R&D Attributes

To clarify the meaning of attributes, the general terms and categories used to characterize the R&D statistics are described first. In this task we followed the definitions and classifications from the following sources: Frascati Manual (OECD, 2002), Manual for Statistics on Scientific and Technological Activities (UNESCO, 1984), UNESCO Institute for Statistics website (http://www.uis.unesco.org), The World Bank website (http://data.worldbank.org), and WIPO website (http://www.wipo.int). The description of terms and categories is followed by the description of the individual attributes, generally divided into R&D inputs (personnel and expenditures) and R&D outputs (patents and high-technology exports).

1. R&D Inputs

1.1. R&D Personnel

"R&D personnel" refers to the employees engaged in the R&D activities, including those who provide direct services such as R&D managers, administrators and clerical staff. They are further divided into:

- **Researchers** – Employees engaged in the conception or creation of new knowledge, products, processes, methods and systems, and in the management of projects.
- **Technicians** – Employees that perform scientific and technical tasks involving application of concepts and operational methods, normally under supervision of researchers.
- **Other supporting staff** – Skilled and unskilled craftsmen, secretarial and clerical staff associated with the R&D projects.

R&D personnel attributes are expressed in:

- **FTE** = Full time equivalent – Denotes person-years spent for R&D. For example, a researcher that is employed 30% of his/hers total working hours on R&D activities represents 0.3 FTE. Those attributes that are expressed in FTEs represent a true measure of the total volume of the R&D activities. As such, they are most suitable for the international comparisons.
- **HC** = Head count – Represents the number of employees.

1.2. R&D Expenditures

Gross domestic expenditure on R&D (GERD) is total expenditure on R&D performed on the national territory during a year, including R&D performed within a country and funded from abroad but excluding payments made abroad for R&D.

Purchasing Power Parities (PPP$) is a currency conversion method that eliminates differences in price levels among countries. GERD converted by the PPP method accounts for the same set of international prices of R&D activities so that comparisons between countries reflect only differences in the amount spent for R&D.

1.3. Institutional Classification Scheme

The "Institutional Classification Scheme" classifies R&D institutions into sectors based on the characteristic properties of their funding and activities (OECD, 2002). The sectors are established based on the standard classification of economic activities defined in System of National Accounts (UN, 1968), with the adjustment to accommodate the higher education sector.

The sectors are:

- **Business enterprise** sector includes institutions whose primary activity is the market production of goods and services for sale at an economically significant price.
- **Government** sector includes institutions that: a) supply common services to the community (except higher education), which are not convenient to offer at market price; b) administer the state and the economic and social policy of the community.
- **Private non-profit** sector includes private non-market institutions serving to general public, as well as private individuals and households. Non-profit institutions provide services for the benefit of their members or for charity purposes, and are financed from membership subscriptions and donations. This category further includes any funds from households intended for R&D activities.
- **Higher education** sector includes institutions of post-secondary education (universities, colleges of technology etc.) no matter of their source of finance or legal status, and institutions such as research institutes, experimental stations and clinics associated with higher education institutions.
- **Abroad** includes institutions and individuals located outside of a country, as well as international organizations within a country that do not belong to business enterprise sector. It does not include vehicles, ships, aircrafts and space satellites that are abroad, but are operated by domestic entities.

The attributes that are differentiated according to the institutional classification scheme are "GERD per capita (PPP$)", "Total R&D personnel (FTE)" and "Total researchers (FTE)".

2. R&D Outputs

An application for patent implies a submission of a form containing information about the applicant, the inventor and a specification of the form of intellectual property protection.

A grant of patent implies obtaining a set of exclusive rights when a patent is "granted".

A patent of resident refers to an application filed with the Office of or acting for the State in which the first applicant has residence.

A patent of non-resident refers to an application filed with the Office of or acting for the State in which the first applicant does not have residence.

High-technology export represents the export of products, which are the results of high R&D intensity activities, e.g., in aerospace, computers, pharmaceuticals, scientific instruments, and electrical machinery.

3. GNI per capita – Class

GNI stands for Gross National Income and represents the total value of goods and services produced within a country.

GNI per capita is computed by: first, converting GNI in national currency into US$ using The World Bank Atlas method; and second, by dividing the converted GNI by the midyear population.

The World Bank Atlas conversion method results in the values of GNI per capita that are internationally comparable by reducing the impact of exchange rate fluctuations.

Discretization of the "GNI per capita" attribute is based on The World Bank classification system, which divides countries into low-, middle- and high-income countries. These

categories are based on The Bank's operational lending categories, with the goal to provide more help to poorer countries. The thresholds are based on a summary measure of well-being (such as poverty incidence and infant mortality) and are updated yearly to account for the effect of international inflation.

4. Attributes

ATTRIBUTE	DESCRIPTION
R&D INPUTS – R&D PERSONNEL	
Total R&D personnel (FTE)	The number of person-years spent for R&D activities.
R&D personnel – Female (FTE)	The number of person-years spent for R&D activities by females.
R&D personnel – Female (FTE) (%)	The percentage of person-years spent for R&D activities by females.
Total R&D personnel (HC)	The number of employees in the R&D sector.
R&D personnel – Female (HC)	The number of female employees in the R&D sector.
R&D personnel – Female (HC) (%)	The percentage of female employees in the R&D sector.
R&D personnel by sector of employment (FTE) – Business enterprise	The number of person-years spent for R&D activities by each of the four sectors.
R&D personnel by sector of employment (FTE) – Government	
R&D personnel by sector of employment (FTE) – Higher education	
R&D personnel by sector of employment (FTE) – Private non-profit	
Total researchers (FTE)	The number of person-years spent by the researchers for R&D activities.
Researchers – Female (FTE)	The number of person-years spent by the female researchers for R&D activities.
Researchers – Female (FTE) (%)	The percentage of person-years spent by the female researchers for R&D activities.
Researchers per million inhabitants (FTE)	Semantically the same as the "Total researchers (FTE)" attribute; however, this time expressed per million inhabitants.
Total researchers (HC)	The number of researchers in the R&D sector.
Researchers – Female (HC)	The number of female researchers in the R&D sector.
Researchers – Female (HC) (%)	The percentage of female researchers in the R&D sector.
Researchers per million inhabitants (HC)	Semantically the same as the "Total researchers (HC)" attribute; however, this time expressed per million inhabitants.
Researchers by sector of employment (FTE) – Business enterprise	The number of person-years spent by the researchers for R&D activities, by each of the four sectors.
Researchers by sector of employment (FTE) – Government	
Researchers by sector of employment (FTE) – Higher education	
Researchers by sector of employment (FTE) – Private non-profit	
Total technicians (FTE)	The number of person-years spent by the technicians for R&D activities.
Technicians – Female (FTE)	The number of person-years spent by the female technicians for R&D activities.
Technicians per million inhabitants (FTE)	Semantically the same as the "Total technicians (FTE)" attribute; however, this time expressed per million inhabitants.
Total technicians (HC)	The number of technicians in the R&D sector.
Technicians – Female (HC)	The number of female technicians in the R&D sector.
Technicians per million inhabitants (HC)	Semantically the same as the "Total technicians (HC)" attribute; however, this time expressed per million inhabitants.
Total other supporting staff (FTE)	The number of person-years spent by the supporting staff for R&D activities.
Other supporting staff – Female (FTE)	The number of person-years spent by the female supporting staff for R&D activities.
Total other supporting staff (HC)	The number of supporting staff employees in the R&D sector.

Other supporting staff – Female (HC)	The number of female supporting staff employees in the R&D sector.
R&D INPUTS – R&D EXPENDITURES	
GERD per capita (PPP$)	GERD expressed in different quantities.
GERD as % of GDP	
Total GERD (000 PPP$)	
Source of Funds for R&D – Business Enterprise (%)	The distribution of GERD over the five sectors.
Source of Funds for R&D – Government (%)	
Source of Funds for R&D – Higher education (%)	
Source of Funds for R&D – Private non-profit (%)	
Source of Funds for R&D – Funds from abroad (%)	
Source of Funds for R&D – Not distributed funds (%)	
R&D OUTPUTS	
Applications for patents (residents)	The number of applications for patents where the first applicant is a resident of a country.
Applications for patents (non-residents)	The number of applications for patents where the first applicant is a non-resident of a country.
Applications for patents (total)	The total number of applications for patents submitted by a country.
Grants of patents (residents)	The number of granted patents where the first applicant is a resident of a country.
Grants of patents (non-residents)	The number of granted patents where the first applicant is a non-resident of a country.
Grants of patents (total)	The total number of granted patents for a country.
High-technology exports (% of manufactured exports)	The percentage of high-technology exports in total exports of a country.

References

OECD (2002) Frascati Manual: Proposed Standard Practice for Surveys on Research and Experimental Development. Paris, France: OECD.

UN (1968) A System of National Accounts, Studies in Methods Series F, No. 2, Rev. 3, New York.

UNESCO (1984) Manual for Statistics on Scientific and Technological Activities. Paris, France.