating R&D workers from its demographic surveys.

NCSES has adopted and recommends using estimates for R&D workers that include employees who report *performing basic research, applied research, or experimental development as primary work activities*.

This previous measure has been presented by NCSES in past publications and included workers who reported *design* as a primary activity as well as employees whose secondary activities were in R&D or design. The exclusion of design as part of the NCSES definition aligns it more closely with international guidance. The following analysis provides an overview of the impact of changing the old measure to the new measure for R&D workers, resulting in a substantially lower estimate of R&D workers than previously reported by the old definition.

Background and Definitions

The Organisation of Economic Co-operation and Development (OECD) *Frascati Manual* (Frascati) provides the international guidance on which the new R&D worker measure presented in this report is based. Frascati defines R&D personnel according to their R&D function, regardless of level of education, degree field, or occupation: (1) researchers and their managers, (2) technicians, and (3) support staff such as clerical staff that provide direct services for R&D (OECD 2015). Frascati also defines R&D to include three types of research activities: basic research, applied research, and experimental development.² The NSCG is a biennial, cross-sectional survey that provides data on individuals with a bachelor's degree or higher level of education.³ For respondents who are employed at the time of the survey, the NSCG asks them to identify work activities on which they spend the most hours during a typical week.⁴ Using the two definitions from Frascati as guidance, individuals who select basic research, applied research, or development as their primary work activities are referred to here as *R&D workers*.

While the NSCG provides information on R&D activities of workers, it does not meet the standards needed to provide an estimate of R&D personnel as defined by Frascati. In particular, Frascati recommends classifying R&D personnel by the actual function (in terms of tasks) of the individuals contributing to the intramural R&D activities of the organization in which they perform these tasks. The NSCG asks respondents to report if their primary work activity is basic research, for example, rather than to describe what their function is in performing basic research. The result is that there is no one-to-one crosswalk between R&D personnel functions and types of R&D activities. Further, the Frascati definition identifies R&D personnel “regardless of level of education,” and the NSCG is a survey of college graduates only. While the new definition is more closely aligned with international guidance, given these technical deviations from the Frascati definition, the new estimate does not align completely with these standards. Therefore, this new NSCG estimate is referred to as *R&D workers* rather than the Frascati term *R&D personnel*.

NSCG Estimates of R&D Workers

The NSCG offers the ability to take a broad approach to measuring R&D workers, and this was the approach used in developing the measure for past NCSES publications, which included workers engaged in R&D or design as a primary or secondary work activity (RDD2) (NSB 2019a). This approach produced the largest estimate among the R&D measures listed in [table 1](#) (RD1, RDD1, RD2, RDD2). While this may provide a comprehensive measure of all the workers possibly engaged in R&D activity, it does not meet the Frascati criteria for R&D personnel. This measure diverges from the international guidelines with its inclusion of the work activity “design of equipment and process, structures, models” (design) as a component of R&D. While there are an estimated 0.1 million (DE1) to 2.5 million (DE2) workers engaged in design activities, these activities are not necessarily a component of R&D based on the Frascati statistical definition of R&D.

Table 1

Workers engaged in R&D or design and as a percentage of total employment, by alternative measures of R&D workers: 2015

(Number and percent)

R&D workers measure	Description of R&D workers measure	Weighted R&D workers (number)	R&D workers as a percentage of total employment (%)
RD1	R&D as primary work activity	3,219,000	7
RDD1	R&D or design as primary work activity	4,298,000	9
RD2	R&D as primary or secondary work activity	8,272,000	18
RDD2	R&D or design as primary or secondary work activity	10,275,000	22
DE1	Design as primary work activity	1,079,000	2
DE2	Design as primary or secondary work activity	2,532,000	6

Note(s):

Weighted U.S. employment of college-educated individuals for percentage calculations is 45,941,000.

Source(s):

National Center for Science and Engineering Statistics, National Survey of College Graduates (NSCG), 2015.

The NSCG asks respondents to indicate which work activity they spend the “second most hours” of their work week doing. These are referred to as “secondary work activities.” In past publications, NCSES has also included those workers who chose basic research, applied research, experimental development, or design as their secondary work activity. The two measures that exclude design employment, RD1 and RD2, are in principle consistent with Frascati definitions of R&D personnel and researchers. However, only RD1, which excludes secondary work activities, is consistent with available statistics on researchers from U.S. R&D expenditures surveys, where R&D expenditures include labor cost. Excluding design and focusing only on R&D work activities, the inclusion of workers who spend the second most hours of their week on R&D more than doubles the resulting estimate ([table 1](#)). This is true regardless of sector of work ([table 2](#)). The

inclusion of R&D as a secondary work activity led to estimates of R&D workers that ranged from 75% higher for the federal government sector to 10 times higher for 2-year colleges and pre-college institutions than the measure of those for whom R&D was a primary work activity only. The inclusion of design led to modest increases in the measure, regardless of sector of work.

Table 2**Total employment and R&D workers among those with a bachelor's degree or higher, by broad sector: 2015**

(Number and standard error)

Sector	Total employment		RD1		RD2		RDD2	
	Weighted estimate	Standard error	Weighted estimate	Standard error	Weighted estimate	Standard error	Weighted estimate	Standard error
All sectors	45,941,000	288,500	3,219,000	92,000	8,272,000	155,500	10,275,000	167,500
4-year college or university	2,776,000	57,000	595,000	25,000	1,052,000	37,000	1,115,000	39,000
2-year college and precollege institutions	6,825,000	32,500	103,000	19,000	1,146,000	67,000	1,237,000	69,000
For-profit business or industry	23,978,000	242,000	1,592,000	64,000	3,904,000	116,000	5,408,000	123,500
Self-employed, not incorporated	3,381,000	104,000	249,000	35,000	645,000	56,500	758,000	58,500
Nonprofit business or industry	4,256,000	102,500	268,000	24,000	563,000	35,000	669,000	37,500
Federal government	1,762,000	82,500	248,000	18,000	434,000	27,000	488,000	27,500
State and local government	2,963,000	18,000	165,000	17,000	529,000	57,500	600,000	58,000

Note(s):

RD1 indicates that R&D is the individual's primary work activity. RD2 indicates that R&D is the individual's primary or secondary work activity. RDD2 indicates that R&D or design is the individual's primary or secondary work activity. The only statistically significant differences between RD2 and RDD2 occur for the "all sectors" category and for-profit and nonprofit business sectors.

Source(s):

National Center for Science and Engineering Statistics, National Survey of College Graduates (NSCG), 2015.

New NCSES Headline Measure for R&D Workers

Workers engaged in basic research, applied research, and experimental development (R&D) as a primary work activity (RD1) is the new NCSES headline measure for R&D workers. This measure excludes design, which aligns more closely with international guidance; design as a work activity will continue to be separately available from the NSCG.⁵ The measure also excludes data on R&D as a secondary work activity. However, like design, these data will also be available. The inclusion of these two elements drives increases in the measure and diverges from international guidance on how to measure R&D workers. NCSES will use R&D as a primary work activity (RD1) as the headline measure for R&D workers in future publications.

Notes

1 This report is based on research from the NCSES Working Group on R&D Employment Measurement, which included three of this publication's coauthors: working group champion John Jankowski and members Amy Burke, Daniel Foley, and Francisco Moris. Other members of the working group were Wang-Ying Chang and Katherine Hale (retired November 2018).

2 *Basic research* is experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundations of phenomena and observable facts, without any particular application or use in view. *Applied research* is original investigation undertaken to acquire new knowledge; it is, however, directed primarily toward a specific practical aim or objective. *Experimental development* is systematic work, drawing on knowledge gained from research and practical experience and producing additional knowledge, which is directed to producing new products or processes or to improving existing products or processes (OECD 2015, chapter 2, paragraph 2.9).

3 For more information about the NSCG, see <https://www.nsf.gov/statistics/srvygrads/>.

4 See items A24 and A25 in the 2015 NSCG survey form. For NSCG survey forms, see <https://www.nsf.gov/statistics/srvygrads/#qs>.

5 Statistics on design employment may be useful to track innovation-related activities beyond R&D (Galindo-Rueda and Millot 2015) as well as related topics such as the skilled technical workforce (NSB 2019b).

References

Galindo-Rueda F, Millot V. 2015. Measuring Design and Its Role in Innovation. *OECD Science, Technology and Industry Working Papers*. No. 2015/01. Paris: OECD Publishing. Available at <https://doi.org/10.1787/5js7p6lj6zq6-en>. Accessed 8 January 2021.

National Science Board (NSB), National Science Foundation. 2019a. Science and Engineering Indicators 2020: Science and Engineering Labor Force. *Science and Engineering Indicators 2020*. NSB-2019-8. Alexandria, VA. Available at <https://nces.nsf.gov/pubs/nsb20198/>. Accessed 8 January 2021.

National Science Board (NSB), National Science Foundation. 2019b. *The Skilled Technical Workforce: Crafting America's Science and Engineering Enterprise*. NSB-2019-23. Alexandria, VA. Available at <https://www.nsf.gov/nsb/publications/2019/nsb201923.pdf>. Accessed 8 January 2021.

Organisation for Economic Co-operation and Development (OECD). 2015. *Frascati Manual 2015: Guidelines for Collecting and Reporting Data on Research and Experimental Development*. The Measurement of Scientific, Technological and Innovation Activities. Paris: OECD Publishing. Available at <https://doi.org/10.1787/9789264239012-en>. Accessed 8 January 2021.

Suggested Citation

Burke A, Finamore J, Foley D, Jankowski J, Moris F; National Center for Science and Engineering Statistics (NCSES). 2021. *Measuring R&D Workers Using NCSES Statistics*. NSF 21-335. Alexandria, VA: National Science Foundation. Available at <https://nces.nsf.gov/pubs/nsf21335/>.

Contact Us

Report Authors

Amy Burke
Program Director
Science and Engineering Indicators Program, NCSES
Tel: (703) 292-7219
E-mail: aburke@nsf.gov

John Finamore
Program Director
Human Resources Statistics Program, NCSES

Daniel Foley
Senior Analyst
Human Resources Statistics Program, NCSES

John Jankowski
Program Director
Research and Development Statistics Program, NCSES

Francisco Moris
Senior Analyst
Research and Development Statistics Program, NCSES

NCSES

National Center for Science and Engineering Statistics
Directorate for Social, Behavioral and Economic Sciences
National Science Foundation
2415 Eisenhower Avenue, Suite W14200
Alexandria, VA 22314
Tel: (703) 292-8780
FIRS: (800) 877-8339
TDD: (800) 281-8749
E-mail: ncsesweb@nsf.gov