Scientific Activities of Provincial Research Organizations

Activities in the natural sciences and engineering

Guide to the collection of data in the natural sciences and engineering

Introduction

This introduction provides an overview of the process of collecting scientific expenditures data. Definitions and explanatory notes relating to natural sciences and engineering, scientific and technological activities, and other terms used are given in subsequent sections.

Since 1973, Statistics Canada has been collecting detailed expenditure and full-time equivalent data on scientific activities of provincial research organizations. These data, coupled with data from other surveys, have been used by policy analysts in federal and provincial governments, research managers and the media to elaborate on the provincial scientific activities.

Intramural research and development expenditures are a direct input into the Canadian gross domestic expenditures on research and development (GERD) indicators.

Expenditures on research and development (R&D) and related scientific activities (RSA) are subdivided into “current expenditures” and “capital expenditures”. Current expenditures indicate the “where” and “by whom” the activities are performed. (e.g., internally by the organization or by external performers).

Personnel are allocated to research and development or related scientific activities, and distributed into the following categories: scientific and professional personnel, supporting personnel, and other.

1. Total scientific and technological expenditures by activity in the natural sciences and engineering

Definitions and explanations of terms

Natural sciences and engineering includes disciplines concerned with understanding, exploring, developing or utilizing the natural world. Included are such disciplines as the engineering, mathematical, life and physical sciences.

The questionnaire covers two consecutive fiscal years and the headings for both years are identical. One set of definitions/explanations therefore suffices.

Actual and preliminary expenditures on scientific and technological activities are to be classified according to the type of scientific activity and who performed or will perform the scientific activity (intramural or extramural).

Scientific and technological (S&T) activities are required for the generation, dissemination or initial application of the new S&T knowledge. The central activity is scientific research and experimental development (R&D). In addition there are a number of activities closely related to R&D, and are termed related scientific activities (RSA). The RSA identified as being appropriate for the provincial research organization in the natural sciences and engineering are: scientific data collection, information services, and special services and studies.

A. Research and development (R&D)

Research and experimental development – creative work undertaken on a systematic basis in order to increase the stock of knowledge, and the use of this stock of knowledge to devise new applications.

In this survey, the term research and development (R&D) is synonymous with research and experimental development.

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The basic criterion for distinguishing R&D from related scientific activities is the presence in R&D of an appreciable element of novelty and the resolution of scientific and/or technological uncertainty. New knowledge, products or processes are sought. The work is normally performed by, or under the supervision of, persons with postgraduate degrees in the natural sciences and engineering.

An R&D project generally has three characteristics:

- a substantial element of uncertainty, novelty and innovation;
- a well-defined project design; and
- a report on the procedures and results of the project.

Examples:

- Special investigation of a particular mortality in order to establish the side effects of certain medical treatments.
- The investigation of new methods of measuring temperature is research as is the study and development of new systems and techniques for interpreting the data.
- The development of new methods of identifying tree species and determining if they are diseased.
- The creation of a new transportation system as a prototype and the technical evaluation of its operations.

R&D is generally carried out by specialized R&D units. However, an R&D project may also involve the use of non R&D facilities (e.g., testing grounds), the purchase or construction of specialized equipment and materials, and the assistance of other units. Costs of such items, attributable to the project, are to be considered R&D costs.

R&D units may also be engaged in non R&D activities such as technical advisory services, testing, or construction of special equipment for other units. So far as is practical, the effort devoted to such operations should be excluded from R&D.

Intramural (internal) R&D

Intramural (internal) R&D is defined as all expenditures for R&D performed within your organization by your personnel during a specific period, whatever the source of funds.

Current expenditures - includes costs (expenditures) incurred for scientific activities carried out by in-house personnel including salaries and contributions to employee benefit plans (e.g. pension); materials and supplies; contract payments to contractors working on site within your organization's premises; as well as costs for personnel engaged in the administration of extramural (external) R&D contracts, grants and contributions.

Capital expenditures – expenditures on construction, acquisition or preparation of land, buildings, machinery and equipment are capital expenditures. All other expenditures are current expenditures.

Extramural (external) R&D

Extramural (external) payments are made by the provincial research organizations for R&D activities performed by extramural sectors and these sectors are defined as follows:

Business enterprise – business and government enterprises including public utilities and government-owned firms. Incorporated consultants providing scientific and engineering services are also included. Industrial research institutes located at Canadian universities are considered to be in the higher education sector.

Higher education – composed of all universities, colleges of technology and other institutes of post-secondary education, whatever their source of finance or legal status. It also includes all research institutes, experimental stations and clinics operating under the direct control of, or administered by, or associated with, the higher education establishments.

Hospitals and health organizations – Canadian hospitals and health organizations which are not part of university medical schools.

Federal, provincial and municipal governments – departments and agencies of these governments. Government enterprises, such as provincial utilities are included in the business enterprise sector.

Other Canadian performers – include Canadian non-profit institutions that are not serving the health field or business enterprise sector; individuals or organizations in Canada not belonging to any of the above sectors, and all foreign government agencies, foreign companies (including foreign subsidiaries of Canadian firms), international organizations, non-resident foreign nationals and Canadians studying or teaching abroad.

Extramural expenditures include:

Contract payments to an outside institution or individual performing R&D.

R&D grants and contributions – awards to organizations or individuals for the conduct of R&D and intended to benefit the recipients.

B. Related scientific activities (RSA)

Related scientific activities involve the generation, dissemination and application of scientific and technological knowledge. The kinds of related scientific activities for the natural sciences and engineering are described below.

Related scientific activities include:

Scientific data collection – the gathering, processing, collating and analyzing of data on natural phenomena. These data are normally the results of surveys, routine laboratory analyses or compilations of operating records.

Data collected as part of an existing or proposed research project are charged to R&D. Similarly, the costs of analyzing existing data as part of a research project are R&D costs, even when the data were originally collected for some other purpose. The development of new techniques for data collection is also to be considered an R&D activity.

Examples of scientific data collection are: routine geological, hydrographic, oceanographic and topographic surveys; routine astronomical observations; maintenance of meteorological records; and wildlife and fisheries surveys.

Information services – all work directed to recording, classifying, translating and disseminating scientific and technological information as well as museum services. Included are the operations of scientific and technical libraries, S&T consulting and advisory services, the Patent Office, the publication of scientific journals and monographs, and the organizing of scientific conferences. Grants for the publication of scholarly works are also included.

General purpose information services or information services directed primarily towards the general public are excluded, as are general departmental and public libraries. When individual budgets exist, the costs of libraries which belong to institutions otherwise entirely classified to another activity, such as R&D, should be assigned to information services. The costs of printing and distributing reports from another activity, such as R&D, are normally attributable to that activity.

Special services and studies – work directed towards the establishment of national and provincial standards for materials, devices, products and processes; the calibration of secondary standards; non-routine quality testing; feasibility studies and demonstration projects.

Sub categories under Special services and studies include:

Testing and standardization – work directed towards the establishment of national and international standards for materials, devices, products and processes, the calibration of secondary standards and non-routine quality testing. The development of new measures for standards, or of new methods of measuring or testing, is R&D and should be reported as such. Exclude routine testing such as monitoring radioactivity levels or soil tests before construction.

Feasibility studies – technical investigations of proposed engineering projects to provide additional information required to reach decisions on implementation. Besides feasibility studies per se, the related activity of demonstration projects are to be included. Demonstration projects involve the operation of scaled-up versions of a facility or process, or data on factors such as costs, operational characteristics, market demand and public acceptance. Projects called "demonstration projects" but which conform to the definition of R&D should be considered R&D. Once a facility or process is operated primarily to provide a service or to gain revenue, rather than as a demonstration, it should no longer be included with feasibility studies. In all demonstration projects, only the net costs should be considered.

Administration of extramural RSA programs – the costs, including salaries, of personnel engaged in the administration of contracts and grants and contributions for related scientific activities that are to be performed outside the provincial research organizations.

NOTE: If any of these activities are performed in direct support of an R&D project or program, include the expenditures in the R&D section above.

Intramural (internal) RSA expenditures

Current expenditures – includes costs (expenditures) incurred for related scientific activities carried out by in-house personnel including salaries and contributions to employee benefit plans (e.g. pension); materials and supplies; contract payments to contractors working on site within your organization's premises; as well as costs for personnel engaged in the administration of extramural (external) R&D contracts, grants and contributions.

Capital expenditures – expenditures on construction, acquisition or preparation of land, buildings, machinery and equipment are capital expenditures. All other expenditures are current expenditures.

Extramural RSA expenditures include:

Contract payments to an outside institution or individual performing RSA.

RSA grants and contributions – awards to organizations or individuals for the conduct of RSA and intended to benefit the recipients.

2. Source of funds for intramural (internal) research and development (R&D) in the natural sciences and engineering

This question identifies the sources of funds for expenditures on research and development performed by your organization. It will help to ensure that work funded from outside the provincial research organization is not overlooked.

R&D budget of the provincial research organization (operating capital, and grants and contributions) – that portion of the total provincial research organizational budget which was spent on natural science and engineering R&D activities.

Federal government – all R&D funds from the departments and agencies of the federal government used for natural science and engineering activities.

Provincial/Territorial government – all R&D funds from the provincial/territorial government used for natural science and engineering activities.

Canadian business enterprises – all R&D funds from business enterprises used for natural science and engineering activities.

Other Canadian sources – all R&D funds for natural science and engineering activities from sources not specified above for example, higher education, hospitals and private non-profit organizations.

Foreign sources – all R&D funds from sources located outside the jurisdictional boundary of Canada.

3. Personnel in full-time equivalent (FTE) engaged in scientific and technological activities in the natural sciences and engineering

Full-time equivalent (FTE) – a measure of the time actually devoted to the conduct of scientific activities. Example calculation: an employee who is engaged in scientific activities for half a year has a full-time equivalence of 0.5. If, out of five scientists engaged in R&D work, one works solely on R&D projects and the remaining four devote only one quarter of their working time to R&D, then: FTE = 1 + ¼ + ¼ + ¼ + ¼ = 2.0.

Scientific and professional personnel - FTE in jobs that require at least one academic degree or nationally recognized professional qualification (e.g. professional engineers) as well as those with equivalent experience.

Supporting personnel (technicians and technologists) – personnel in jobs that require specialized vocational or technical training beyond the secondary education level (e.g., community colleges and technical institutes) as well as those with experience equivalent to this training.

Other – clerical, secretarial, administrative, operational and other support personnel.

Enquiries should be directed to:

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