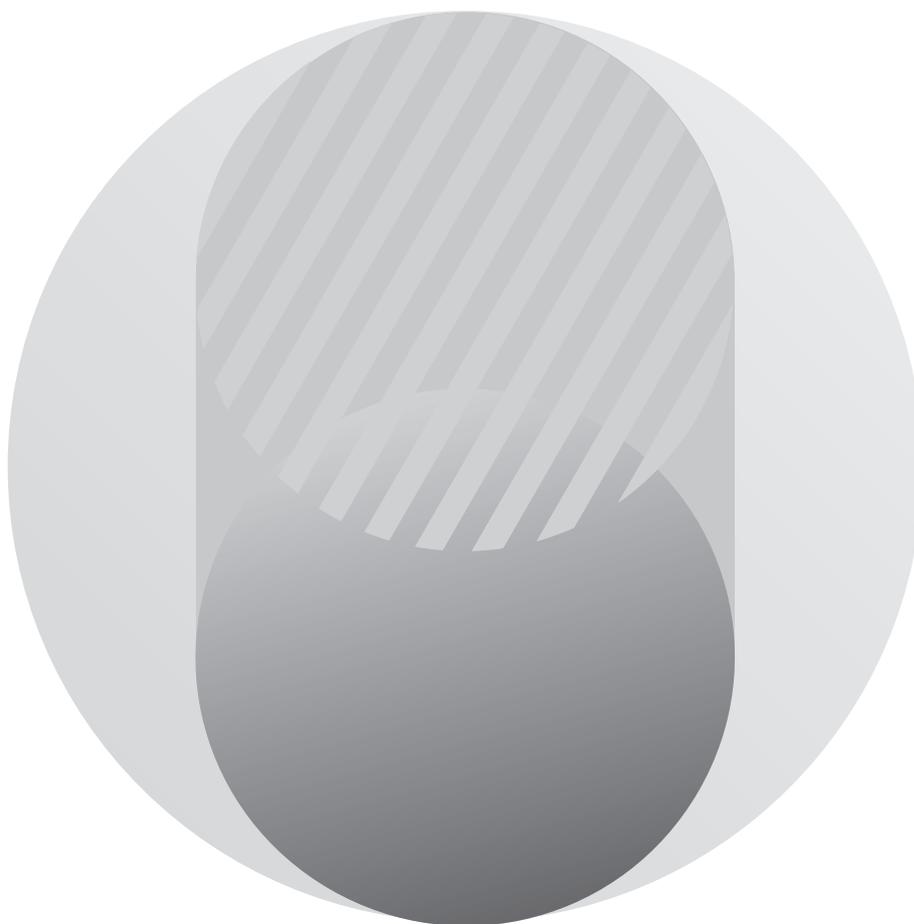




Methodological report

Research and experimental development



Methodological report

Research and experimental development

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Main abbreviations

Abbreviation	Meaning
BDL	Local Data Bank
BDM	Macroeconomic Data Bank
BERD	Business enterprise expenditure on R&D
BES	Business enterprise sector
BJS	Base of Statistical Units
DBW	Knowledge Database
Eurostat	Statistical Office of the European Union
FTE	Full-time equivalent
FORD	Fields of Research and Development
GBARD	Government budget allocations for R&D
GERD	Gross domestic expenditure on R&D
GOV	Government sector
GOVERD	Government expenditure on R&D
HERD	Higher education expenditure on R&D
HES	Higher education sector
IP Box	Intellectual Property Box
NABS	Nomenclature for the Analysis and Comparison of Scientific Programmes and Budgets
NACE	Statistical Classification of Economic Activities in the European Community
OECD	Organisation for Economic Cooperation and Development
PBSSP	Statistical survey program of official statistics
PNP	Private non-profit sector
PNPERD	Private non-profit expenditure on R&D
R&D	Research and development
EU	European Union

Introduction

Observation and measurement of research and experimental development are possible thanks to information collected by Statistics Poland within the survey on research and experimental development (R&D) included in the Statistical survey program of official statistics (PBSSP) – survey 1.43.01.

The survey methodology complies with guidelines developed by EUROSTAT and OECD included in *the Frascati Manual 2015: Guidelines for Collecting and Reporting Data on Research and Experimental Development*, OECD, 2015 (Polish version, Statistics Poland, 2018). Implementing guidelines included in the Manual ensures international comparability of R&D data.

Commission Implementing Regulation (EU) 2020/1197 of 30 July 2020 laying down technical specifications and arrangements pursuant to Regulation (EU) 2019/2152 of the European Parliament and of the Council on European business statistics repealing 10 legal acts in the field of business statistics (OJ L 271, 18.8.2020, p. 1-170, as amended) is an international law instrument from which stems an obligation to implement the survey.

The Act of 29 June 1995 on Official Statistics (Journal of Laws of 2022 item 459, as amended) and the annual regulations of the Council of Ministers concerning the PBSSP establishing the survey programme for a given year constitute the basis for conducting the survey on research and experimental development (R&D) in Poland.

Conducting the survey on research and experimental development provides a lot of valuable information on research and scientific potential of a country as well as its change and effects. Results of the survey are used to formulate a public policy of a country via providing indicators allowing an assessment of level of attainment of adopted strategic objectives.

An aim of the survey is providing information on research and experimental development. In accordance with the definition included in the Frascati Manual it encompasses 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. The survey has been conducted on an ongoing basis, which enables providing information concerning changes in knowledge resources related to R&D.

The following publication presents the methodology of the conducted survey on research and experimental development. It comprises of seven chapters. The first chapter concerns subjective and objective scope of the survey, the second one the survey type and method. In the subsequent chapters data sources, variables used in the survey, organisation and management of survey implementation, data presentation and evaluation of survey quality were presented.

Data on research and experimental development have been collected annually by Statistics Poland since 1999. Since 2009 the Statistical Office in Szczecin has been the author unit responsible for collecting and processing statistical data in this regard. Up to 2011 reporting concerning research and experimental development was conducted with the use of two questionnaires: PNT-01 – *Report on research and experimental development (R&D)* and PNT-01/s – *Report on research and experimental development (R&D) in higher education sector*. Since 2012 the third questionnaire has been implemented PNT-01/a – *Report on research and experimental development (R&D) and government budget allocations for R&D in government and local government units*. Names of PNT-01/s and PNT-01/a questionnaires have slightly changes over the years, however, this have not affected the scope of collected data. Since the reporting year 2021 all data regarding R&D, from both entities for the higher education sector and government and local government units, have been collected within one set of data PNT-01 – *Report on research and experimental development (R&D)*.

1. Subjective and objective scope of survey

The research and experimental development (R&D) survey covers national economy entities conducting scientific research or experimental development on a continuous or occasional basis, financing their performance or allocating budgetary funds to scientific research and experimental development.

Entities under an obligation to submit *Report on research and experimental development (R&D)* include:

- the Chancellery of the Prime Minister;
- ministries;
- the National Centre for Research and Development;
- the National Science Centre;
- the National Atomic Energy Agency;
- marshal offices;
- voivodship labour offices;
- national economic entities, regardless of the number of persons employed, conducting main economic activity classified into NACE Rev. 2 division 72 – Scientific research and development;
- the Postgraduate Medical Education Centre;
- higher education institutions which conduct their activities on the basis of the Act of 20 July 2018, the Law on Higher Education and Science (Journal of Laws of 2022 item 574, as amended);
- national economic entities conducting research and experimental development apart from other main economic activity, regardless of the number of persons employed.

Within entities engaged in R&D the following can be distinguished:

- dedicated research entities, i.e. entities whose main (statutory) aim is conducting scientific research and experimental development or its direct support. They include:
 - institutes, including scientific institutes of the Polish Academy of Sciences, operating on the basis of the Act of 30 April 2010 on the Polish Academy of Sciences (Journal of Laws 2020 item 1796), research institutes, operating on the basis of the Act of 30 April 2010 on the Research Institutes (Journal of Laws 2022 item 498), as well as institutes operating within the Łukasiewicz Research Network, operating on the basis of the Act of 21 February 2019 on the Łukasiewicz Research Network (Journal of Laws 2020 item 2098),
 - higher education institutions, operating under the Act of 20 July 2018, the Law on Higher Education and Science (Journal of Laws 2022 item 574, as amended) covering all universities, higher schools of technology, etc. but excluding other tertiary level education institutions, university research institutes or centres, university hospitals or clinics as well as research organisations, the R&D of which is controlled by the higher education sector,
 - others, i.e. other entities classified into NACE Rev. 2 division 72 - Scientific research and development as well as other institutionally linked auxiliary or supervising units, classified or unclassified into NACE Rev. 2 division 72 - Scientific research and development;
- economic entities which apart from their main activity perform or fund research and development.

Research and development as well as research equipment are the subject of the survey. Information collected with the use of the survey covers:

1. Engagement of a unit in R&D – determines whether a unit conducted research and development or funded performance of such works by other unit using internal funds in a surveyed reporting period. Data on engagement of a unit in R&D are used to determine the number of R&D entities;
2. Intramural R&D expenditures - expenditures incurred on R&D performed within a statistical unit during a reporting year, whatever the source of funds. They include current expenditures as well as gross fixed capital expenditures for R&D, excluding depreciation of fixed assets. Data are collected in thousand PLN rounded to one decimal place by:
 - type of incurred costs,
 - source of funding,
 - type of funding flows,

- type of R&D,
- fields of research and development,
- type of activity to which an R&D product was dedicated,
- socio-economic objectives;

3. R&D personnel by:

- main groups – breakdown introduced in the Frascati Manual 2015 dividing persons engaged in R&D according to the employment status,
- educational level,
- R&D functions;

4. Intellectual property protection – including data on applications for inventions and granted patents in national and international patent institutions;

5. Funds from the government budget allocations for research and development by:

- financing models,
- socio-economic objectives;

6. Research equipment – including data on gross value of research equipment as well as value of amortisation.

All mentioned above breakdowns are presented in detail in chapter 6.2.

2. Survey type and method

Research and experimental development indicators are collected via a mandatory full-scale survey conducted every year. Data within the survey are collected with the use of a dataset PNT-01 – *Report on research and experimental development (R&D)*. Statistical population is determined with the use of entity selection algorithms from the Base of Statistical Units (BJS). The R&D survey file includes:

- all legal entities classified into NACE Rev. 2 division 72 – Scientific research and development, which as at the update date of BJS were legally active entities and conducting economic activities (APE=11);
- all institutes, which include research institutes, scientific institutes of the Polish Academy of Sciences and institutes of the Łukasiewicz Research Network, which as at the update date of BJS were legally active entities and conducting economic activities, were in liquidation or were in bankruptcy (APE=11, 12, 13, 14);
- all higher education institutions classified into NACE Rev. 2 subclass 8542 – Tertiary education which as at the update date of BJS were legally active entities and conducting economic activities (APE=11);
- selected government and local government entities, such as the Chancellery of the Prime Minister, ministries, the National Centre for Research and Development, the National Science Centre, the National Atomic Energy Agency, marshal offices, voivodship labour offices;
- entities conducting scientific research or experimental development on a continuous or occasional basis as well as entities financing R&D performance by other units.

Purposeful selection of units to the survey file takes place on the basis of various types of information sources concerning R&D. Sources of selection of units are among others:

1. Data collected with the use of datasets (questionnaires):
 - PNT-01 – *Report on research and experimental development (R&D)* for years preceding the survey year – includes entities which indicated incurring intramural or extramural expenditures on R&D in this questionnaire in the previous years;
 - PNT-02 – *Questionnaire on innovations in industry*¹ for the year preceding the survey year – includes entities which in this questionnaire in the previous year indicated:
 - incurring intramural or extramural expenditures on R&D,
 - using tax credits or allowances for research and experimental development (R&D) or other innovation activities;
 - PNT-02/u – *Questionnaire on innovations in services*¹ for the year preceding the survey year – includes entities which in this questionnaire in the previous year indicated:
 - incurring intramural or extramural expenditures on R&D,
 - using tax credits or allowances for research and experimental development (R&D) or other innovation activities;
 - MN-01 – *Questionnaire on biotechnology research and experimental development* for the year preceding the survey year – includes entities which in this questionnaire in the previous year indicated incurring intramural or extramural expenditures on R&D in biotechnology;
 - MN-02 – *Questionnaire on biotechnology in business enterprises* for the year preceding the survey year – includes entities which in this questionnaire in the previous year indicated incurring intramural or extramural expenditures on R&D in biotechnology;
 - PNT-05 – *Questionnaire on nanotechnology research and experimental development* for the year preceding the survey year – includes entities which in this questionnaire in the previous year indicated incurring intramural or extramural expenditures on R&D in nanotechnology;
 - PNT-06 – *Questionnaire on nanotechnology in business enterprises* for the year preceding the survey year – includes entities which in this questionnaire in the previous year indicated incurring intramural or extramural expenditures on R&D in nanotechnology;

¹ Data on innovation from the 2019-2021 edition of the survey are collected as part of one dataset PNT-02 *Questionnaire on innovations*. In subsequent reporting periods, data on innovation will be obtained only for even years, according to the rounds of the European Community Innovation Survey (CIS).

- SP – *Annual enterprise survey* for the year preceding the survey year – includes entities which in this questionnaire in the previous year indicated incurring intramural or extramural expenditures on R&D;
- SP-3 – *Report on economic activities of enterprises* for the year preceding the survey year – includes entities which in this questionnaire in the previous years indicated incurring intramural or extramural expenditures on R&D;
- DNU-K – *Quarterly report on international trade in services* for 1st, 2nd or 3rd quarter of the year preceding the survey year - includes entities which in this questionnaire indicated acquiring or providing services related to R&D to non-residents.

2. Administrative sources:

- a list of entities with status of R&D centre published on the website of the Ministry of Development and Technology;
- a list of entities which signed an agreement with the National Centre for Research and Development to conduct R&D projects;
- a list of entities which received funds from the National Centre for Research and Development for R&D projects;
- a list of entities which received funds from the National Science Centre for R&D;
- a list of entities which received external funding from Regional Operational Programmes for a project whose title suggested that this entity may be engaged in R&D;
- a list of entities whom the Patent Office of the Republic of Poland granted patent for an invention during the survey year;
- a list of entities which during a fiscal year preceding the survey year used tax relief consisting in deducting costs incurred on R&D from basic taxable amount (so-called 'eligible costs'), included in costs of revenues;
- a list of entities which during a fiscal year preceding the survey year used IP Box relief (also known as Innovation Box or Patent Box) consisting in preferential taxation of income from intellectual property rights subject to legal protection (e.g. a patent, software copyright) and were created, developed or improved within R&D conducted by an entity.

Sources of selection of entities to the R&D survey file, apart from those mentioned above, include various type of information indicating that a given entity conducts or may conduct R&D, such as information from websites of entities, press articles and various rankings and lists.

Entities which during the survey implementation reported willingness to take part in the survey to the Statistical Office in Szczecin, as well as the ones about which the Statistical Office received information that they may be engaged in R&D, e.g. according to the information received from implemented surveys or administrative data, are also added to the survey file.

3. Data gathering tools/data sources

A basic tool for gathering data as part of the survey on research and experimental development is *Report on research and experimental development (R&D)* – questionnaire PNT-01. National economy entities covered by a reporting obligation are requested to submit data in an electronic form via the Reporting Portal of Statistics Poland which enables filling in a questionnaire on-line (Computer Assisted Web Interview method – CAWI). Logging in is possible via an account activated previously. The procedure of setting up an account is described in the Guide to electronic reporting available on the Reporting Portal website: <http://form.stat.gov.pl/formularze/przewodnik/psinfo.htm>.

Under exceptional circumstances it is possible to fill in and submit a questionnaire in a paper form. Moreover, a respondent can fulfil a reporting obligation by providing the necessary information to a contact person during a telephone interview.

Electronic questionnaires are a representation of a dataset PNT-01 determined in the PBSSP for a given year. An electronic questionnaire on the Reporting Portal enables logical and calculating control of data entered into a questionnaire as well as control of consistency between sections of a questionnaire. In order to decrease respondent burden mechanisms for logical linking of questions enabling automatic filling in of data on the basis of previous answers were implemented in a questionnaire. If errors, inconsistencies or providing wrong answers by an entity occur, a message indicating where data should be checked is displayed. Two types of errors can be distinguished, so-called absolute errors which do not allow accepting a questionnaire and discretionary errors which are informative only and do not block such possibility. In the case of absolute errors, data should be corrected or a contact person should be contacted in order to explain doubts and accept a questionnaire. Accepting data on the Reporting Portal means meeting a reporting obligation by an entity.

Depending on a type of question answers are given via:

- ticking a correct answer, e.g. in yes/no questions,
- providing a numeric value in a box in questions concerning, i.a. the value of expenditures or the number of personnel,
- selecting a correct answer from a list – from a so-called ‘glossary’.

The model questionnaire PNT-01 for the year 2021 constitutes an annex 1 to the following study and is also available on the website: <http://form.stat.gov.pl/formularze/2022/passive/PNT-01.pdf>.

After closing the survey edition on the Reporting Portal further works are conducted in the IT system of the survey.

4. Variables used in the survey

4.1. Main variables

The variables presented below are the ones most frequently appearing in publications and databases. National and foreign recipients of data also pay the greatest attention to them. Quality as well as quantity variables are collected via *Report on research and experimental development (R&D)*.

Quality variables concern, i.a.:

- conducting research and experimental development;
- financing performance of research and experimental development by other unit with internal funds;
- owning research equipment.

Quantity variables include:

- intramural R&D expenditures – this variable determines the amount of expenditures on research and experimental development performed within a unit during a reporting year;
- R&D personnel – this variable determines the number of personnel engaged in research and experimental development performed within a unit.

Mentioned above quantity variables are collected with the use of questionnaire PNT-01 by a number of breakdowns, which allows providing comprehensive information to data users.

A detailed list of variables is included in annex 2 and is available on the website:

<http://form.stat.gov.pl/formaty/zmienne-zestaw.php?rok-pbssp=2021&rok-p=2022&idzst=336>

4.2. Measures, indicators and calculating methods

The most frequently used research and experimental development indicators:

- R&D entities – this indicator is calculated on the basis of the number of entities conducting research and experimental development or financing performance of such activities by other entity during a reporting year. This indicator is presented as of 31 December. It is presented in publications and databases of Statistics Poland in natural numbers and:
 - per 100 thousand population – the number of population as of 30 June is used for calculation,
 - per 100 thousand of national economic entities – the number of national economic entities according to REGON register as of the first half of the year is used for calculation;
- Intramural R&D expenditures – are presented in statistics as aggregated values. The total amount of intramural R&D expenditures performed within the territory of a country during a reporting period is called gross domestic expenditure on R&D (GERD). Data in this regard are presented in publications and databases of Statistics Poland in thousand or million PLN and:
 - per capita – the number of population as of 30 June is used for calculation,
 - per 1 person employed (in headcount) in R&D – the number of internal R&D personnel is used for calculation,
 - as a relation to GDP (current prices) – the value of gross domestic product in current prices pursuant to ESA 2010 methodological standards is used for calculation;
- R&D personnel – all persons engaged directly in research and experimental development, whether employed by a statistical unit or external contributors fully integrated into the statistical unit's R&D activities, as well as those providing direct services for the R&D activities (such as R&D managers, administrators, technicians and clerks). The value of an indicator is determined as a sum of persons indicated in questionnaire PNT-01 as internal personnel and external personnel engaged in research and experimental development. Data on personnel are collected in headcount and full-time equivalent (FTE). Data on internal personnel are the most important information related to R&D personnel in Polish R&D statistics. This indicator is presented in publications and databases of Statistics Poland in headcount and FTE as well as:

- per 1000 economically active persons (of which researchers) – for calculating the relation the number of internal personnel in FTE (numerator) and as the base (denominator) number of economically active persons were adopted on the basis of the Labour Force Survey (LFS) — annual averages,
- per 1000 employed persons (of which researchers) – for calculating the relation the number of internal personnel in FTE (numerator) and as the base (denominator) number of employed persons were adopted on the basis of the Labour Force Survey (LFS) — annual averages,
- as the share of internal R&D personnel to economically active population – for calculating the relation the number of internal personnel in headcount (numerator) and as the base (denominator) number of economically active persons were adopted on the basis of the Labour Force Survey (LFS) — annual averages,
- as the share of internal R&D personnel to employed persons – for calculating the relation the number of internal personnel in headcount (numerator) and as the base (denominator) number of employed persons were adopted on the basis of the Labour Force Survey (LFS) — annual averages;
- Research equipment – sets of research, measurement and laboratory equipment of low level of versatility and high level of technical parameters (usually having higher precision class than standard equipment used for manufacturing or operational purposes). Data on gross value of research equipment are collected in thousand PLN to one decimal place and are presented in statistics as aggregated values. This indicator is presented in publications and databases of Statistics Poland in thousand and million PLN as of 31 December. Value of this indicator is also used to calculate the level of consumption of research equipment which determined the relation of amortisation of research equipment to gross value of research equipment fulfilling criteria for being included in fixed assets (in entity's books) as of 31 December.

4.3. Definition of key terms

Research and experimental development (R&D) – 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. An activity must fulfil five basic criteria to be considered R&D. The activity must be:

1. novel – aimed at new findings,
2. creative – based on original, not obvious concepts and hypotheses,
3. uncertain – uncertain about the final outcome or cost, including devoted time,
4. systematic – conducted in a planned way (the aim of the R&D project and the sources of funds must be defined),
5. transferable and/or reproducible – leading to results that could be reproduced.

R&D entities – entities conducting research and experimental development as main economic activity, implementing R&D projects alongside other main activity or financing performance of R&D by other entities.

Intramural R&D expenditures – all current expenditures and gross fixed capital expenditures for R&D performed within a statistical unit during a reporting period, whatever the source of funds.

Current R&D expenditures – labour costs on R&D personnel and other current costs used in R&D. Current expenditures include: labour costs, external R&D personnel remuneration, non-capital purchases of materials, supplies, equipment and services to support R&D, e.g. expenditures on water and fuel (including gas and electricity), books, journals, subscriptions to libraries, etc.

Labour costs – compensation of employed personnel, comprise annual wages and salaries and all associated costs or fringe benefits, such as bonus payments, stock options, holiday pay, contributions to pension funds. They include also other social security payments and payroll taxes. These costs include as well civil-law agreements concluded with internal personnel (with an employment contract with an entity). In the case of owners, costs of paid social security contributions in a part corresponding to engagement in R&D should be included in labour costs. Data cover only labour costs of persons employed whose FTE amounted to a minimum of 0.1 of total working time or whose contribution to R&D was very significant.

Remuneration of external personnel – includes employment costs, that is remuneration of persons employed only on the basis of a mandate contract or a contract for specific work (also participants of PhD and MA studies) as well as costs related to engagement of personnel leased from other institution and self-employed (B2B co-operation) and other payments for persons directly engaged in R&D projects.

Other current costs – comprise purchases of materials, supplies, equipment and services to support R&D performed by a statistical unit in a reporting year, used and consumed during one year. This category includes:

- costs for external services, i.a. services supporting an internal R&D project outsourced to other entities, e.g.
 - outsourcing by a pharmaceutical company to a laboratory doing blood tests of patients taking part in research on new drugs. For a principal – a pharmaceutical company – it is a cost related to implementation of an R&D project, while for a contractor – a laboratory – it is routine work conducted in accordance with accepted standards and methods,
 - developing by an enterprise a concept of new software, use of which would streamline processes taking place in an enterprise and then outsources software creation to a software development company. For a principal it would be an experimental development, while for a software company – conducting works without R&D characteristics;
- license fees for the use of intellectual property rights up to a year;
- costs for materials, non-durable articles, water and fuel (including gas and electricity);
- costs for books, journals, reference materials, and subscriptions to libraries and scientific societies, etc.;
- remuneration of R&D personnel whose FTE amounted to less than 0.1 of total working time or whose contribution to R&D was not very significant;
- costs for intermediary services including: external processing, transport, renovation, security, banking, postal, ICT, publishing or municipal services, etc;
- costs of business trips;
- property insurance.

Capital R&D expenditures – the annual gross amount paid for the acquisition of fixed assets that are used repeatedly or continuously in the performance of R&D for more than one year.

Internal R&D funds – the amount of money spent on R&D that originate within the control of and are used for R&D at the discretion of a reporting statistical unit. Internal R&D funds do not include R&D funds received from other statistical units explicitly for intramural R&D.

External R&D funds – the amount of money spent on R&D that originate outside the control of a reporting unit.

Extramural R&D expenditures – expenditures on R&D performed outside a statistical unit (extramural R&D). Funds on extramural R&D of this unit should include only internal funds (not from external sources) provided to an outside unit for R&D performance including both where there is an expected compensatory delivery of R&D (exchange or purchase) and where no compensatory delivery is expected (transfer or grant).

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. Basic research consists in an analysis of properties, structures and relationships with a view of formulating and testing hypotheses, theories or laws. It involves pure basic research and oriented basic research.

Applied research – original investigation undertaken in order to acquire new knowledge. It is, however, directed primarily towards a specific, practical aim or objective. It involves works aimed at the acquisition of new knowledge or skills, directed at developing new products, processes or services or for bringing about a significant improvement in them. Synonymous with application research defined in Article 4 on the Act of 20 July 2018, the Law on Higher Education and Science (Journal of Laws of 2022 item 574, as amended) as works aimed at the acquisition of new knowledge or skills, directed at developing new products, processes or services or for bringing about a significant improvement in them.

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.

Gross domestic expenditure on R&D (GERD) – total intramural expenditure on R&D performed in the national territory during a specific reporting period.

Business enterprise expenditure on R&D (BERD) – represents the component of GERD incurred by units belonging to the Business enterprise sector. It is the measure of intramural R&D expenditures within the Business enterprise sector during a specific reporting period.

Government expenditure on R&D (GOVERD) – represents the component of GERD incurred by units belonging to the Government sector. It is the measure of expenditures on intramural R&D within the Government sector during a specific reporting period.

Higher education expenditure on R&D (HERD) – represents the component of GERD incurred by units belonging to the Higher education sector. It is the measure of intramural R&D expenditures within the Higher education sector during a specific reporting period.

Private non-profit expenditure on R&D (PNPERD) – represents the component of GERD incurred by units belonging to the Private non-profit sector. It is the measure of intramural R&D expenditures within the Private non-profit sector during a specific reporting period.

Government budget allocations for R&D (GBARD) – encompass all spending allocations met from sources of government revenue foreseen within the budget, such as taxation. Spending allocations by extra-budgetary government entities are only within the scope to the extent that their funds are allocated through the budgetary process. Likewise, R&D financing by public corporations is outside the scope of GBARD statistics, as it is based on funds raised within the market and outside the budgetary process. Only in the exceptional case of budgetary provisions for R&D to be carried out or distributed from public corporations should this be counted as part of GBARD.

Institutional sectors in accordance with the Frascati Manual 2015 – sectors grouping statistical units on the basis of common features and characteristics. For the purpose of R&D statistics institutional sectors defined in the Frascati Manual 2015 developed by the OECD are singled out. Classification of institutional sectors used in the System of National Accounts constitutes a basis of this classification. A general outline of links between both types of institutional sectors is presented in table 1.

Table 1. General outline of links between institutional sectors used in the System of National Accounts and in R&D statistics (the Frascati Manual 2015, OECD)

Institutional sectors in the System of National Accounts	Sectors by the Frascati Manual (OECD)			
	business enterprise BE	government GOV	higher education HE	private non-profit PNP
Corporations (financial and non-financial)	the same entities as in the System of National Accounts (including public corporations), excluding higher education institutions in this sector		higher education institutions in the corporations sector	
General government		the same entities as in the System of National Accounts, excluding institutions of higher education sector	higher education institutions in the general government sector	
Households	enterprise-like self-employed (most likely captured as quasi corporations)			the same entities as in the System of National Accounts, except for the households enterprise-like self-employed
Non-profit institutions serving households (NPISH)			higher education institutions in the non-profit institutions sector	the same entities as in the System of National Accounts, excluding institutions of higher education sector

Both the OECD manual and the System of National Accounts divide national economic entities by institutional sectors. However, there are methodological difficulties in a simple indication of corresponding sectors in both classifications. Institutional sectors in the System of National Accounts cover non-financial corporations, financial corporations, general government, households, non-profit institutions serving households (NPISH), households and the rest of the world. The Frascati Manual 2015 includes the following sectors: business enterprise, government, higher education, private non-profit and the rest of the world.

The business enterprise sector (BES) – comprises:

- all resident corporations, including not only legally incorporated enterprises, regardless of the residence of their shareholders. This group includes all other types of quasi-corporations, i.e. units capable of generating a profit or other financial gain for their owners, recognised by law as separate legal entities from their owners, and set up for purposes of engaging in market production at prices that are economically significant;
- the unincorporated branches of non-resident enterprises are deemed to be residents because they are engaged in production on the economic territory on a long-term basis;
- all resident non-profit institutions (NPIs) that are market producers of goods or services or serve business.
- This sector comprises both private and public sector enterprises.

The government sector (GOV) – consists of the following groups of resident institutional units:

- all units of central (federal), regional (state) or local (municipal) government, including social security institutions, except those units that provide higher education services or fit the description of higher education institutions provided in the Frascati Manual 2015;
- all non-market NPIs that are controlled by government units that are not part of the Higher education sector.

This sector does not include public sector enterprises, even when all the equity of such enterprises is owned by government units. Public enterprises are included in the Business enterprise sector.

The higher education sector (HES) – comprises all universities, colleges of technology and other institutions providing formal tertiary education programmes, whatever their source of funding or legal status, and all research institutes, centres, experimental stations and clinics that have their R&D activities under the direct control or administration of higher education institutions.

The private non-profit sector (PNP) – comprises:

- all non-profit institutions serving households (NPISH), as defined in the SNA 2008, except those included in the Higher education sector;
- households and private individuals engaged or not engaged in market activities.

The rest of the world – comprises the following groups of national institutional units:

- all institutions and individuals without a location, place of production or premises within the economic territory on which or from which the unit engages and intends to continue engaging, either indefinitely or over a finite but long period of time, in economic activities and transactions on a significant scale;
- all international organisations and supranational entities, defined further below, including facilities and operations within the country's borders.

Research equipment – sets of research, measurement and laboratory equipment of low level of versatility and high level of technical parameters (usually having higher precision class than standard equipment used for manufacturing or operational purposes).

Gross value of research equipment – initial value of research equipment classified as fixed assets and used in R&D according to the purchase price or manufacturing costs included in the accounting records as of 31 December.

Amortisation of research equipment – the cumulative value of amortisation of research equipment classified as fixed assets and used for R&D, included in the accounting records as of 31 December.

Degree of research equipment consumption in research and experimental development – relation of amortisation of research equipment to gross value of research equipment.

R&D personnel – all persons engaged directly in R&D, whether employed by the statistical unit or external contributors fully integrated into the statistical unit's R&D activities, as well as those providing direct services for the R&D activities (such as R&D managers, administrators, technicians and clerical staff).

Internal R&D personnel (persons employed) – persons employed by the statistical unit who contribute to the unit's intramural R&D activities.

External R&D personnel (contributors) – are independent (self-employed) or dependent (employee) workers fully integrated into a statistical unit's R&D projects without formally being persons employed by the same R&D-performing statistical unit.

Researchers – professionals conducting research and improving or developing concepts, theories, models, techniques, instrumentation, software or operational methods. The tasks of researchers especially involve:

- conducting research, experiments, tests and analyses;
- developing concepts, theories, models, techniques, instrumentation, software and operational methods;
- gathering, processing, evaluating, analysing, and interpreting research data;
- evaluating the results of investigations and experiments, and making conclusions using different techniques and models;
- applying principles, techniques and processes to develop or improve practical applications;
- advising on designing, planning and organising the testing, construction;
- providing advice and support to governments, organisations and businesses on the application of research results;
- planning, directing and coordinating R&D conducted by institutions providing related services for other organisations;
- preparing scientific papers and reports.

Technicians and equivalent staff – persons participating in R&D by performing scientific and technical tasks involving the application of concepts, operational methods and the use of research equipment, normally under the supervision of researchers. Their tasks include:

- carrying out bibliographic searches and selecting relevant material from archives and libraries;
- preparing computer programs;
- carrying out experiments, tests and analyses;
- providing technical assistance and support in R&D, or testing prototypes;
- operating, maintaining and repairing research equipment;
- preparing materials and equipment for experiments, test and analyses;
- recording measurements, making calculations and preparing charts and graphs;
- collecting information using accepted scientific methods;
- assisting in analysing data, keeping records and preparing reports;
- carrying out statistical surveys and interviews.

Other supporting staff – persons with different skills and functions whose activities contribute directly to conducting intramural R&D but do not perform the function of researchers or technicians. These activities range from administrative and secretarial work to the provision or the management of materials and devices needed to run an R&D project. These R&D personnel typically perform supporting functions connected to R&D such as planning, information and financial support, legal and patent services, and assistance in assembling, adjusting, maintaining and repairing scientific equipment and instruments. Managers and administrators dealing mainly with financial and personnel matters and general administration, insofar as their activities are a direct service to R&D, are included as 'other supporting staff'.

Full-time equivalent (FTE) – a conversion unit defined as a ratio of working hours actually spent on R&D by particular employees during a reporting year to the total number of hours conventionally worked in the same position by an individual or by a group. One full-time equivalent (FTE) means one person-year devoted exclusively to R&D.

Classification of field of research and development (FORD) – developed by the OECD in the framework of the Frascati Manual and is used to classify R&D units and resources by fields of enquiry, namely, broad knowledge domains based primarily on the content of the R&D subject matter. Classification of fields of science and scientific disciplines as well as artistic disciplines prepared by the Ministry of Science and Higher Education is also used in Poland and it covers: humanities, engineering and technology, medical and health sciences, agricultural sciences, social sciences, natural sciences, theological sciences and the arts. In order to ensure international comparability of R&D data, the classification of field of research and development has been used in questionnaire PNT-01 in annex 1.

5. Organisation and management of the survey implementation

The author's unit carrying out research and development (R&D) survey is the Statistical Office in Szczecin. Employees of the Centre for Science, Technology, Innovation and Information Society Statistics, who are responsible for organisation of the survey implementation as well as compilation, analysis and presentation of results, make up a coordinating team. Its duties also include improving methodology of the survey and mainly adjusting it to the methodology included in *the Frascati Manual 2015: Guidelines for Collecting and Reporting Data on Research and Experimental Development*, OECD, 2015 (Polish version, Statistics Poland, 2018). In order to ensure international comparability of data gathered from the survey coordinators take part in meetings organised by Eurostat and OECD as well as co-operate with these institutions during development of additional guidelines related to the survey methodology.

Main tasks of coordinators include:

- preparing assumptions for selecting units for the survey;
- preparing the survey schedule;
- verification of a survey file;
- preparing a model questionnaire for the survey;
- preparing assumptions for logical and accounting control of the questionnaire;
- preparing mock-ups of result tables together with algorithms for their calculation;
- division of tasks related to the implementation of the survey;
- supervision over the course of the survey (i.a. on-going clarification of doubts reported by statisticians or reporting units);
- controlling correctness of a dataset;
- analysing result tables;
- preparation for approval of a dataset;
- preparing and transferring data for publications and databases of Statistics Poland;
- preparing data for Eurostat;
- on-going monitoring of issues related to research and experimental development;
- analysis of government and strategic documents.

Survey coordinators co-operate with a team of programmers from the Centre for Data Engineering in the Statistical Office in Szczecin. The Centre supports processing of data collected from respondents and contributes to their effective verification and analysis by providing, i.a. reports controlling correctness of data. The tasks of the team from the Centre for Data Engineering include, i.a. developing IT system of the survey and creating new functionalities which can streamline everyday work of statisticians and coordinators. Additionally, the Centre is also responsible for operating an application PNT units facilitating comprehensive compilation of all information regarding a given reporting unit held by the Office.

Statisticians, who are employees of the Survey Implementation Department at the Statistical Office in Szczecin, are responsible for direct contact with respondents. Their tasks also include registering paper questionnaires in IT system of the survey as well as sending paper based correspondence, that is sending reminders about a reporting obligation.

Implementation of the survey requires co-operation with other units of official statistics:

- the Statistical Office in Łódź – responsible for preparing graphic layout of questionnaire;
- the Statistical Computing Centre – responsible for developing a survey application on the Reporting Portal, supporting functionalities of the Reporting Portal (sending reminders to its users, e.g. about an imposed reporting obligation, impending date of fulfilling a reporting obligation);
- the National Accounts Department of Statistics Poland – responsible for classifying entities to institutional sectors according to the National Accounts System;
- the Statistical Office in Warsaw – exchange of information regarding engagement of entities in R&D.

The survey is implemented in accordance with provisions of the PBSSP and adhering to ethics of a statistician, especially the principle of maintaining statistical confidentiality and protecting collected data – pursuant to the Act of 29 June 1995 on Official Statistics (Journal of Laws of 2022 item 459, as amended).

6. Presentation of survey results

6.1. Forms of publishing results

Results of the survey on research and experimental development are presented in the first place in news release 'Research and experimental development in Poland' published annually in October. In December a publication under the same title is published presenting a wide scope of data regarding the surveyed phenomenon. Research and experimental development belongs to the thematic area of science and technology. The publication dedicated for the most important survey results concerning this area is 'Science and technology' published annually in March of the year following completing the survey edition.

All above mentioned forms of publishing results are available in an electronic version on the website of Statistics Poland (<https://stat.gov.pl/obszary-tematyczne/nauka-i-technika-spoleczenstwo-informacyjne/nauka-i-technika/>). Additionally, publications are also available in a paper form.

Results of the survey on research and experimental development are also presented in databases:

1. Statistics Poland:
 - Macroeconomic Data Bank (BDM) – data category: annual, area: Research and experimental development, innovation activity of enterprises and information society (<https://bdm.stat.gov.pl/>),
 - Local Data Bank (BDL) – data by areas, category: Science and technology. Information Society, group:
 - Research and experimental development (<https://bdl.stat.gov.pl/BDL/start>),
 - Knowledge Databases (DBW) – Multi-Domain Statistics: Science, technology and information society, thematic data set: Expenditures on R&D (<http://swaid.stat.gov.pl/SitePages/StronaGlownaDBW.aspx>),
 - Strateg – thematic area: Research and innovation (<https://strateg.stat.gov.pl/#/obszary-tematyczne>);
2. Eurostat – database by themes: Science, technology, digital society; Science and technology; Research and development (<https://ec.europa.eu/eurostat/web/main/data/database?msckid=dc9fa72ac61611ec902015899c65d31e>);
3. OECD – topic aspects: Research and development (R&D) (<https://data.oecd.org/innovation-and-technology.htm>).

Data regarding research and experimental development are also published in the following yearbooks:

- Concise Statistical Yearbook of Poland;
- Statistical Yearbook of the Republic of Poland;
- Statistical Yearbook of Voivodships;
- Statistical Yearbook of Industry.

Yearbooks are available in an electronic form on the website: <https://stat.gov.pl/obszary-tematyczne/roczniki-statystyczne/> as well as in a paper form.

Moreover, every Statistical Office uses data on R&D for preparing Statistical Yearbook of a given voivodship as well as Report on the social and economic situation of a voivodship. Publications are available on websites of Statistical Offices in the section: Publications, in the thematic area: Statistical yearbooks and Other publications, respectively.

Results of R&D survey are additionally presented in a leaflet 'Poland in figures' published on website of Statistics Poland in the thematic area: Other publications; Other aggregated publications (<https://stat.gov.pl/obszary-tematyczne/inne-opracowania/inne-opracowania-zbiorcze/>).

6.2. Breakdowns of presented data

Data on research and experimental development are presented by a number of breakdowns:

- territorial – this breakdown classifies data by: voivodships, macroregions (NUTS 1), regions (NUTS 2) and subregions (NUTS 3);
- sectors of performance – this classification results from the methodology of the Frascati Manual 2015 and divides entities engaged in R&D into one of four sectors:
 - business enterprise sector (BES),
 - government sector (GOV),

- higher education sector (HES),
- private non-profit sector (PNP);
- types of entities – this breakdown is described in more detail in the first chapter and divides entities into:
 - dedicated research entities which include:
 - institutes,
 - higher education institutions,
 - others,
 - economic entities;
- size classes – this breakdown is based on the number of persons employed in an entity as of 31 December and divides entities by the following classes:
 - up to 9 persons employed,
 - 10–49 persons employed,
 - 50–249 persons employed,
 - over 249 persons employed:
 - 250-499 persons employed,
 - at least 500 persons employed;
- types of main activity according to NACE Rev. 2 – this breakdown varies substantially depending on the form of publishing results.

Apart from breakdowns presented above, data are also presented in breakdowns depending on the type of analysed variable.

In the case of intramural R&D expenditures, the following breakdowns are used additionally:

- types of costs – this classification determines the type of incurred expenditures during a reporting year and divides them into:
 - current expenditures:
 - labour costs,
 - remuneration of external personnel,
 - other current expenditures,
 - capital expenditures:
 - land and buildings – land, buildings and structures, land and water engineering constructions (groups 0-2 of the Classification of Fixed Assets in force),
 - machinery and equipment – machinery, technical equipment, means of transport and other tools, instruments, movable properties and equipment (groups 3-8 of the Classification of Fixed Assets in force),
 - of which research equipment,
 - computer software – long-term licences or the acquisition of separately identifiable computer software, including programme descriptions and supporting materials for both systems and applications software,
 - other intellectual property products – purchased patents, long-term licences (excluding software licences) or other intangible assets used in R&D;
- origin of funds – this breakdown presents which funds were used to finance expenditures and includes:
 - internal funds,
 - external funds received from:
 - national entities,
 - of which funds from government and local government institutions,
 - foreign entities, including:
 - the European Commission,
 - business enterprises;

- funding sectors (funding sources) – this classification complies with institutional sector classification according to the Frascati Manual 2015. Internal funds of reporting entities are included into funds of a sector to which an entity belongs. The following sectors can be distinguished:
 - business enterprise sector (BES),
 - government sector (GOV),
 - higher education sector (HES),
 - private non-profit sector (PNP),
 - rest of the world;
- types of flow of funds – this breakdown results from the methodology of the Frascati Manual 2015 and distinguished the following items:
 - for transferring results of R&D (e.g. sale of R&D services or co-operation, that is an active participation in joint projects with other business enterprises or institutions),
 - as subvention, subsidy, grant, donation, etc., that is without the necessity to transfer results of R&D;
- types of R&D – this classification complies with the methodology of the Frascati Manual and divides expenditures according to conducted works:
 - basic research,
 - applied research,
 - experimental development;
- fields of research and experimental development (FORD) – this classification complies with the methodology of the Frascati Manual 2015, its detailed division is presented in annex 1 to *Report on research and experimental development (R&D)* which constitutes annex 1 to the following study;
- types of activity to which R&D product was dedicated – this classification complies with the methodology of the Frascati Manual 2015, its detailed division is presented in annex 2 to *Report on research and experimental development (R&D)* which constitutes annex 1 to the following study;
- socio-economic objectives – this classification complies with the methodology of the Frascati Manual 2015, its detailed division is presented in annex 3 to *Report on research and experimental development (R&D)* which constitutes annex 1 to the following study.

Data on personnel in R&D are divided by:

- main groups – this breakdown complies with the methodology of the Frascati Manual 2015 and includes division of personnel into:
 - internal personnel,
 - external personnel;
- sex;
- educational level – this breakdown included the following items:
 - persons with tertiary education:
 - persons with at least scientific degree of doctor:
 - persons with title of professor,
 - persons with scientific degree of habilitated doctor,
 - persons with scientific degree of doctor,
 - other persons with tertiary education,
 - persons with other educational level;
- functions – this breakdown complies with the methodology of the Frascati Manual 2015, it determines functions of individual persons carried out in R&D personnel and includes the following categories:
 - researchers,
 - technicians and equivalent staff,
 - other supporting staff.

In R&D personnel statistics additional breakdowns are used for division of data regarding researchers and include:

- citizenship (nationality):
 - Polish,
 - foreigners:
 - from Europe,
 - from North America,
 - from South America,
 - from Asia,
 - from Africa,
 - other foreigners;
- age groups:
 - under 25 years,
 - 25-34 years,
 - 35-44 years,
 - 45-54 years,
 - 55-64 years,
 - 65 years and more;
- educational level;
- seniority level:
 - the highest grade, e.g. director of research, professor,
 - high grade, e.g. main or senior specialist, principal investigator, senior researcher,
 - medium grade, e.g. specialist, investigator, assistant professor, post-doctoral fellow,
 - the lowest grade, e.g. junior researcher, junior specialist, Ph.D. student.

Different breakdowns apply to funds from government budget allocations for research and experimental development which are classified in accordance with the Frascati Manual 2015 by:

- funding mode – the following items can be distinguished within this breakdown:
 - project funding, e.g. grants/subsidies awarded under competitions. An entity providing government budget funds decides which R&D projects will receive funding,
 - institutional funding – providing funds to entities conducting of financing R&D, e.g. subventions provided to scientific institutes of the Polish Academy of Sciences, research institutes, institutes of the Łukasiewicz Research Network or higher education institutions for conducting R&D. An entity receiving government budget funds decides independently which R&D projects it will conduct;
- socio-economic objectives – this classification complies with items presented in annex 3 to *Report on research and experimental development (R&D)* which constitutes annex 1 to the following study.

7. Survey quality assessment

An aim of the survey is providing information concerning research and experimental development. The main recipients of data are government and local government institutions, the National Bank of Poland, higher education and science institutions (researchers and university teachers, students and PhD students), media as well as Eurostat and OECD.

Efforts are being made to provide results of the highest quality. Due to extensive logical and calculating assumptions, errors and discrepancies in data are avoided. Responses given on a questionnaire are thoroughly analysed and verified against information provided in different questionnaires to the extent concerning R&D, data held by the Office regarding conducted R&D projects and tax reliefs (R&D and IP Box tax relief) as well as data available on the Internet regarding activities of R&D entities. Special emphasis is placed on entities receiving funding for implementation of R&D projects and using R&D tax relief. If questions or doubts related to correct filling in of a questionnaire arise, reporting units may reach out to a contact person for substantial issues who helps filling in a questionnaire correctly and explains methodological issues. Contact details of employees responsible for contact with reporting entities are available on the Reporting Portal in PNT-01 questionnaire and on the website of Statistics Poland (http://form.stat.gov.pl/formularze/przewodnik/kontakt/spr/spr_szczecin_PNT-01.pdf?v=220119).

The survey is implemented in accordance with the schedule and its results are published in accordance with editorial title-plan. Completeness of the survey for the three last editions of the survey (for the years 2018, 2019, 2020) ranged, depending on a questionnaire, from 82% to 100%. In this period PNT-01/a and PNT-01/s questionnaires had the highest completeness. In order to improve completeness and timeliness of surveys automatic reminders are sent to entities from the Reporting Portal as well as e-mails reminding about a reporting obligation. Additionally, entities are reminded by telephone and in the case of lack of contact with an entity, correspondence is sent by post reminding about an unmet reporting obligation.

Imputation of data is performed for units which did not submit *Report on research and experimental development (R&D)*. Imputation covers only entities about which the Statistical Office holds information confirming that they actually conducted R&D or funded performance of R&D by other entity during the reporting year. The following information is used to impute data on R&D expenditures:

- administrative data on R&D tax relief covering tax deductible expenses incurred on R&D;
- data on R&D expenditures included in questionnaire PNT-02;
- data on R&D expenditures included in questionnaire PNT-02/u.

Burden on respondents taking part in the survey is also analysed each year. Two questions placed at the end of a questionnaire are used for this purpose – a reporting entity estimates time dedicated to filling in a questionnaire as well as time dedicated to collecting information necessary to fill in a questionnaire. In order to reduce respondent burden, mechanisms of automatic filling in data in logically related questions (currently, there are over 60 such assumptions) are used in an electronic questionnaire, for example in cases when:

- the number of persons employed in R&D equals the number of women, then rows concerning women are filled in automatically on the basis of answers concerning persons employed;
- all persons engaged in R&D have the function of a researcher, then all data regarding level of education of researchers are filled in automatically on the basis of answers concerning level of education of persons engaged in R&D.

Presented survey results are comparable over time with previously published data regarding this scope and all possible methodological differences in presenting information are indicated when data are compared. Data can be also analysed in spatial terms on a national as well as international level due to guidelines resulting from the Frascati Manual 2015 implemented in the survey.

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Annexes

- Annex 1. PNT-01 – Report on research and experimental development (R&D) for 2021 r.
- Annex 2. Detailed list of variables collected within the survey on research and experimental development