



# Measuring Research and Experimental Development (Part 3)

***SEMINAR-WORKSHOP ON SCIENCE, TECHNOLOGY AND  
INNOVATION INDICATORS: TRENDS AND CHALLENGES***

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# R&D expenditure (general issues)

- The basic measure is “intramural expenditures”; *i.e.* all expenditures for R&D performed within a statistical unit or sector of the economy.
- Another measure, “extramural expenditures”, covers payments for R&D performed outside the statistical unit or sector of the economy.
- For R&D purposes, both current costs and capital expenditures are measured.
- In the case of the government sector, expenditures refer to direct rather than indirect expenditures.

# R&D expenditure

- Depreciation costs are excluded.
- R&D is an activity involving significant transfers of resources among units, organisations and sectors and especially between government and other performers. It is important for science policy advisors and analysts to know who finances R&D and who performs it.

# Measuring R&D expenditure

- A statistical unit may have expenditures on R&D either within the unit (intramural) or outside it (extramural). The full procedure for measuring these expenditures is as follows:
  - Identify the intramural expenditure on R&D performed by each statistical unit.
  - Identify the sources of funds for these intramural R&D expenditures as reported by the performer.
  - Aggregate the data by sectors of performance and sources of funds to derive significant national totals.
  - Optional: Identify the extramural R&D expenditures of each statistical unit.

# R&D expenditure

- R&D expenditure refers to resources actually spent in R&D activities, rather than only budgeted. Therefore, the way to obtain sound data is to rely on responses of R&D performers, rather than funding agencies.

# R&D expenditure: current costs

- **Current costs** are composed of:
  - **labour costs of R&D personnel** (annual wages and salaries and all associated costs or fringe benefits) and
  - **other current costs** (non-capital purchases of materials, supplies and equipment to support R&D, including water, gas and electricity; books, journals, reference materials, subscriptions to libraries, scientific societies, etc.; materials for laboratories such as chemicals or animals, costs for on-site consultants, administrative and other overhead costs (e.g. office, post and telecommunications, insurance), costs for indirect services (e.g. security; storage; use, repair and maintenance of buildings and equipment; computer services; and printing of R&D reports), labour costs of non-R&D personnel).
- Current costs may be prorated if necessary to allow for non-R&D activities within the same statistical unit.

# R&D expenditure: capital expenditure

- **Capital expenditures** are the annual gross expenditures on fixed assets used in the R&D programmes of statistical units, including land and buildings, instruments and equipment, and computer software.
- Expenditure should be reported in full for the period when it took place and should not be registered as an element of depreciation.
- All depreciation provisions for building, plant and equipment, whether real or imputed, should be excluded from the measurement of intramural R&D expenditures.

## ***Criteria for identifying flows of R&D funds***

- For such a flow of funds to be correctly identified, two criteria must be fulfilled:
  - There must be a direct transfer of resources.
  - The transfer must be both intended and used for the performance of R&D.

# Public general university funds (GUF)

To finance their R&D activities, universities usually draw on three types of funds:

- R&D contracts and earmarked grants received from government and other outside sources. ***These should be credited to their original source.***
- Income from endowments, shareholdings and property, plus surplus from the sale of non-R&D services such as fees from individual students, subscriptions to journals and sale of serum or agricultural produce. ***These are the universities' "own funds".***
- The general grant they receive from the ministry of education or from the corresponding provincial or local authorities in support of their overall research/teaching activities. As government is the original source and has intended at least part of the funds concerned to be devoted to R&D, **the R&D content of these public general university funds should be credited to government as a source of funds**, for the purposes of international comparisons.

# Institutional classification

- **Business enterprise** (all firms, organisations and institutions whose primary activity is the market production of goods or services (other than higher education) for sale to the general public at an economically significant price, as well as the private non-profit institutions mainly serving them. Includes public enterprises).
- **Government** (all departments, offices and other bodies which furnish, but normally do not sell to the community, those common services, other than higher education, which cannot otherwise be conveniently and economically provided, as well as those that administer the state and the economic and social policy of the community, as well as NPIs controlled and mainly financed by government, but not administered by the higher education sector Public enterprises are excluded.)

- **Private non-profit** (Non-market, private non-profit institutions serving households (*i.e.* the general public), private individuals or households).
- **Higher education** (All universities, colleges of technology and other institutions of post-secondary education, whatever their source of finance or legal status; all research institutes, experimental stations and clinics operating under the direct control of or administered by or associated with higher education institutions).
- **Abroad** (All institutions and individuals located outside the political borders of a country, except vehicles, ships, aircraft and space satellites operated by domestic entities and testing grounds acquired by such entities; all international organisations (except business enterprises), including facilities and operations within the country's borders).



# GERD - matrix of performing and funding sectors

Funding sectors (Sources of funds)	Sectors of performance				Total
	Business enterprise	Government	Private non-profit	Higher education	
Business enterprise					<i>Total financed by BE sector</i>
Government					<i>Total financed by G sector</i>
Public general university funds (GUF)					<i>Total financed by GUF</i>
Higher education					<i>Total financed by HE sector</i>
Private non-profit (PNP)					<i>Total financed by PNP sector</i>
Funds from Abroad Foreign enterprise (Within same group, Other) Foreign govt. (EU, Intl. org., Other)					<i>Total financed by abroad</i>
<b>Total</b>	<i>Total performed in BE</i>	<i>Total performed in Gov</i>	<i>Total performed in PNP</i>	<i>Total performed in HE</i>	<b>TOTAL GERD</b>

# Classifications

- Institutional classification
- Type of activity
- Fields of Science
- Socio-Economic Objective
- Level of formal qualification (ISCED)
- Fields of Education and Training (ISCED)

# Type of activity

- Basic research.
- Applied research.
- Experimental development.

## 1. Natural Sciences

- 1.1 Mathematics, computer sciences, information sciences
- 1.2 Physical sciences
- 1.3 Chemical sciences
- 1.4 Earth and related environmental sc.
- 1.5 Biological sciences
- 1.6 Other natural sciences

## 2. Engineering and Technology

- 2.1 Civil engineering
- 2.2 Electrical, electronic, information eng.
- 2.3 Mechanical engineering
- 2.4 Chemical engineering
- 2.5 Material engineering
- 2.6 Medical engineering
- 2.7 Environmental engineering
- 2.8 Biotechnology
- 2.9 Nano-technology
- 2.10 Other engineering and tech.

## 3. Medical Sciences

- 3.1 Basic medicine
- 3.2 Clinical medicine
- 3.3 Health sciences
- 3.4 Other medical sciences

## 4. Agricultural Sciences

- 4.1 Agriculture, forestry, and fishery
- 4.2 Animal and dairy science
- 4.3 Veterinary science
- 4.4 Other agricultural sciences

## 5. Social Sciences

- 5.1 Psychology
- 5.2 Economics and business
- 5.3 Educational sciences
- 5.4 Sociology
- 5.5 Law
- 5.6 Political Science
- 5.7 Social and economic geography
- 5.8 Media and communications
- 5.9 Other social sciences

## 6. Humanities

- 6.1 History and archaeology
- 6.2 Languages and literature
- 6.3 Philosophy, ethics and religion
- 6.4 Art
- 6.5 Other humanities

# Socio-economic objectives (SEO)

1. Exploration and exploitation of the Earth.
2. Infrastructure and general planning of land use.
3. Control and care of the environment.
4. Protection and improvement of human health.
5. Production, distribution and rational utilisation of energy.
6. Agricultural production and technology.
7. Industrial production and technology.
8. Social structures and relationships.
9. Exploration and exploitation of space.
10. Non-oriented research.
11. Other civil research.
12. Defence.

- Sex
- Age (groups): Under 25 years; 25-34 years; 35-44 years; 45-54 years; 55-64 years; 65 years and more.

# Classification by Fields of Study (ISCED97)

- **General Programmes** (01 Basic programmes, 08 Literacy & numeracy, 09 Personal development)
- **Education** (14 Teacher training & education science)
- **Humanities and Arts** (21 Arts, 22 Humanities)
- **Social sciences, business and law** (31 Social & behavioural science, 32 Journalism & information, 34 Business & administration, 38 Law)
- **Science** (42 Life sciences, 44 Physical sciences, 46 Mathematics & statistics, 48 Computing)
- **Engineering, manufacturing and construction** (52 Engineering & engineering trades, 54 Manufacturing & processing, 58 Architecture & building)
- **Agriculture** (62 Agriculture, forestry & fishery, 64 Veterinary)
- **Health and welfare** (72 Health, 76 Social services)
- **Services** (81 Personal services, 84 Transport services, 85 Environmental protection, 86 Security services)
- **Not known or unspecified**

# HOW do we collect data?

- R&D Surveys. Innovation surveys.  
Combined R&D-innovation surveys.  
-> Good quality questionnaires are needed!
- Administrative data (budget, personnel list)
- S&T management information systems
- Time-use surveys
- Estimations

Different strategies for different sectors:  
one size does not fit all!

# How do we ORGANIZE a sustainable S&T statistics system?

- Convince policy-makers
- Involve multiple actors
- User/producer consultation
- Create national S&T statistics groups
- Shared ownership of data
- Quality is key – **capacity building of producers**
- Step-by-step approach
- Combine statistics with S&T information systems
- Network with colleagues from similar countries

# Step-by-step approach

- People, then Money
- S&T databases: projects, researchers, institutions, publications
- Sectors (what's easiest? government? HE?)
- First level of the pyramid (taking into account further levels)

- Adopt vs. adapt (ad@pt?) methodologies
- UIS will produce annex to Frascati Manual on measuring R&D in developing countries

# Ad@pting definitions

- Should we measure R&D?
- Should we measure only R&D?
- Should we not measure R&D?
- Should we measure innovation (in business)?
- Should we use international definitions at country level?
- What else should we measure?
- What does not fit the definitions proposed?

# Thank you!

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