9 INDUSTRY, INNOVATION AND INFRASTRUCTURE

Background Information on Research and Development (R&D) Statistics in the UIS Database

Objective

This document serves as a reader's guide to help data users understand and interpret the Research and Development (R&D) data disseminated by the UNESCO Institute for Statistics (UIS).

It presents the following information:

- The list of symbols accompanying data.
- The annual data release cycles.
- The data sources used by the UIS and their updates, including population and economic data used to calculate R&D indicators.
- Technical notes.

The following symbols are used:

(..)   Data not available

(a)   Category not applicable

(n)   Magnitude nil or negligible

(+)   National estimation

(‡)   UIS estimation

Data releases

At present, the UIS launches its annual R&D Statistics Survey in June each year. Accordingly, the UIS releases R&D data through a data release in February/March and a data refresh in October in the subsequent year. The data release includes updated national data (as available) and the data refresh contains the final set of data for the respective survey cycle with new national and regional data.

Data release – February 2024: This release includes new national data for the reference year 2022, as well as updated time series data. The new data are based on the UIS 2023 R&D Statistics Survey as well as statistics obtained from the Ibero-American Network of Science and Technology Indicators (RICYT), as of January 2024. The statistics obtained from the Organisation for Economic Co-operation and Development (OECD), the Statistical Office of the European Union (Eurostat), and the regional averages published are as of October 2023. These will be updated through the subsequent data refresh, tentatively scheduled in October 2024.

UIS R&D data can be accessed in the following ways:

UIS Data Portal, which houses internationally comparable data on R&D for more than 150 countries and territories. This includes data for the two Sustainable Development Goals (SDG) global indicators related to R&D, SDG 9.5.1: R&D expenditure as a proportion of GDP, and SDG 9.5.2: Researchers (in full-time equivalent) per million inhabitants, and a set of selected gender-disaggregated R&D indicators. Country level data and regional averages are available for the period of 1996–2022 and 1996–2021 respectively, as per the February 2024 data release.

Bulk Data Download Service (BDDS), which enables access to all UIS databases in comma-separated values (CSV) format. The R&D data (SDG 9.5 and a set of selected gender-disaggregated R&D indicators) from the February 2024 data release can be referred to through the 'Science' tab in BDDS. The other non-SDG related R&D data and indicators that the UIS used to disseminate in the past (until March 2021), but which are discontinued and not updated through subsequent data releases, can still be accessed through the 'Archive' tab in BDDS. This contains R&D data which had been released as of March 2021.

Note: As of June 2020, the UIS SDMX API has reached its End-of-Life (EOL) and is no longer up-to-date with the latest UIS datasets.

Definitions/Metadata for R&D data and indicators can be accessed at: http://uis.unesco.org/en/glossary.

Stay informed of the latest data releases by signing up for the UIS email alert service at: http://uis.unesco.org.

Data sources

Underlying data in the UIS database or data used for calculating indicators are based on data provided by UNESCO Member States through the UIS Annual R&D Statistics Survey. In addition, the UIS obtains raw data directly from the Organisation for Economic Co-operation and Development (OECD), the Statistical Office of the European Union (Eurostat) and the Ibero-American Network of Science and Technology Indicators (RICYT), for countries which participate in the data collections of these organizations.

At the national level, data sources for R&D statistics are nationally representative R&D surveys, and/or data compiled through administrative data sources or data derived by a combination of the two, by the National Statistical Offices or relevant line ministries such as the Ministry of Science and Technology.

Figure 1 presents the UIS R&D database and dissemination cycle, illustrating the centralized collection of data that originate from different sources.

FIGURE 1. UIS R&D DATABASE PRODUCTION AND DISSEMINATION CYCLE
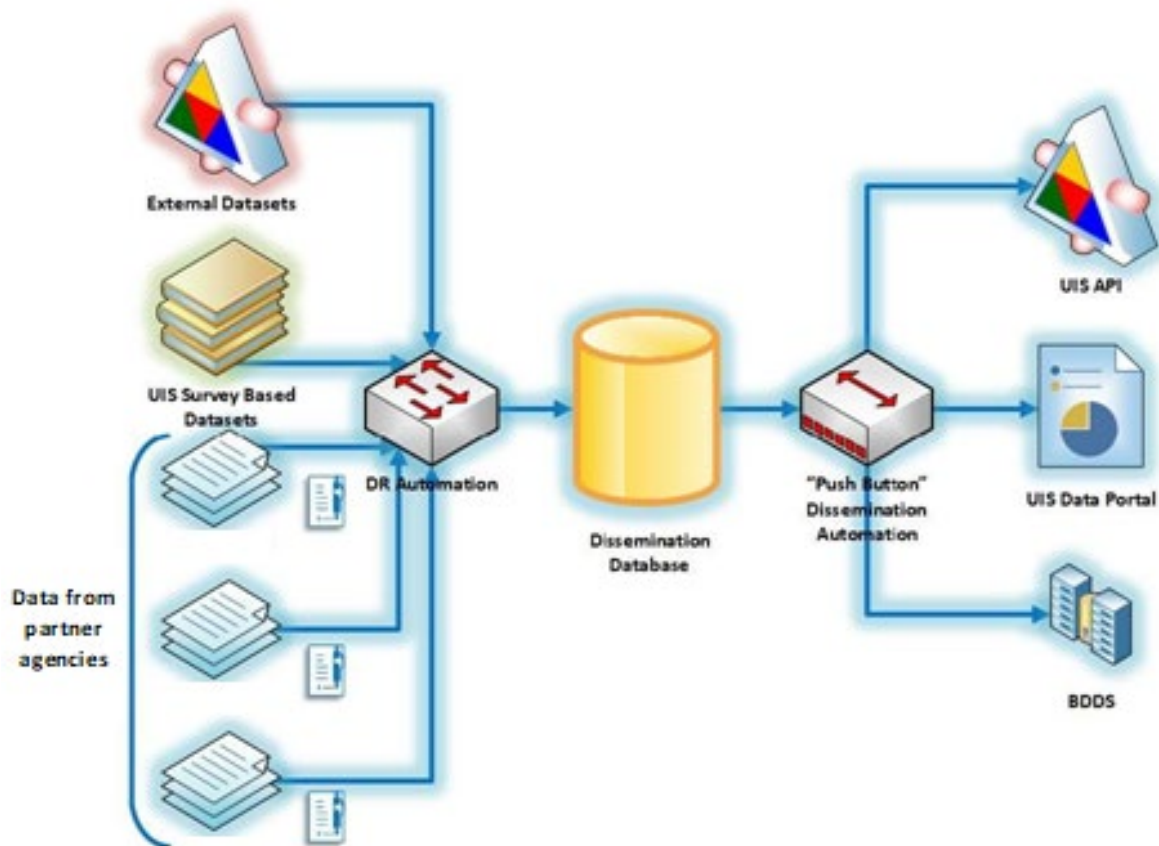
Source: UNESCO Institute for Statistics.

Note: DR = data release

Overview of indicators currently available

Table 1 provides a snapshot of the SDG indicators available in the UIS database.

TABLE 1. DESCRIPTION AND DETAILS OF SDG INDICATOR RELEASED FOR R&D

SDG indicator	Indicator name	Indicator description			
		Is the indicator being reported for the first time? (Y/N)	**Total number of countries for which the indicator is available**	**Range of years for which data are available for the indicator**	**Dimensions of disaggregation**
9.5.1	Research and development expenditure as a proportion of GDP	N	151	1996–2022	N/A
9.5.2	Researchers (in full-time equivalent) per million inhabitants	N	142	1996–2022	N/A

Table 2 provides a snapshot of the other policy relevant R&D indicators available in the UIS database.

TABLE 2. DESCRIPTION AND DETAILS OF OTHER POLICY RELEVANT INDICATORS RELEASED FOR R&D

Indicator name		Indicator description		
		Is the indicator being reported for the first time? (Y/N)	**Total number of countries for which the indicator is available**	**Range of years for which data are available for the indicator**
Female researchers as a percentage of total researchers (in headcounts - HC and full-time equivalents - FTE)	− Researchers (HC) - % Female	N*	149	1996–2022
	− Researchers (FTE) - % Female	N*	120	1996–2022
	− Female researchers as a percentage of total researchers (HC) - Business enterprise − Female researchers as a percentage of total researchers (HC) - Government − Female researchers as a percentage of total researchers (HC) - Higher education − Female researchers as a percentage of total researchers (HC) - Private non-profit	N*	141**	1996–2022
	− Female researchers as a percentage of total researchers (FTE) - Business enterprise − Female researchers as a percentage of total researchers (FTE) - Government − Female researchers as a percentage of total researchers (FTE) - Higher education − Female researchers as a percentage of total researchers (FTE) - Private non-profit	N*	115**	1996–2022

Notes:

*UIS has been again disseminating a set of selected gender-disaggregated R&D indicators as of the March 2023 data release (which were discontinued during the June 2022 release).

**Availability of data varies depending on the sector of employment. This figure is based on the sector for which highest level of data are available.

UIS R&D data collection

The UIS collects R&D statistics in aggregated form from UNESCO Member States through its annual R&D Statistics Survey as well as from its partner agencies.

UIS Survey of Research and Experimental Development (R&D) Statistics

The UIS administers an R&D data collection, through its Survey of Research and Experimental Development (R&D) Statistics, focusing on a minimum set of data, covering human and financial resources devoted to R&D at the national level. It is specially focused on the essential underlying datasets of R&D personnel and expenditure, which are needed for the production and validation of the two SDG global indicators related to R&D, SDG 9.5.1: R&D expenditure as a proportion of GDP, and SDG 9.5.2: Researchers (in full-time equivalent) per million inhabitants, and a set of selected gender-disaggregated R&D indicators, ensuring the required quality aspects.

The UIS R&D Statistics Survey questionnaire is sent directly to approximately 125 countries annually (which are not covered by the data collections of other partner agencies), to collect the most recent data. The questionnaire is based on international standards, classifications and other measures that are regularly reviewed and modified by the UIS to address emerging statistical issues and improve data quality. Notably, the concepts, definitions and classifications related to R&D statistics used in the questionnaire are based on the Frascati Manual (OECD, 2015).

The questionnaire, instruction manual and other related supporting documents can be downloaded from the UIS website at: http://uis.unesco.org/uis-questionnaires.

Data obtained from partner agencies

Underlying data for the remainder of countries are obtained from the Organisation for Economic Co-operation and Development (OECD), the Statistical Office of the European Union (Eurostat) and the Ibero-American Network of Science and Technology Indicators (RICYT). In agreement with these three organizations, their data (which were collected from their member states/associated member states, etc., – around 65 countries) are either directly obtained from the respective databases (OECD and Eurostat) or received from the partner agency (RICYT). These partnerships were established in order to reduce the response burden on countries.

External data sets: Inputs to calculate indicators

Population estimates

The main source of population estimates is from the following reference: United Nations, Department of Economic and Social Affairs, Population Division (2022). World Population Prospects 2022: The 2022 Revision, (https://population.un.org/wpp/).

Where UN Population Division (UNPD) estimates are not available, or where population issues have arisen, national data or UIS estimates are used. Population-based indicators are listed as missing (..) if population data are not available.

Summary of population data sources

The UN Population Division (UNPD) is the standard source of population data used for the calculation of population-based R&D indicators at the UIS. For the February 2024 data release, total population as of 1 January for each reference year, is used from the 2022 Revision of World Population Prospects when calculating indicator values for SDG 9.5.2 (Researchers per million inhabitants).

Exceptionally, for four countries, population data from different sources are used to generate more precise indicator values. The exceptions, summarized in **Table 3**, can be classified as follows:

- Population data by UNPD represent a geographically larger area than R&D data. Without adjustments, this would lead to an underestimation of population-based indicators. Countries in this group include Cyprus, Republic of Moldova, Serbia and Ukraine.

Compared to the 2019 Revision of World Population Prospects, the UNPD has revised its estimation method for national population figures in the 2022 Revision of World Population Prospects (details are available at: https://population.un.org/wpp/Publications/Files/WPP2022_Methodology.pdf).

TABLE 3. SOURCES OF POPULATION DATA FOR UIS R&D INDICATOR CALCULATION

Source of population data	Number of countries	Criteria used
United Nations Population Division (UNPD): World Population Prospects 2022, released in July 2022	158	UNPD is the main source of population data used for calculation of population based R&D indicators by the UIS for all countries, with the exception of the countries below in this column.
Eurostat population database	3	Countries for which R&D data do not cover certain areas but UNPD data do*: Cyprus (excluding areas not under the control of the national government) Serbia (excluding Kosovo and Metohija) Ukraine (2015 onwards: excluding areas not under the control of the national government)
Data obtained from National Statistical Offices	1	Countries for which R&D data do not cover certain areas but UNPD data do*: Republic of Moldova (excluding some districts: the left side of the river Nistru and municipality Bender)

Note: *Refer to section on 'Country notes' for additional information.

Economic statistics

The main source of economic data for gross domestic product (GDP) in current local currency, the GDP deflator, is the World Bank (World Development Indicators DataBank) as of October 2023. The UIS also uses the PPP conversion factor (local currency per international dollar), from the most recent World Bank International Comparison Program of 2017. For countries where GDP estimates are not published by the World Bank, data are obtained from the United Nations Statistics Division (UNSD), as of January 2024. Economic-based indicators are listed as missing (..) if the underlying economic data are not available.

High level summary of countries that reported data that could not be released

Table 4 below presents a summary of the number of countries for which R&D data were reported through the UIS 2023 R&D Statistics Survey but not released, grouped by key causes.

TABLE 4. UIS SURVEY OF R&D STATISTICS – SUMMARY OF CAUSES PREVENTING THE PUBLICATION OF DATA

Issues preventing the publication of data submitted through the UIS 2023 R&D Statistics Survey for the reference year 2022 (or latest available year)	Number of countries
Significant partial/under-coverage data	3
Significant data quality issues / Data do not correspond with Frascati Manual guidelines.	2

Note: the table includes only countries where the data received is not published. There are new data being published for 42 countries.

Technical notes

Resources

Frascati Manual, OECD (2015): The OECD Frascati Manual provides standard guidelines and recommendations for collecting and reporting internationally comparable statistics on the financial and human resources devoted to R&D. This can be referred to at: http://www.oecd-ilibrary.org/science-and-technology/frascati-manual-2015_9789264239012-en.

The UIS provides a guide to conducting an R&D survey for countries starting to measure R&D. This can be referred to at: http://uis.unesco.org/sites/default/files/documents/guide-to-conducting-an-rd-survey-for-countries-starting-to-measure-research-and-experimental-development-2014-en.pdf.

R&D data

The underlying R&D data compiled at the national level should comply with the concepts/definitions provided in the international standards (i.e., Frascati Manual). According to the guidelines, the reported data should cover all sectors of performance (government, higher education, business enterprise and private non-profit sectors, as defined in the Frascati Manual), representing all institutions, which are engaged in R&D activities in a particular country.

R&D data are not collected on a regular basis in many developing countries and not all sectors of R&D performance (those mentioned above) are fully covered. In some cases, certain sectors are partially covered, and in particular, the business enterprise sector is often not covered. To inform data users of any discrepancies between standard classifications and national practices, as well as differences in coverage, appropriate footnotes accompany data/indicators which are published in the UIS database to adequately document the results and provide explanations. These limitations should be taken into consideration when comparing data among countries.

According to the Frascati Manual guidelines, data on R&D personnel (including 'researchers') should be compiled/reported in headcounts (HC) and full-time equivalents (FTE). These are two different units of measurement to account for human resources devoted to R&D. However, the unit of underlying data (i.e., number of researchers) used for SDG Indicator 9.5.2 (researchers per million inhabitants) is in FTEs. In some developing countries, data on the number of researchers are only collected/reported in HCs and they lack the data based on FTEs. This leads to the unavailability of Indicator 9.5.2.

The R&D regional averages are based on both publishable data and non-publishable estimated or imputed data. They are calculated based on R&D data as of October 2023. In addition, population estimates and economic data from the UNPD's 2022 Revision of World Population Prospects and the World Bank's World Development Indicators DataBank (as of June 2023) respectively, are used. The regional groupings used in UIS Data Portal for R&D regional averages are based on SDG Regions, UIS Regions and World Bank Income Groups (July 2023).

Country notes

Cyprus: R&D data for Cyprus do not cover areas that are not under control of the national government, whereas the 2022 Revision of the World Population Prospects data do. The population data (population on 1 January) used for the calculation of indicators (1998 – 2021) were taken from Eurostat population database (as of July 2023), as is the R&D data.

Republic of Moldova: R&D data do not cover districts from the left side of the river Nistru and municipality Bender, whereas the 2022 Revision of the World Population Prospects data do. The population data (population on 1 January) used to calculate indicators (2003 – 2022) were taken from the National Bureau of Statistics (NBS) of the Republic of Moldova (as of August 2023). In addition, as of 2014, revised population data include the usual resident population, replacing resident population figures.

Serbia: R&D data do not cover Kosovo and Metohija. The population data (population on 1 January) used for the calculation of indicators (1999 – 2022) were taken from Eurostat population database (as of July 2023).

Ukraine: R&D data do not cover some regions (Autonomous Republic of Crimea, the city of Sevastopol, and parts of some other zones) that have not been under government control since 2015, whereas the 2022 Revision of the World Population Prospects do. The population

data (population on 1 January) used for the calculation of indicators (2015 – 2022) were taken from Eurostat population database (as of July 2023).