



National Center for Science and
Engineering Statistics

Definitions of Research and Development: An Annotated Compilation of Official Sources

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Introduction

Advances in science and technology are responsible for greatly improving domestic productivity, prosperity, health, and welfare. Many of these advances were the result of planned, systematic work carried out by private businesses, government entities, institutes of higher education, and nonprofit organizations. Further, this work produces value in addition to benefits realized by those who are actually performing the work. Knowledge generated by this work produces “spillover” benefits that occur because “[i]deas generated by one inventor may lead other inventors to create other new ideas.”¹ This work is commonly referred to by a variety of terms, such as research, research and development, product development, technology development, product improvement, and planning and development. Policymakers interested in tracking the advancement of science and technology benefit from a consistent way to measure this economic activity.

The National Center for Science and Engineering Statistics (NCSES), and the Center’s predecessor organizations within the U.S. National Science Foundation, have been surveying domestic establishments that perform or fund **research and development (R&D)** for nearly 75 years. NCSES is the U.S. principal statistical agency with the unique mission to serve as the nation’s provider of trusted, quality data on the science and engineering enterprise. This mandate began with the National Science Foundation Act of 1950 and was re-authorized by **Section 505 of the America COMPETES Reauthorization Act of 2010**. Together, NCSES establishment surveys provide an estimate of the total amount of R&D performed in the United States, sources of funding for R&D, and the type of R&D performed. Measurement error is an ongoing challenge with respect to R&D. Even though definitions of R&D are detailed within individual surveys and even though survey definitions are aligned with domestic and international standards, some respondents either over- or underreported R&D as a result of “a combination of confirmation bias, misunderstanding of survey concepts due to lack of reading supporting instructions, and respondent inability to match survey concepts to [respondent] records.”² These measurement challenges are common to all efforts to conduct R&D surveys in the United States and around the world.

For certain survey respondents, the statistical definition of R&D does not agree with their preconceived understanding of “research and development.” Respondents in different economic sectors (i.e., government, business, higher education, and nonprofit organization) face different accounting definitions of R&D or perhaps are accountable for financial standards that explicitly do not define R&D.³ Survey respondents in the business sector also face R&D definitions used to file for the federal research and experimentation tax credit and regulatory requirements by other federal agencies such as the Securities and Exchange Commission. All of these definitions of R&D differ from the statistical definitions used in NCSES surveys, with respect to the types of activities that may be identified as R&D or the categories of costs that are included in R&D.

The ability of a survey to accurately and precisely measure an economic concept depends considerably on respondents’ understanding of how the survey defines that concept. For NCSES surveys, this requirement is complicated by the existence of different interpretations of R&D that are often more salient to respondents than the statistical definition used in NCSES surveys. Understanding the differences between these various standards for defining R&D is therefore critically important when reviewing survey responses and when communicating with respondents. In recognition of varying definitions and recordkeeping practices, NCSES R&D surveys typically begin by collecting R&D measures that align with respondent records and then ask respondents to provide additional data needed to transform these measures to values consistent with the required statistical definition of R&D. In this way, NCSES minimizes measurement error associated with estimating domestic R&D performance. Further, this statistical definition, tied to international guidance, is the only definition of R&D that is consistent for domestic R&D performers regardless of their economic sector.

The remainder of this document provides definitions of R&D from U.S. and international sources and by performing sector. By providing this resource, NCSES aims to facilitate a better understanding of R&D reporting requirements and improve the quality of R&D data. The first section (I) presents statistical definitions of R&D from the Organisation for Economic Co-operation and Development (OECD) *Frascati Manual 2015: Guidelines for Collecting and Reporting Data on Research and Experimental Development*. The next three sections are organized by sectors of the U.S. economy that

perform or fund R&D—businesses (II), federal and state governments (III), and academic and nonprofit organizations (IV). Sources for definitions of R&D include the Office of Management and Budget (OMB), federal procurement, tax and accounting guidance, and surveys from NCSES. The last section (V) presents R&D definitions from international statistical manuals on National Accounts and globalization.

R&D definitions are provided unedited as they appear in their original sources.

I. OECD—Frascati Manual

Description

The updated Frascati Manual (7th ed., OECD 2015) provides the definition of R&D and its components: basic research, applied research, and experimental development. To provide guidance on what is and what is not an R&D activity, five criteria are provided: the activity must be novel, creative, uncertain in its outcome, systematic, and transferable or reproducible.

Definition

2.5 Research and experimental development (R&D) comprise creative and systematic work undertaken in order to increase the stock of knowledge—including knowledge of humankind, culture and society—and to devise new applications of available knowledge.

2.6 A set of common features identifies R&D activities, even if these are carried out by different performers. R&D activities may be aimed at achieving either specific or general objectives. R&D is always aimed at new findings, based on original concepts (and their interpretation) or hypotheses. It is largely uncertain about its final outcome (or at least about the quantity of time and resources needed to achieve it), it is planned for and budgeted (even when carried out by individuals), and it is aimed at producing results that could be either freely transferred or traded in a marketplace. For an activity to be an R&D activity, it must satisfy five core criteria.

2.7 The activity must be:

- novel
- creative
- uncertain
- systematic
- transferable and/or reproducible.

2.8 All five criteria are to be met, at least in principle, every time an R&D activity is undertaken whether on a continuous or occasional basis. The definition of R&D just given is consistent with the definition of R&D used in the previous editions of the *Frascati Manual* and covers the same range of activities.

2.9 The term R&D covers three types of activity: basic research, applied research and experimental development. 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 in order to acquire new knowledge. It is, however, directed primarily towards 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.

Distribution by type of R&D

2.23 A breakdown by type of R&D is recommended for use in all four of the sectors used in this manual [Business enterprise; Higher education; Government; and Private nonprofit].

2.24 There are three types of R&D:

- basic research
- applied research
- experimental development.

Basic research

2.25 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

2.29 Applied research is original investigation undertaken in order to acquire new knowledge. It is, however, directed primarily towards a specific, practical aim or objective.

Experimental development

2.32 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.

Source

OECD, *Frascati Manual*, 7th ed, Chapter 2. The full *Frascati Manual* is available at <https://www.oecd.org/publications/frascati-manual-2015-9789264239012-en.htm>.

II. U.S. Business Enterprise R&D

A. Financial Accounting Standards Board

Description

Financial Accounting Standards Board (FASB) Accounting Standards Codification (ASC) provides U.S. GAAP (generally accepted accounting principles) for businesses. ASC is organized by “topics” and Topic 730 is devoted to R&D (formerly covered in FASB Statement No. 2, “Accounting for Research and Development Costs”). Material formerly covered in FASB Statement No. 68, “Research and Development Arrangements,” also appears under Topic 730. The FASB material below, copyrighted by the Financial Accounting Foundation, 401 Merritt 7, Norwalk, CT 06856, is used with permission.

Definition

Topic 730, Research and Development, 730-10-20, Glossary

Research is planned search or critical investigation aimed at discovery of new knowledge with the hope that such knowledge will be useful in developing a new product or service (hereinafter “product”) or a new process or technique (hereinafter “process”) or in bringing about a significant improvement to an existing product or process.

Development is the translation of research findings or other knowledge into a plan or design for a new product or process or for a significant improvement to an existing product or process whether intended for sale or use. It includes the conceptual formulation, design, and testing of product alternatives, construction of prototypes, and operation of pilot plants.

Topic 730, Research and Development, 730-10-55, Implementation Guidance and Illustrations, Examples of Activities Typically Included in Research and Development, 55-1

The following activities typically would be considered research and development within the scope of this Topic (unless conducted for others under a contractual arrangement [see this section’s notes below]):

- a. Laboratory research aimed at discovery of new knowledge
- b. Searching for applications of new research findings or other knowledge
- c. Conceptual formulation and design of possible product or process alternatives
- d. Testing in search for or evaluation of product or process alternatives
- e. Modification of the formulation or design of a product or process
- f. Design, construction, and testing of preproduction prototypes and models
- g. Design of tools, jigs, molds, and dies involving new technology
- h. Design, construction, and operation of a pilot plant that is not of a scale economically feasible to the entity for commercial production
- i. Engineering activity required to advance the design of a product to the point that it meets specific functional and economic requirements and is ready for manufacture
- j. Design and development of tools used to facilitate research and development or components of a product or process that are undergoing research and development activities

Examples of Activities Typically Excluded from Research and Development 55-2

The following activities typically would not be considered research and development within the scope of this Topic:

- a. Engineering follow-through in an early phase of commercial production
- b. Quality control during commercial production including routine testing of products
- c. Troubleshooting in connection with breakdowns during commercial production
- d. Routine, ongoing efforts to refine, enrich, or otherwise improve upon the qualities of an existing product
- e. Adaptation of an existing capability to a particular requirement or customer's need as part of a continuing commercial activity
- f. Seasonal or other periodic design changes to existing products
- g. Routine design of tools, jigs, molds, and dies
- h. Activity, including design and construction engineering, related to the construction, relocation, rearrangement, or start-up of facilities or equipment other than the following:
 1. Pilot plants (see [h] in the preceding paragraph)
 2. Facilities or equipment whose sole use is for a particular R&D project [see this section's notes below]
- i. In Legal work in connection with patent applications or litigation, and the sale or licensing of patents.

Notes

Topic 730 covers R&D expenses or R&D costs funded by the reporting entity. Accounting for the costs of R&D activities conducted for others under a contractual arrangement is part of accounting for contracts in general (see, for example, Topic 606). See also paragraphs 25-8 to 25-10 under 730-20-25.

See Subtopic 912 under 730 for guidance to government contractors related to identifying R&D activities included in government contracts and the accounting for such activities.

For guidance on R&D arrangements, see Subtopics 730-20 and 810-30. For guidance regarding design and development costs for products to be sold under long-term supply arrangements, see Subtopic 340-10. Topic 850 specifies disclosure requirements for related party transactions.

For guidance on materials, property, plant, and equipment acquired or constructed for R&D projects, see paragraph 25-2 under 730-10-25 and Topic 360. For intangibles and contract services used for R&D, see paragraph 25-2 under 730-10-25 and Topic 720.

For guidance on computer software as a cost of R&D (formerly covered in part in FASB Statement No. 86 "Accounting for the Costs of Computer Software to Be Sold, Leased, or Otherwise Marketed" paragraphs 28–36), see Topic 730 subtopic 10, especially paragraphs 25-3 and 25-4. Subtopic 350-40 covers general guidance on costs of computer software developed or obtained for internal use and Subtopic 985-20 covers computer software intended to be sold, leased or marketed. In particular, paragraph 985-20-25-1 offers guidance regarding costs incurred to establish the technological feasibility of a computer software product. For guidance related to a funded software-development arrangement, see paragraphs 985-605-25-86 through 25-87.

The accounting for recognized intangible assets acquired by an entity, other than intangibles acquired in a business combination, is specified in Topic 350 (formerly covered in FASB Statement No. 142 "Goodwill and Other Intangible Assets"). R&D assets acquired in a business combination or an acquisition by a not-for-profit entity is covered in Subtopic 805-20.

The material from FASB in this section was compiled in 2016 and is not meant to be an exhaustive summary of U.S. business R&D accounting guidance. For more information and FASB updates, see cited source.

Source

FASB statements and other pronouncements. Available at <https://asc.fasb.org> and <https://asc.fasb.org/730/tableOfContent>.

B. U.S. Code of Federal Regulations

Description

Section 1.174-2 of the U.S. Code of Federal Regulations (*Title 26, Internal Revenue*) specifies the definition of R&D for tax filing purposes.

Definition

1.174-2 Definition of research and development expenditures.

(a) *In general.*

(1) The term *research or experimental expenditures* generally includes all such costs incident to the development or improvement of a product. The term includes the costs of obtaining a patent, such as attorneys' fees expended in making and perfecting a patent application. Expenditures represent research and development costs in the experimental or laboratory sense if they are for activities intended to discover information that would eliminate uncertainty concerning the development or improvement of a product. Uncertainty exists if the information available to the taxpayer does not establish the capability or method for developing or improving the product or the appropriate design of the product. Whether expenditures qualify as research or experimental expenditures depends on the nature of the activity to which the expenditures relate, not the nature of the product or improvement being developed or the level of technological advancement the product or improvement represents. The ultimate success, failure, sale, or use of the product is not relevant to a determination of **eligibility** under section 174. **Costs** may be eligible under section 174 if paid or **incurred** after **production** begins but before uncertainty concerning the development or improvement of the product is eliminated.

(2) *Production costs.* Except as provided in **paragraph (a)(5)** of this section (the rule concerning the **application** of section 174 to **components** of a product), **costs** paid or **incurred** in the **production** of a product after the elimination of uncertainty concerning the development or improvement of the product are not eligible under section 174.

(3) For purposes of this section, the term *product* includes any pilot model, process, formula, invention, technique, patent, or similar property, and includes products to be used by the taxpayer in its trade or business as well as products to be held for sale, lease, or license.

(4) For purposes of this section, the term pilot model means any representation or model of a product that is produced to evaluate and resolve uncertainty concerning the product during the development or improvement of the product. The term includes a fully-functional representation or model of the product or, to the extent **paragraph (a)(5)** of this section applies, a **component** of the product.

(5) *Application of section 174 to components of a product.* If the **requirements** of **paragraph (a)(1)** of this section are not met at the level of a product (as defined in **paragraph (a)(3)** of this section), then whether expenditures represent research and development **costs** is determined at the level of the **component** or subcomponent of the product. The presence of uncertainty concerning the development or improvement of certain components of a product does not necessarily indicate the presence of uncertainty concerning the development or improvement of other components of the product or the product as a whole. The rule in this paragraph (a)(5) is not itself applied as a reason to exclude research or experimental expenditures from section 174 **eligibility**.

(6) The term *research or experimental expenditures* does not include expenditures for:

- i. The ordinary testing or inspection of materials or products for quality control (quality control testing);
- ii. Efficiency surveys;
- iii. Management studies;
- iv. Consumer surveys;
- v. Advertising or promotions;
- vi. The acquisition of another's patent, model, production or process; or
- vii. Research in connection with literary, historical, or similar projects.

(7) *Quality control testing*. For purposes of **paragraph (a)(6)(i)** of this section, testing or inspection to determine whether particular units of materials or products conform to specified parameters is **quality control testing**. However, **quality control testing** does not include testing to determine if the design of the product is appropriate.

(8) *Expenditures for literary, historical, or similar research—cross reference*. See section 263A and the regulations thereunder for **cost** capitalization rules which apply to expenditures paid or **incurred** for research in connection with literary, historical, or similar projects involving the **production** of **property**, including the **production** of films, sound recordings, video tapes, books, or similar properties.

(9) *Research or experimental expenditures limited to reasonable amounts*. Section 174 applies to a research or experimental expenditure only to the extent that the **amount** of the expenditure is reasonable under the circumstances. In general, the **amount** of an expenditure for research or experimental **activities** is reasonable if the **amount** would ordinarily be paid for like **activities** by like enterprises under like circumstances. **Amounts** supposedly paid for research that are not reasonable under the circumstances may be characterized as disguised **dividends**, gifts, loans, or similar payments. The **reasonableness requirement** of this paragraph (a)(9) does not apply to the **reasonableness** of the type or nature of the **activities** themselves.

(10) *Amounts paid to others for research or experimentation*. The provisions of this section apply not only to **costs** paid or **incurred** by the **taxpayer** for research or experimentation undertaken directly by him but also to expenditures paid or **incurred** for research or experimentation carried on in his behalf by another **person** or **organization** (such as a research institute, foundation, engineering company, or similar contractor). However, any expenditures for research or experimentation carried on in the **taxpayer's** behalf by another **person** are not expenditures to which section 174 relates, to the extent that they represent expenditures for the **acquisition** or improvement of **land** or **depreciable property**, used in connection with the research or experimentation, to which the **taxpayer acquires** rights of **ownership**.

(b) *Certain expenditures with respect to land and other property*.

(1) *Land and other property*. Expenditures by the **taxpayer** for the **acquisition** or improvement of **land**, or for the **acquisition** or improvement of **property** which is subject to an **allowance** for **depreciation** under section 167 or **depletion** under section 611, are not deductible under section 174, irrespective of the fact that the **property** or **improvements** may be used by the **taxpayer** in connection with research or experimentation. However, allowances for **depreciation** or **depletion** of **property** are considered as research or experimental expenditures, for purposes of section 174, to the extent that the **property** to which the **allowances** relate is used in connection with research or experimentation. If any part of the **cost** of **acquisition** or improvement of **depreciable property** is attributable to research or experimentation (whether made by the **taxpayer** or another), see subparagraphs (2), (3), and (4) of this paragraph.

(2) *Expenditure resulting in depreciable property.* Expenditures for research or experimentation which **result**, as an end product of the research or experimentation, in **depreciable property** to be used in the **taxpayer's trade or business** may, subject to the **limitations** of subparagraph (4) of this paragraph, be allowable as a current expense deduction under section 174(a). Such expenditures cannot be amortized under section 174(b) except to the extent provided in paragraph (a)(4) of § 1.174-4.

(3) *Amounts paid to others for research or experimentation resulting in depreciable property.* If expenditures for research or experimentation are **incurred** in connection with the construction or manufacture of **depreciable property** by another, they are deductible under section 174(a) only if made upon the **taxpayer's** order and at his risk. No deduction will be **allowed (i)** if the **taxpayer purchases** another's product under a performance guarantee (whether express, implied, or imposed by local law) unless the guarantee is limited, to engineering specifications or otherwise, in such a way that economic utility is not taken into **account**; or **(ii)** for any part of the **purchase price** of a product in regular **production**. For example, if a **taxpayer** orders a specially-built automatic milling machine under a guarantee that the machine will be capable of producing a given number of units per hour, no portion of the expenditure is deductible since none of it is made at the **taxpayer's** risk. Similarly, no deductible expense is **incurred** if a **taxpayer** enters into a **contract** for the construction of a new type of chemical **processing** plant under a turn-key **contract** guaranteeing a given annual **production** and a given consumption of raw material and fuel per unit. On the other hand, if the **contract** contained no guarantee of quality of **production** and of quantity of units in relation to consumption of raw material and fuel, and if real doubt existed as to the capabilities of the process, expenses for research or experimentation under the **contract** are at the **taxpayer's** risk and are deductible under section 174(a). However, see subparagraph (4) of this paragraph.

(4) *Deductions limited to amounts expended for research or experimentation.* The **deductions** referred to in paragraphs (b)(2) and (3) of this section for expenditures in connection with the **acquisition** or **production** of **depreciable property** to be used in the **taxpayer's trade or business** are limited to **amounts** expended for research or experimentation within the meaning of section 174 and **paragraph (a)** of this section.

(c) *Exploration expenditures.* The provisions of section 174 are not applicable to any expenditures paid or **incurred** for the purpose of ascertaining the existence, **location**, extent, or quality of any deposit of ore, **oil**, gas or other mineral. See sections 617 and 263.

(d) *Effective/applicability date.* The eighth and ninth sentences of § 1.174-2(a)(1); § 1.174-2(a)(2); § 1.174-2(a)(4); § 1.174-2(a)(5); § 1.174-2(a)(11) Example 3 through Example 10; § 1.174-2(b)(4); and § 1.174-2(b)(5) apply to **taxable years** ending on or after July 21, 2014. **Taxpayers** may apply the provisions enumerated in the preceding sentence to **taxable years** for which the **limitations** for assessment of tax has not expired.

Source

26 CFR 1.174-2. Available at <https://www.law.cornell.edu/cfr/text/26/1.174-2>.

C. 26 U.S. Code § 41 - Credit for Increasing Research Activities

Definition

The Credit for Increasing Research Activities provides definitions for qualified research expenses and explicit guidance on the amount of the research credit that may be claimed.

For purposes of 26 U.S. Code § 41

(1) In general, the term "qualified research" means research—

- (A) with respect to which expenditures may be treated as specified research or experimental expenditures under section 174,
- (B) which is undertaken for the purpose of discovering information
 - (i) which is technological in nature, and
 - (ii) the application of which is intended to be useful in the development of a new or improved business component of the taxpayer, and
- (C) substantially all of the activities of which constitute elements of a process of experimentation for a purpose described in paragraph (3).

Such a term does not include any activity described in paragraph (4).

Paragraph 3: Purposes for which research may qualify for credit

For purposes of paragraph (1)(C)—

(A) In general

Research shall be treated as conducted for a purpose described in this paragraph if it relates to—

- (i) a new or improved function,
- (ii) performance, or
- (iii) reliability or quality.

(B) Certain purposes not qualified

Research shall in no event be treated as conducted for a purpose described in this paragraph if it relates to style, taste, cosmetic, or seasonal design factors.

Paragraph 4: Activities for which credit not allowed

The term “qualified research” shall not include any of the following:

- (A) Research after commercial production: Any research conducted after the beginning of commercial production of the business component.
- (B) Adaptation of existing business components: Any research related to the adaptation of an existing business component to a particular customer’s requirement or need.
- (C) Duplication of existing business component: Any research related to the reproduction of an existing business component (in whole or in part) from a physical examination of the business component itself or from plans, blueprints, detailed specifications, or publicly available information with respect to such business component.
- (D) Surveys, studies, etc.
 - Any—
 - (i) efficiency survey,
 - (ii) activity relating to management function or technique,
 - (iii) market research, testing, or development (including advertising or promotions),

(iv) routine data collection, or

(v) routine or ordinary testing or inspection for quality control.

(E) Computer software

Except to the extent provided in regulations, any research with respect to computer software which is developed by (or for the benefit of) the taxpayer primarily for internal use by the taxpayer, other than for use in—

(i) an activity which constitutes qualified research (determined with regard to this subparagraph), or

(ii) a production process with respect to which the requirements of paragraph (1) are met.

(F) Foreign research: Any research conducted outside the United States, the Commonwealth of Puerto Rico, or any possession of the United States.

(G) Social sciences, etc.: Any research in the social sciences, arts, or humanities.

(H) Funded research: Any research to the extent funded by any grant, contract, or otherwise by another person (or governmental entity).

Source

26 U.S. Code § 41. Available at <https://www.law.cornell.edu/uscode/text/26/41>.

D. NCSES Surveys on Business R&D

- Business Enterprise Research and Development (BERD) Survey
- Annual Business Survey (R&D for Microbusiness module)

Business Enterprise Research and Development (BERD) Survey

Description

The BERD Survey is the primary source of information on R&D performed or funded by businesses within the United States and is successor to the Business R&D and Innovation Survey and the Survey of Industrial Research and Development. The BERD Survey covers for-profit, nonfarm businesses with 10 or more employees. The survey is conducted by the Census Bureau for NCSES. For more information and statistics, see the [BERD Survey page](#).

NSF is authorized to collect this information under Sections 1861–1876 of the National Science Foundation Act of 1950, as amended, and Section 505 of the America COMPETES Reauthorization Act of 2010.

Definition

R&D comprise creative and systematic work undertaken in order to increase the stock of knowledge and to devise new applications of available knowledge. This includes (a) activities aimed at acquiring new knowledge or understanding without specific immediate commercial applications or uses (basic research); (b) activities aimed at solving a specific problem or meeting a specific commercial objective (applied research); and (c) systematic work, drawing on research and practical experience and resulting in additional knowledge, which is directed to producing new products or processes or to improving existing products or processes (development). R&D includes both direct costs such as salaries of researchers as well as administrative and overhead costs clearly associated with the company's R&D.

The term R&D does NOT include expenditures for the following:

- Costs for routine product testing, quality control, and technical services unless they are an integral part of an R&D project
- Market research
- Efficiency surveys or management studies
- Literary, artistic, or historical projects, such as films, music, or books and other publications
- Prospecting or exploration for natural resources

The following are examples of activities that typically would be excluded from research and development (in accordance with FASB Statement of Financial Accounting Standards No. 2 "Accounting for Research and Development Costs" [https://fasb.org/page/document?pdf=aop_fas2.pdf&title=FAS%202%20\(AS%20AMENDED\)](https://fasb.org/page/document?pdf=aop_fas2.pdf&title=FAS%202%20(AS%20AMENDED))).

- Engineering follow-through in an early phase of commercial production
- Quality control during commercial production including routine testing of products
- Troubleshooting in connection with breakdowns during commercial production
- Routine, ongoing efforts to refine, enrich, or otherwise improve upon the qualities of an existing product
- Adaptation of an existing capability to a particular requirement or customer's need as part of a continuing commercial activity
- Seasonal or other periodic design changes to existing products
- Routine design of tools, jigs, molds, and dies
- Activity, including design and construction engineering, related to the construction, relocation, rearrangement, or start-up of facilities or equipment other than (1) pilot plants and (2) facilities or equipment whose sole use is for a particular research and development project
- Legal work in connection with patent applications or litigation, and the sale or licensing of patents

Does R&D include development of software and Internet applications?

Research and development activity in software and Internet applications refers only to activities with an element of uncertainty and that are intended to close knowledge gaps and meet scientific and technological needs...regardless of the eventual user (internal or external).

R&D activity in software INCLUDES the following:

- Software development or improvement activities that expand scientific or technological knowledge
- Construction of new theories and algorithms in the field of computer science

R&D activity in software EXCLUDES the following:

- Software development that does not depend on a scientific or technological advance, such as the following:
 - supporting or adapting existing systems
 - adding functionality to existing application programs, and
 - routine debugging of existing systems and software
- Creation of new software based on known methods and applications

- Conversion or translation of existing software and software languages
- Adaptation of a product to a specific client, unless knowledge that significantly improved the base program was added in that process

Source

NCSES, BERD Survey questionnaires. Available at <https://nces.nsf.gov/surveys/business-enterprise-research-development/>.

Annual Business Survey (R&D for Microbusinesses module)

Description

The Annual Business Survey (ABS) is the primary source of information on R&D for nonfarm, for-profit businesses operating in the United States with one to nine employees. For businesses with one or more employees, the ABS also collects data on innovation, technology, intellectual property, business owner characteristics, and additional content that changes annually. The ABS is conducted by the Census Bureau in partnership with NCSES.

NSF is authorized to collect this information under Sections 1861–1876 of the National Science Foundation Act of 1950, as amended, and Section 505 of the America COMPETES Reauthorization Act of 2010.

ABS Microbusinesses module: For businesses with one to nine employees, the survey collects the following information:

- R&D performance
- Total and R&D employment
- Sources of R&D funding
- Type of R&D work (basic research, applied research, and development)
- Type of R&D cost (e.g., salaries and fringe benefits)

Definition

Research and development (R&D) comprise creative and systematic work undertaken in order to increase the stock of knowledge and to devise new applications of available knowledge.

The term R&D does NOT include expenditures for the following:

- Costs for routine product testing, quality control, and technical services unless they are an integral part of an R&D project
- Market research
- Efficiency surveys or management studies
- Literary, artistic, or historical projects, such as films, music, or books and other publications
- Prospecting or exploration for natural resources

R&D activity in software INCLUDES the following:

- Software development or improvement activities that expand scientific or technological knowledge
- Construction of new theories and algorithms in the field of computer science

R&D activity in software EXCLUDES:

- Software development that does not depend on a scientific or technological advance, such as the following:
 - supporting or adapting existing systems
 - adding functionality to existing application programs, and
 - routine debugging of existing systems and software
- Creation of new software based on known methods and applications
- Conversion or translation of existing software and software languages
- Adaptation of a product to a specific client, unless knowledge that significantly improved the base program was added in that process

Type of R&D

- Basic research – activities aimed at acquiring new knowledge or understanding without specific immediate commercial applications or uses.
- Applied research – activities aimed at solving a specific problem or meeting a specific commercial objective.
- Experimental development – systematic work, drawing on research and practical experience and resulting in additional knowledge, which is directed to producing new products or processes or to improving existing products or processes.

Source

NCSES, ABS description and questionnaires. Available at <https://nces.nsf.gov/surveys/annual-business-survey/>.

III. Federal and State Government R&D

A. Office of Management and Budget Circular A-11

Description

OMB prescribes budget regulations for federal agencies. Part II of Circular A-11 covers development of the president's budget and provides guidance on agency submissions to OMB. Section 84 of the circular defines budget authority, outlays, and offsetting receipts for the conduct of R&D, construction and rehabilitation of R&D facilities, and R&D equipment.

Definition

Conduct of research and development (R&D): Research and experimental development activities are defined as creative and systematic work undertaken in order to increase the stock of knowledge—including knowledge of people, culture, and society—and to devise new applications using available knowledge.

Include:

- Administrative expenses for R&D, such as the operating costs of research facilities, minor equipment purchases, and other overhead costs.

Exclude:

- Investments in physical assets such as major equipment and facilities that support R&D programs. These investments should generally be reported under physical assets.
- Routine product testing, quality control, collection of general-purpose statistics, routine monitoring, and evaluation of an operational program (when that program is not R&D). Spending of this type should generally be reported as non-investment activities.
- Training of scientific and technical personnel should be reported as conduct of education and training. However, if an activity includes a mixture of R&D objectives as well as the education of graduate students, agencies should report under the lowest relevant line item.

Basic research is defined as experimental or theoretical work undertaken primarily to acquire new knowledge of underlying foundations of phenomena and observable facts. Basic research may include activities with broad or general applications in mind, such as the study of how plant genomes change, but should exclude research directed towards a specific application or requirement, such as the optimization of the genome of a specific crop species.

Applied research is defined as original investigation undertaken in order to acquire new knowledge. Applied research is, however, directed primarily towards a specific practical aim or objective.

Experimental development is defined as creative and systematic work, drawing on knowledge gained from research and practical experience, which is directed at producing new products or processes or improving existing products or processes. Like research, experimental development will result in gaining additional knowledge.

For reporting experimental development activities, include the following:

- The production of materials, devices, and systems or methods, including the design, construction and testing of experimental prototypes.

- Technology demonstrations, in cases where a system or component is being demonstrated at scale for the first time, and it is realistic to expect additional refinements to the design (feedback R&D) following the demonstration. However, not all activities that are identified as “technology demonstrations” are R&D.

Exclude:

- User demonstrations where the cost and benefit of a system are being validated for a specific use case. This includes low-rate initial production activities.
- Pre-production development, which is defined as non-experimental work on a product or system before it goes into full production, including activities such as tooling, and development of production facilities. For example, exclude activities and programs that are categorized as “Operational Systems Development” in the Department of Defense’s budget activity structure. Activities and programs of this type should generally be reported as investments in other major equipment.

Physical assets are land, structures, equipment, and intellectual property (e.g., software or applications) that have an estimated useful life of two years or more; or commodity inventories. This character class code is used to enter amounts for the purchase, construction, manufacture, rehabilitation, or major improvement of physical assets regardless of whether the assets are owned or operated by the federal government, states, municipalities, or private individuals. The cost of the asset includes both its purchase price and all other costs incurred to bring it to a form and location suitable for its intended use. Within this character class code, agencies are also required to identify spending for R&D facilities and major equipment.

For reporting construction and rehabilitation of R&D facilities, include the following:

- Construction of facilities that are necessary for the execution of an R&D program. This may include land, major fixed equipment, and supporting infrastructure such as a sewer line, or housing at a remote location. Many laboratory buildings will include a mixture of R&D facilities and office space. The fraction of the building directly related to the conduct of R&D may be calculated as a percentage of the building’s total square footage.

Exclude:

- Construction of other facilities, such as office space (which should be reported in the other construction and rehabilitation category on line 1313 or 1314).
- Major movable R&D equipment.

For reporting Major equipment R&D (lines 1321 and 1322), include the following:

- Acquisition, design, or production of major movable equipment, such as mass spectrometers, research vessels, DNA sequencers, and other movable major instruments for use in R&D activities.
- Programs of \$1 million or more that are devoted to the purchase or construction of R&D major equipment (see section 84.3(a)).

Exclude:

- Minor equipment purchases, such as personal computers, standard microscopes, and simple spectrometers (report these under Conduct of R&D charter class 14xx).
- Software, applications, and other information technology (see section 55) that have an estimated useful life of two years or more, not used for R&D activities.
- Acquisition, design, integration, recapitalization, improvement or production of major movable equipment, not used for R&D activities.

- User demonstrations where the cost and benefits of a system are being validated for a specific use case.
- Pre-production development, which is defined as non-experimental work on a product or system before it goes into full production.

For reporting Other Physical Assets (lines 1351 and 1352), include the following:

- Amounts for all physical assets not captured under another category, such as conservation, reforestation, and range improvements; grants to state or local governments for the purchase of land or structures; and amounts for certain privately held assets, including improvements to private farms, land, and sales of such land and structures.
- Offsetting receipts collected from the sale of federal government physical assets.

Exclude:

- The operation and maintenance of land and structures.

Source

OMB Circular A-11. Available at <https://whitehouse.gov/wp-content/uploads/2018/06/a11.pdf>.

B. Federal Acquisitions Regulations

Description

The Federal Acquisitions Regulations (FAR) was established to codify uniform policies for the acquisition of supplies and services by executive agencies. Basic research is defined in FAR Part 2–Definitions of Words and Terms, subpart 2.101, “Definitions.” Applied research and development are defined in FAR Part 35–Research and Development Contracting, subpart 35.001, “Definitions.” Full text of FAR Parts is available at <https://www.acquisition.gov/?q=browsefar>.

Definition

Basic research means that research is directed toward increasing knowledge in science. The primary aim of basic research is a fuller knowledge or understanding of the subject under study, rather than any practical application of that knowledge.

Applied research means the effort that (a) normally follows basic research, but may not be severable from the related basic research; (b) attempts to determine and exploit the potential of scientific discoveries or improvements in technology materials, processes, methods, devices, or techniques; and (c) attempts to advance the state of the art. When being used by contractors in cost principle applications, this term does not include efforts whose principal aim is the design, development, or testing of specific items or services to be considered for sale; these efforts are within the definition of “development,” given below.

Development, as used in this part, means the systematic use of scientific and technical knowledge in the design, development, testing, or evaluation of a potential new product or service (or of an improvement in an existing product or service) to meet specific performance requirements or objectives. It includes the functions of design engineering, prototyping, and engineering testing; it excludes subcontracted technical effort that is for the sole purpose of developing an additional source for an existing product.

Source

The Federal Acquisitions Regulations (FAR). Available at <https://www.acquisition.gov/?q=browsefar>.

C. Department of Defense Research, Development, Test, and Evaluation Budget Activities

Description

The Research, Development, Test, and Evaluation (RDT&E) budget activities are broad categories reflecting different types of Department of Defense (DOD) science and technology activities. These definitions guide internal budget documents and submissions of data to other government agencies. The following is drawn from DOD's Financial Management Regulation (DOD 7000.14-R), Volume 2B, Chapter 5 (Research, Development, and Evaluation Appropriations). (As a historical artifact from previous DOD budget authority terminology, funds for RDT&E budget activity categories 1 through 8 are sometimes referred to as 6.1 through 6.8.)

Definition

Budget Activity 1, Basic Research. Basic research is systematic study directed toward greater knowledge or understanding of the fundamental aspects of phenomena and of observable facts without specific applications towards processes or products in mind. It includes all scientific study and experimentation directed toward increasing fundamental knowledge and understanding in those fields of the physical, engineering, environmental, and life sciences related to long-term national security needs. It is farsighted high payoff research that provides the basis for technological progress. Basic research may lead to: (a) subsequent applied research and advanced technology developments in Defense-related technologies, and (b) new and improved military functional capabilities in areas such as communications, detection, tracking, surveillance, propulsion, mobility, guidance and control, navigation, energy conversion, materials and structures, and personnel support. Program elements in this category involve pre-Milestone A efforts.

Budget Activity 2, Applied Research. Applied research is systematic study to understand the means to meet a recognized and specific need. It is a systematic expansion and application of knowledge to develop useful materials, devices, and systems or methods. It may be oriented, ultimately, toward the design, development, and improvement of prototypes and new processes to meet general mission area requirements. Applied research may translate promising basic research into solutions for broadly defined military needs, short of system development. This type of effort may vary from systematic mission-directed research beyond that in Budget Activity 1 to sophisticated breadboard hardware, study, programming and planning efforts that establish the initial feasibility and practicality of proposed solutions to technological challenges. It includes studies, investigations, and non-system specific technology efforts. The dominant characteristic is that applied research is directed toward general military needs with a view toward developing and evaluating the feasibility and practicality of proposed solutions and determining their parameters. Applied Research precedes system specific technology investigations or development. Program control of the Applied Research program element is normally exercised by a general level of effort. Program elements in this category involve pre- Milestone B efforts, also known as Concept and Technology Development phase tasks, such as concept exploration efforts and paper studies of alternative concepts for meeting a mission need.

Budget Activity 3, Advanced Technology Development (ATD). This budget activity includes development of subsystems and components and efforts to integrate subsystems and components into system prototypes for field experiments and/or tests in a simulated environment. Budget Activity 3 includes concept and technology demonstrations of components and subsystems or system models. The models may be form, fit, and function prototypes or scaled models that serve the same demonstration purpose. The results of this type of effort are proof of technological feasibility and assessment of subsystem and component operability and producibility rather than the development of hardware for service use. Projects in this category have a direct relevance to identified military needs. Advanced Technology Development demonstrates the general military utility or cost reduction potential of technology when applied to different types of military equipment or techniques. Program elements in this category involve pre-Milestone B efforts, such as system concept demonstration, joint and Service-specific experiments or Technology Demonstrations and generally have Technology Readiness Levels of 4, 5, or 6. (For further discussion on Technology Readiness Levels, see the Assistant Secretary of Defense for Research

and Engineering's Technology Readiness Assessment (TRA) Guidance.) Projects in this category do not necessarily lead to subsequent development or procurement phases, but should have the goal of moving out of Science and Technology (S&T) and into the acquisition process within the Future Years Defense Program (FYDP). Upon successful completion of projects that have military utility, the technology should be available for transition.

Budget Activity 4, Advanced Component Development and Prototypes (ACD&P). Efforts necessary to evaluate integrated technologies, representative modes or prototype systems in a high fidelity and realistic operating environment are funded in this budget activity. The ACD&P phase includes system specific efforts that help expedite technology transition from the laboratory to operational use. Emphasis is on proving component and subsystem maturity prior to integration in major and complex systems and may involve risk reduction initiatives. Program elements in this category involve efforts prior to Milestone B and are referred to as advanced component development activities and include technology demonstrations. Completion of Technology Readiness Levels 6 and 7 should be achieved for major programs. Program control is exercised at the program and project level. A logical progression of program phases and development and/or production funding must be evident in the FYDP.

Budget Activity 5, System Development and Demonstration (SDD). SDD programs have passed Milestone B approval and are conducting engineering and manufacturing development tasks aimed at meeting validated requirements prior to full-rate production. This budget activity is characterized by major line-item projects and program control is exercised by review of individual programs and projects. Prototype performance is near or at planned operational system levels. Characteristics of this budget activity involve mature system development, integration, and demonstration to support Milestone C decisions, and conducting live fire test and evaluation and initial operational test and evaluation of production representative articles. A logical progression of program phases and development and production funding must be evident in the FYDP consistent with the Department's full funding policy.

Budget Activity 6, RDT&E Management Support. This budget activity includes management and support for research, development, test, and evaluation efforts and funds to sustain and/or modernize the installations or operations required for general research, development, test, and evaluation. Test ranges, military construction, maintenance support of laboratories, operation and maintenance of test aircraft and ships, and studies and analyses in support of the RDT&E program are funded in this budget activity. Costs of laboratory personnel, either in-house or contractor operated, would be assigned to appropriate projects or as a line item in the Basic Research, Applied Research, or ATD program areas, as appropriate. Military construction costs directly related to major development programs are included in this budget activity.

Budget Activity 7, Operational System Development. This budget activity includes development efforts to upgrade systems that have been fielded or have received approval for full rate production and anticipate production funding in the current or subsequent fiscal year. All items are major line-item projects that appear as RDT&E Costs of Weapon System Elements in other programs. Program control is exercised by review of reviewing individual projects. Programs in this category involve systems that have received approval for Low Rate Initial Production (LRIP). A logical progression of program phases and development and production funding must be evident in the FYDP, consistent with the Department's full funding policy.

Budget Activity 8, Software and Digital Technology Pilot Programs.

- 1.5.8.1. Software and Digital Technology Pilot Program requirements for funding in BA 8 includes software, electronic tools, systems, applications, resources, acquisition of services, business process re-engineering activities, functional requirements development, technical evaluations, and other activities in direct support of acquiring, developing, deploying, sustaining, enhancing, and modernizing Software Digital Technology Pilot Programs.
- 1.5.8.2. Pilot programs may purchase Commercial off the Shelf (COTS) software, tools, and services necessary to meet the program's requirements.

- 1.5.8.3. Software and Digital Technology Pilot Programs may be nominated to Under Secretary of Defense (Acquisition & Sustainment). Approved pilot program nominations will be submitted with the President’s Budget request.
- 1.5.8.4. A system project participating in the Pilot Program may be removed from BA 8 if the project has not been successful in meeting criteria established for the Pilot Program by the Secretary of Defense.

Source

DOD, Financial Management Regulation (DOD 7000.14-R), Volume 2B, Chapter 5. Available at https://comptroller.defense.gov/portals/45/documents/fmr/current/02b/02b_05.pdf.

D. NCSES Surveys on Federal R&D Funding

- Survey of Federal Funds for Research and Development (with the Survey of Federal Science and Engineering Support to Universities, Colleges, and Nonprofit Institutions integrated as a module)
- Federal Facilities Research and Development (FFRD) Survey
- FFRDC Research and Development Survey

Survey of Federal Funds for Research and Development

Description

The Survey of Federal Funds for Research and Development is the primary source of information about federal funding for R&D in the United States. The survey is an annual census completed by the federal agencies that conduct R&D programs. For general information about this survey, please see the [Federal Funds for R&D Survey page](#).

Changes associated with the volume 71 (FYs 2021 and 2022) redesign of the Survey of Federal Funds for Research and Development include the integration of the Survey of Federal Science and Engineering Support to Universities, Colleges, and Nonprofit Institutions (Federal S&E Support Survey) as a module within the Survey of Federal Funds for Research and Development utilizing the same definitions (NCSES will continue to publish the [Federal S&E Support Survey](#) data separately).

NSF is authorized to collect this information under Sections 1861–1876 of the National Science Foundation Act of 1950, as amended, and Section 505 of the America COMPETES Reauthorization Act of 2010.

Definitions

R&D: Research and experimental development (R&D) activities are defined as creative and systematic work undertaken in order to increase the stock of knowledge—including knowledge of people, culture, and society—and to devise new applications using available knowledge.

For reporting R&D activities, include the following:

- Administrative expenses for R&D, such as the operating costs of research facilities and equipment and other overhead costs.

Exclude:

- Investments in physical assets such as major equipment and facilities that support R&D programs. These investments should generally be reported under R&D Plant.
- Routine product testing, quality control, collection of general-purpose statistics, routine monitoring, and evaluation of an operational program (when that program is not R&D).

- Training of scientific and technical personnel should be reported as conduct of education and training.

RDT&E (for DOD only): The Department of Defense’s research, development, test, and evaluation (RDT&E) can be both (1) activities for the development of a new system, or to expand the performance of fielded systems, and (2) an appropriation. The RDT&E budget activities are broad categories reflecting different types of RDT&E efforts, which include Basic Research ([Budget Authority] BA 1); Applied Research (BA 2); Advanced Technology Development (ATD) (BA 3); Major Systems Development, which includes Advanced Component Development and Prototypes (ACD&P) (BA 4), System Development and Demonstration (SDD) (BA 5), and RDT&E Management Support (BA 6); Operational Systems Development (BA 7); and Software and Digital Technology Pilot Programs (BA 8). The definitions of these categories are established by Department of Defense Instruction 5000.02, “Operation of the Defense Acquisition System.” For more information, see Budget Activities 1 through 8 in the DOD Financial Management Regulation (FMR), Volume 2B, Chapter 5, pages 5-4, 5-5, and 5-6 at https://comptroller.defense.gov/portals/45/documents/fmr/current/02b/02b_05.pdf.

R&D plant: R&D plant is defined as spending on both R&D facilities and major equipment as defined in Office of Management and Budget (OMB) Circular A-11 Section 84 (Schedule C) and includes physical assets, such as land, structures, equipment, and intellectual property (e.g., software or applications) that have an estimated useful life of two years or more. Reporting for R&D plant includes the purchase, construction, manufacture, rehabilitation, or major improvement of physical assets regardless of whether the assets are owned or operated by the federal government, states, municipalities, or private individuals. The cost of the asset includes both its purchase price and all other costs incurred to bring it to a form and location suitable for use.

For reporting construction of R&D facilities and major moveable R&D equipment, include the following:

- Construction of facilities that are necessary for the execution of an R&D program. This may include land, major fixed equipment, and supporting infrastructure such as a sewer line, or housing at a remote location. Many laboratory buildings will include a mixture of R&D facilities and office space. The fraction of the building that is considered to be R&D may be calculated based on the percentage of square footage that is used for R&D.
- Acquisition, design, or production of major movable equipment, such as mass spectrometers, research vessels, DNA sequencers, and other movable major instrumentation for use in R&D activities.
- Programs of \$1 million or more that are devoted to the purchase or construction of R&D major equipment.

Exclude the following:

- Construction of other non-R&D facilities
- Minor equipment purchases, such as personal computers, standard microscopes, and simple spectrometers (report these costs under total R&D, not R&D plant)

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.

Type of R&D: Type of R&D has three components for non-DOD respondents: basic research, applied research, and development.

Basic research: Basic research is defined as experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundations of phenomena and observable facts. Basic research may include activities with broad or general applications in mind, such as the study of how plant genomes change, but should exclude research directed towards a specific application or requirement, such as the optimization of the genome of a specific crop species. Basic research represents Department of Defense Budget Activity 1.

Applied research: Applied research is defined as original investigation undertaken in order to acquire new knowledge. Applied research is, however, directed primarily towards a specific practical aim or objective. Applied research represents Department of Defense Budget Activity 2.

Experimental development: Experimental development is defined as creative and systematic work, drawing on knowledge gained from research and practical experience, which is directed at producing new products or processes or improving existing products or processes. Like research, experimental development will result in gaining additional knowledge.

For reporting experimental development activities, include the following:

- The production of materials, devices, and systems or methods, including the design, construction, and testing of experimental prototypes.
- Technology demonstrations, in cases where a system or component is being demonstrated at scale for the first time, and it is realistic to expect additional refinements to the design (feedback R&D) following the demonstration. However, not all activities that are identified as “technology demonstrations” are R&D.

For DOD Agencies, development itself is divided into three categories: advanced technology development, major systems development, and operational systems development and software and digital technology pilot programs.

- **Advanced technology development:** This category is used for activities in DOD’s Budget Activity 3. For more information, see Budget Activity 3 on pages 5-4 and 5-5 of the DOD Financial Management Regulation (FMR), Volume 2B, Chapter 5, at https://comptroller.defense.gov/portals/45/documents/fmr/current/02b/02b_05.pdf.
- **Major systems development:** This category is used for activities in DOD’s Budget Activities 4 through 6. For more information, see Budget Activities 4 through 6 on page 5-5 of the DOD Financial Management Regulation (FMR), Volume 2B, Chapter 5 at https://comptroller.defense.gov/portals/45/documents/fmr/current/02b/02b_05.pdf. NOTE: As of the FY 2016 data collection, major systems development no longer includes Budget Activity 7. In addition, major systems development does not include Budget Activity 8, which was formally added to the DOD Financial Management Regulation (FMR), Volume 2B, Chapter 5 in September 2022.
- **Operational systems development and software and digital technology pilot programs:** This category is used for activities in DOD’s Budget Activities 7 and 8. For more information, see Budget Activities 7 and 8 on page 5-6 of the DOD Financial Management Regulation (FMR), Volume 2B, Chapter 5 at https://comptroller.defense.gov/portals/45/documents/fmr/current/02b/02b_05.pdf.

Source

NCSES, Survey of Federal Funds for R&D forms. Available at <https://ncses.nsf.gov/surveys/federal-funds-research-development/>.

Federal Facilities Research and Development (FFRD) Survey

Description

The FFRD Survey is the first national effort to collect information on R&D performed at federal facilities and fills a critical gap in data on the U.S. performance of R&D. Federal facility data are critical to collecting high-quality information on R&D activity within federal facilities. NSF will use the collected information to produce critical national estimates of spending on R&D and will make the facility level data from this survey available to the public through data tables and other resources on our website.

NSF is authorized to collect this information under Sections 1861–1876 of the National Science Foundation Act of 1950, as amended, and Section 505 of the America COMPETES Reauthorization Act of 2010.

Definition

What is research and development (R&D)? [Source: Office of Management and Budget (OMB) Circular A11; *Frascati Manual*, 2015]

R&D comprises creative and systematic work undertaken in order to increase the stock of knowledge—including knowledge of people, culture, and society—and to devise new applications using available knowledge. R&D has five major features:

- **Novel:** Advances current knowledge or creates new knowledge
- **Creative:** Focuses on original concepts and hypotheses
- **Uncertain:** Outcomes are not completely determined at the outset of a project
- **Systematic:** Projects are planned and budgeted
- **Transferable/Reproducible:** Methodology and results are transferable to or reproducible in other situations and locations

This questionnaire asks about three different types of R&D your facility may conduct:

- **Basic research** is experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundations of phenomena and observable facts. Basic research may include activities with broad or general applications in mind, such as the study of how plant genomes change, but should exclude research directed toward a specific application or requirement, such as the optimization of the genome of a specific crop species.
- **Applied research** is original investigation undertaken to acquire new knowledge. It is directed primarily toward a specific, practical aim or objective.
- **Experimental development** is systematic work, drawing on knowledge gained from research and practical experience, which is directed at producing new products or processes, or improving existing products or processes. Like research, experimental development will result in gaining additional knowledge.

Experimental development includes:

- Producing materials, devices, and systems or methods, including designing, constructing, and testing experimental prototypes.
- Technology demonstrations, in cases where a system or component is demonstrated at scale for the first time, and additional refinements to the design (feedback R&D) are expected following the demonstration. However, not all “technology demonstrations” are R&D.

Experimental development does not include:

- User demonstrations where the cost and benefits of a system are being validated for a specific use case. This includes low-rate initial production activities.
- Pre-production development, which is defined as non-experimental work on a product or system before it goes into full production, including activities such as tooling and development of production facilities. Activities and programs of this type should generally be reported as investments in other major equipment.

What should I include in my answers for questions 1–5?

Please report your facility’s FY 2022 expenditures for R&D, meaning the money that was spent in FY 2022 for R&D projects. These costs are sometimes also referred to as outlays. Note the survey is not collecting appropriation or obligation totals, only final FY expenditures/outlays for R&D performed within the facility.

Include:

- Labor costs for R&D projects
- Non-capital purchases of materials, supplies, equipment, and services to support R&D performance
- General administration costs in support of R&D activities

For DOD facilities, experimental development includes:

- Advanced technology development (ATD) (Budget Activity 3)
- Major systems development (Budget Activities 4–6), consisting of:
 - Advanced component development and prototypes (ACD&P) (Budget Activity 4)
 - System development and demonstration (SDD) (Budget Activity 5)
 - Research, development, testing, and evaluation (RDT&E) management support (Budget Activity 6)

What are research, development, testing, and evaluation (RDT&E) activities (DOD only)?

RDT&E consists of all the activities described above for R&D conduct plus:

Operational systems development (Budget Activity 7)—pre-production development of non-experimental work on a product or system before it goes into full production, including activities such as tooling and development of production facilities.

For DOD facilities, definitions are established by Department of Defense Instruction 5000.02 “Operation of the Defense Acquisition System.” For more information, see RDT&E Budget Activities 1 through 7 in the DOD Financial Management Regulation (FMR), Volume 2B, Chapter 5, at: http://comptroller.defense.gov/Portals/45/documents/fmr/Volume_02b.pdf.

What should I include in my answer for question 1 (DOD only)?

Question 1 requests a total for all RDT&E activities, the remainder of the questionnaire focuses only on R&D activities (Budget Activities 1–6).

Please report your facility’s fiscal year **expenditures** for RDT&E, meaning the money that was spent in the fiscal year for RDT&E projects. These costs are sometimes also referred to as outlays.

Note the survey is not collecting appropriation or obligation totals, only final FY expenditures/outlays for RDT&E performed within the facility.

Include:

- Labor costs for RDT&E projects
- Non-capital purchases of materials, supplies, equipment, and services to support RDT&E performance
- General administration costs in support of RDT&E activities

What should I include in my answers for questions 2–5?

Please report your facility’s fiscal year **expenditures** for R&D only (Budget Activities 1–6).

Source

NCSES, FFRD Survey forms. Available at <https://nces.nsf.gov/surveys/federal-facilities-research-development/>.

FFRDC Research and Development Survey

Description

The FFRDC Research and Development Survey is the primary source of information on separately budgeted R&D expenditures at federally funded research and development centers (FFRDCs) in the United States. Conducted annually for university-administered FFRDCs since FY 1953 and all FFRDCs since FY 2001, the survey collects information on R&D expenditures by source of funds and types of research and expenses. The survey is an annual census of the full population of eligible FFRDCs. See [the survey page](#) for more information and the [Master List of FFRDCs](#) maintained by NCSES.

NSF is authorized to collect this information under Sections 1861–1876 of the National Science Foundation Act of 1950, as amended, and Section 505 of the America COMPETES Reauthorization Act of 2010.

Definition

Research and Development (R&D)

R&D is creative and systematic work undertaken in order to increase the stock of knowledge—including knowledge of humankind, culture, and society—and to devise new applications of available knowledge. R&D covers three activities defined below—basic research, applied research, and experimental development.

- 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 in order to acquire new knowledge. It is directed primarily towards 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.

Source

NCSES, FFRDC R&D Survey forms. Available at <https://nces.nsf.gov/surveys/ffrdc-research-development/>.

E. State Government R&D

Survey of State Government R&D

Description

This NCSES survey is the only source for comprehensive, uniform statistics regarding the extent of R&D activity performed and funded by departments and agencies in each of the nation's 50 state governments, the government of the District of Columbia, and the government of Puerto Rico. For general information, see the [Survey of State Government R&D page](#).

NSF is authorized to collect this information under Sections 1861–1876 of the National Science Foundation Act of 1950, as amended, and Section 505 of the America COMPETES Reauthorization Act of 2010.

Definition

R&D comprise creative and systematic work undertaken in order to increase the stock of knowledge—including knowledge of humankind, culture, and society—and to devise new applications of available knowledge.

- R&D is aimed at new findings (novel)
 - It has not been done before
 - It may produce findings that could be published in academic journals
 - It includes ideas that could be patented
- R&D focuses on original concepts or ideas (creative)
 - Increases our knowledge of the subject
 - Helps create new products or applications
- R&D outcomes are uncertain (because it's never been done before)
 - Solutions are not always obvious or expected
 - Uncertain about cost, time, or ability to achieve results
- R&D is planned and budgeted (systematic)
 - Projects processes and outcomes are documented
 - Projects are planned and managed
- R&D results in solutions that others may find useful (transferable)
 - Findings can be generalized to other situations and locations
 - Findings are reproducible

What is NOT R&D?

- Construction and acquisition of land and facilities used primarily for R&D (reported separately in this survey)
- Fixed equipment used primarily for R&D (reported separately in this survey)
- Program planning and evaluation
- Business development services for new companies
- Commercialization (includes promoting/producing the products/services from R&D projects)
- Economic/policy/feasibility studies
- General patient services
- Information systems
- Management studies
- Marketing of products/services
- Market research or analysis
- Routine data collection/dissemination
- Routine monitoring/testing
- Strategic planning

- Technology transfer

Source

NCSES, Survey of State Government R&D forms. Available at <https://nces.nsf.gov/surveys/state-government-research-development/>.

IV. U.S. Higher Education R&D and R&D by Nonprofit Organizations

A. Guidance from the Office of Management and Budget

Description

OMB issued the Uniform Administrative Requirements, Cost Principles, and Audit Requirements for Federal Awards, Title 2 Part 200 of the Code of Federal Regulations (CFR) in December 2013. This guidance supersedes and streamlines requirements from the following OMB Circulars: A-21, A-50, A-87, A-89, A-102, A-110, A-122, and A-133. The full text of 2 CFR Part 200 is available at <https://www.ecfr.gov/current/title-2/subtitle-A/chapter-II/part-200>.

Previous definitions for R&D reporting relevant to educational institutions, hospitals, state and local governments, and nonprofit organizations were addressed in OMB Circulars A-21, A-110, and A-133. Although these circulars are still available (https://obamawhitehouse.archives.gov/omb/circulars_default), they are, with limited exceptions, no longer applied to assistance awards issued after the implementation date of 26 December 2014.

Definition

Research and Development (R&D) means all research activities, both basic and applied, and all development activities that are performed by non-federal entities. The term research also includes activities involving the training of individuals in research techniques where such activities utilize the same facilities as other research and development activities and where such activities are not included in the instruction function.

“Research” is defined as a systematic study directed toward fuller scientific knowledge or understanding of the subject studied. “Development” is the systematic use of knowledge and understanding gained from research directed toward the production of useful materials, devices, systems, or methods, including design and development of prototypes and processes.

Source

2 CFR 200.1 [https://www.ecfr.gov/current/title-2/part-200#p-200.1\(Research%20and%20Development%20\(R%26amp%3BD\)\)](https://www.ecfr.gov/current/title-2/part-200#p-200.1(Research%20and%20Development%20(R%26amp%3BD))).

B. Higher Education R&D

Higher Education Research and Development (HERD) Survey

Description

This NCSES survey is the primary source of information on R&D expenditures at U.S. colleges and universities and is the successor to the Survey of Research and Development Expenditures at Universities and Colleges. The HERD Survey collects information on R&D expenditures by field of research and source of funds and gathers information on types of research and expenses and headcounts of R&D personnel. The survey is an annual census of institutions that expended at least \$150,000 in separately budgeted R&D in the fiscal year. For general information about this survey, please see the [HERD Survey page](#).

NSF is authorized to collect this information under Sections 1861–1876 of the National Science Foundation Act of 1950, as amended, and Section 505 of the America COMPETES Reauthorization Act of 2010.

Definition

R&D is creative and systematic work undertaken to increase the stock of knowledge— including knowledge of humankind, culture, and society—and to devise new applications of available knowledge. R&D covers three activities defined below— basic research, applied research, and experimental development.

- 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 in order to acquire new knowledge. It is directed primarily towards 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.

Source

NCSES, HERD Survey forms. Available at <https://nces.nsf.gov/surveys/higher-education-research-development/>.

C. R&D by Nonprofit Organizations**Nonprofit Research Activities Survey****Description**

The Nonprofit Research Activities (NPRA) Survey measures R&D performance and funding at U.S. 501(c) nonprofit organizations. It is currently collected as a separate module of the ABS data collection.

NSF is authorized to collect this information under Sections 1861–1876 of the National Science Foundation Act of 1950, as amended, and Section 505 of the America COMPETES Reauthorization Act of 2010.

- R&D performance
- Total and R&D employment
- Sources of R&D funding
- Type of R&D work (basic research, applied research, and experimental development)
- R&D field

Definition

For the purposes of this survey, research includes research and experimental development. Research and experimental development comprise creative and systematic work to:

- Increase the stock of knowledge, including knowledge of humankind, culture, and society

OR

- Devise new applications of available knowledge, including materials, products, devices, processes, systems, or services

Research activities must be...

- Novel: projects that advance current knowledge or create new knowledge

- Creative: projects focused on original concepts and hypotheses
- Uncertain: project outcomes are unable to be completely determined at the outset
- Systematic: projects are planned and budgeted
- Transferable/Reproducible: project methodology and results are transferable/reproducible to other situations and locations

May meet the criteria for research

- Laboratory or animal studies
- Clinical trials
- Prototype development
- Outcomes research
- Development/measurement of new methods to deliver/measure social service outcomes
- Policy research
- Humanities research
- Research traineeships
- Other experimental studies

Most likely do not meet the criteria for research

- Internal program monitoring or evaluation
- Public service grants or outreach programs
- Education or training programs
- Quality control testing
- Market research
- Management studies/efficiency surveys
- Literary, artistic, or historical projects, such as films, music, or books and other publications
- Feasibility studies, unless included as part of an overall research project

Type of R&D Work

- Basic research: 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: Original investigation undertaken in order to acquire new knowledge. It is directed primarily towards a specific, practical aim or objective.
- Experimental development: 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.

Source

NCSES, Nonprofit Research Activities module of the ABS questionnaire. Available at <https://nces.nsf.gov/surveys/nonprofit-research-activities/>.

V. R&D in National Accounts and Globalization Manuals

A. R&D in the System of National Accounts (SNA)

Description

The System of National Accounts, 2008 (2008 SNA) is a statistical framework that provides a comprehensive set of macroeconomic accounts for policy and research purposes. The 2008 SNA recognized R&D as investment or produced asset in an economy (SNA 6.230, 10.98). R&D is defined in paragraph 10.103 (Chapter 10: The capital account, Section B: Gross capital formation).

Definition

10.103 Intellectual property products include the results of research and development (R&D). Research and [experimental] development consists of the value of expenditures on creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and use of this stock of knowledge to devise new applications.

Source

United Nations (UN) Statistical Division—2008 System of National Accounts.

B. Measuring R&D in global economic activities

Description

Guidance for official statistics on trade, investment, and international production—called global value chains (GVCs) in recent economics and policy research literature—explicitly cover R&D and related intangible assets under the heading of “intellectual property products” (IPP). (In addition to R&D, IPPs include software and databases, entertainment, literary or artistic originals, and the results from mineral exploration.) The information below briefly covers selected international statistical manuals.

OECD Handbook on Deriving Capital Measures of Intellectual Property Products, 2010

This handbook uses the SNA 2008 R&D definition (10.103) and describes domestic R&D output for purposes of national and international economic accounts in terms of three components consistent with both the SNA and *Frascati*: own account R&D (R&D conducted and used internally regardless of funding source); custom R&D (R&D conducted for, and funded by, another unit); and speculative or non-customized R&D.

Balance of Payments and International Investment Position Manual, 6th ed., 2009 (BPM6)

The manual covers accounting and statistical standards to compile the balance of payments (BOP), a statement that summarizes economic transactions—including R&D and other IPP—between residents and nonresidents (BPM6 2.2(b)). BPM6 incorporated R&D as an intellectual property product within the balance of payments (see BPM6 Table 10.4 and related text).

OECD Benchmark Definition of Foreign Direct Investment (FDI), 4th ed., 2008

This guidance describes definitions and measurement procedures for FDI flows and stocks consistent with the Balance of Payments and International Investment Position Manual. It also covers definitions of activities of multinational enterprises (MNEs) (AMNE for short) including sales, value added, employment, R&D, and international trade. For related definitions, see Statistics on the Activities of Multinational Enterprises, Chapter 12 in *U.S. International Economic Accounts: Concepts and Methods*, Bureau of Economic Analysis, 2014.

Manual on Statistics of International Trade in Services (MSITS), 2010

This manual covers statistics on international supply of services, including R&D services as defined in MSITS paragraph 3.234.

Definition

3.234. Research and development services covers those services that are associated with basic research, applied research and experimental development of new products and processes and covers activities in the physical sciences, the social sciences and the humanities.

Guide to Measuring Global Production, 2015

This manual further elaborates on measurement issues from GVCs and related global manufacturing arrangements and transactions, including exchanges of R&D and other intangibles or intellectual property products. See Chapter 4 (Ownership of intellectual property products inside global production).

Source

OECD, *Frascati Manual*, 7th ed, "Measurement of R&D Globalisation," Chapter 11. Available at <https://www.oecd.org/publications/frascati-manual-2015-9789264239012-en.htm>.

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United Nations Economic Commission for Europe, Organisation for Economic Co-operation and Development (UNECE, OECD). 2015. *Guide to Measuring Global Production*. Geneva, Switzerland. Available at <http://www.unece.org/info/media/news/statistics/2016/unece-provides-practical-guidance-on-measuring-global-production/doc.html>.

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Notes

- 1 Myers K, Lanahan L. 2022. Estimating Spillovers from Publicly Funded R&D: Evidence from the U.S. Department of Energy. *American Economic Review* 112 (7):2393–2423.
- 2 Shackelford B, Heilig S. 2011. *Effect of Form Design on the Reporting of Complex Concepts in a Survey of Businesses: Evidence from the Business R&D and Innovation Survey*. JSM Proceedings, Government Statistics Section. Alexandria, VA: American Statistical Association, pp. 2863–2875.
- 3 Effective September 2019, the Federal Accounting Standards Board eliminated definitions and reporting requirements for federal R&D. See https://files.fasab.gov/pdffiles/handbook_sffas_57.pdf.

Contact

NCSES

National Center for Science and Engineering Statistics
Directorate for Social, Behavioral and Economic Sciences
U.S. 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