

INSTITUTO NACIONAL DE ESTADISTICA



Community Innovation Survey in Enterprises (CIS)

Year 2022

Methodology

Index

I	Introduction	3
1	Background	3
2	New feature starting in the 2021 edition: new practical implementation of the “enterprise” statistical unit	4
3	Analysis of the innovation process through surveys	6
4	Problems relating to the survey methodology	10
5	The European Innovation Scoreboard	11
II	Methodology	12
1	Objectives	12
2	Scope	12
3	Statistical unit and reporting unit	13
4	Variables and their definition	16
5	Sample design	25
6	Information collection	33
7	Processing of results	33
8	Tabulation of results	36

I Introduction

Currently, the innovation process is considered to be the main driving force of economic growth in countries with advanced economies, as well as being an important factor that contributes to their social and cultural evolution. Over the past few years, innovation and technological change have become increasingly important themes in economic analysis and in political decision-making in developed countries. These are aspects in which there are serious information problems, especially due to the absence of reliable systematic data.

1 Background

Within this context, an important element of the work recently carried out by the Organisation for Economic Co-operation and Development (OECD) has been the development and improvement of useful indicators to integrate technological issues into the analysis of economic policy. There have also been several initiatives, both national and international, regarding innovation. To coordinate all these activities, the OECD presented a preliminary version of a method for the collection and interpretation of data on technological innovation (Innovation Manual) to the meeting of the Working Party of National Experts on Science & Technology Indicators in Paris on 10 December 1990, which was revised throughout 1991. In 1992, the OECD Proposed Guidelines for Collecting and Interpreting Technological Innovation Data, better known as the Oslo Manual, was publicly released. In 1997, the second edition was published. The European Statistical Office (EUROSTAT) then began to carry out various studies aimed at collecting data on innovation in EU Member States in collaboration with the OECD. For this reason, EUROSTAT submitted a draft Council decision on R&D and innovation statistics, which was approved in January 1994. In 1993, these studies culminated in a draft Community Innovation Survey (CIS), with 1992 as the reference year, using a harmonised questionnaire to collect data on the innovation of enterprises in the European Community. A questionnaire was sent to approximately 90,000 enterprises in the 12 EU countries. The methodology used was based on the OECD's Oslo Manual. In 1997 and 2001, the collection of questionnaires for the second and third CIS began, referring to 1996 and 2000 respectively.

Meanwhile, between 1985 and 1986 in Spain, the *Círculo de Empresarios* [Circle of Entrepreneurs] carried out work aimed at around 700 enterprises, obtaining results on the characteristics of innovative enterprises, the nature and intensity of their innovative effort, the results of this effort and the way in which enterprises perceive the innovation process. Subsequently, in 1994, another study of a similar nature was carried out.

For its part, the National Statistics Institute (INE) planned to carry out an Community Innovation Survey for enterprises following the recommendations of the OECD's Oslo Manual. Information began to be collected for this in September 1992. This survey was aimed at around 20,000 manufacturing enterprises with 20 or more employees. However, budgetary problems hindered the recruitment of interviewers responsible for information collection. For this reason, the INE was forced to cancel the survey when the majority of questionnaires had already been sent to enterprises. The INE informed enterprises of this in October 1992, indicating that the information received and voluntarily submitted to the INE would be analysed and used as a pilot study. In this pilot study, which was not a priori designed as such, it was possible to analyse information provided by around 2,400 enterprises. In addition, the use of data in this pilot study was included within the draft CIS, despite the fact that a completely harmonised

questionnaire was not used. The information obtained in 1992 cannot be considered to be representative of the Spanish reality as it was not obtained using sampling techniques, nor was the sample chosen, but rather came from the enterprises that voluntarily responded.

Given that the methodological work and harmonisation of definitions and classifications was at a very advanced stage, it was considered that, at the international level, there was a stable framework for the development of internationally comparable data on innovation. This, coupled with the undeniable utility of obtaining basic information on innovation in Spanish enterprises, led the National Statistics Institute to resume the Community Innovation Survey in 1994. This study allowed indicators to be obtained that brought us closer to determining the structure and effects of the innovation process, as well as providing a framework for future research. The continuity of the innovation survey is reflected in the successive subsequent studies referring to 1996, 1998, 2000, 2002 and 2003. Since 2002, it has been carried out annually, in coordination with the R&D Activities Statistics.

Over the time, the Oslo Manual has evolved and modified the definition of innovative companies. With the creation of the Oslo Manual in 2005, the definition of an innovative company is expanded. An innovative company is the one that carries out product, process, marketing or organisational innovation. This definition of an innovative company has been further modified in version 4 of the OECD Oslo Manual published in 2018. In this last version, a company will be innovative if it carries out product and/or business process innovations. These latest innovations encompass process, marketing and organisational innovations of the previous manual, except for product design which is added to product innovation.

Until 2020, the Statistics on R+D activities in the Enterprises sector were coordinated on an annual basis with the Business Innovation Survey. Due to the change in the frequency of the Business Innovation Survey, which became biennial as of the reference year, 2020, the Statistics on R+D activities in the Enterprises sector will only coordinate with the Business Innovation Survey for even-numbered years and will be collected independently in odd-numbered years.

In the 2022 edition, as an application of the European regulation 2019/2152, the statistical unit of the Innovation Unit is modified, becoming the Statistical Enterprise as defined in the European Union Regulation 696/93, relative to the observation statistics units and analysis of the production system.

2 New feature starting in the 2021 edition: new practical implementation of the “enterprise” statistical unit

The statistical definition of the “enterprise” statistical unit is established by a regulation of the European Union (696/93) that defines it as the “smallest combination of legal units that constitutes an organized unit producing goods or services and that enjoys a certain degree of decision-making autonomy, particularly when using the resources available to it. The enterprise exercises one or more activities in several places. An enterprise can correspond to a single legal unit”.

Until the 2020 Innovation Survey, the INE, like most European Union statistical offices, would identify the enterprise statistical unit with the Legal Unit (in the Spanish case,

through the Tax ID number or NIF) for operational purposes. Thus, **for statistical purposes, each Legal Unit formed one enterprise.**

However, the progressive complexity of the way in which **business groups** operate internally nowadays caused the European Statistical System (ESS) to search for an improvement as regards the way in which the activity of these groups is reflected in the official statistics on enterprises. In fact, Legal Units that belong to business groups sometimes sell their products or provide their services exclusively or mainly within the group, without being market-oriented or having decision-making autonomy over the entire production process.

For all these reasons, in accordance with the European Statistical System (SEE), **based on data with reference 2022, the Innovation Survey establishes a new practical application of the statistical concept of Enterprise**, by which an “enterprise” can be:

- An independent Legal Unit that is not part of the company group, meaning that it should have decision-making autonomy.
- A company group formed for one or more Legal Units.
- A subset of one or more Legal Units of a company group.

This change in the treatment of enterprises, which has also been implemented in the Statistical Use of the Central Enterprise Register (SUCER), was announced by the INE in a Press Release dated 17 December 2019:

https://www.ine.es/prensa/nueva_definicion_empresa.pdf

It should be noted that most of the Enterprises are independent Legal Units, so the Enterprise=Legal Unit identity remains valid. The change will only affect Legal Units that are part of company groups (3.1% of the total). However, the latter units are quite important in economic and employment terms, meaning that the Innovation Survey data series prepared under the new Statistical Enterprise approach is not strictly comparable to that of previous years, prepared under the traditional criteria based on separate Legal Units.

In order to elaborate the Innovation Survey under this new “Statistical Enterprise” approach, a method was developed based on the following steps, each of which will be described in greater detail in the corresponding sections of this methodological document.

1. Delineation of the Statistical Enterprises that operate in company groups using the so-called *Profiling* methodology and typification of the Legal Units comprising them (see details in section 3.3 of this document)
2. Adjustment of the sample design and the information collection phase (see details in sections 5 and 6 of this document).
3. Aggregation of the Legal Units that make up each sample Statistical Enterprise and study of the combinations of typologies of said Legal Units (see details in section 7.2.1).
4. Consolidation of sample Statistical Enterprises that consist of more than one Legal Unit and that have relationships between them. For these enterprises, flows between their Legal Units are identified to proceed with the cancellation of intra-company transactions (see details in section 7.2.2).

5. Construction of complete statistics, based on Statistical Enterprises, whether they are independent Legal Units or enterprise group Companies (see details in section 7.2.3).

The essential idea is that if the Legal Units of a Statistical Enterprise exclusively or primarily serve other Legal Units of the same Enterprise (for example, selling products under a vertical integration of the production process or providing services as an auxiliary relationship), these servile Legal Units must be combined with the others which they support to form the authentic “Enterprise” statistical unit. As such, the corresponding variables must be combined and consolidated. Legal Units that are not part of groups continue to be considered Enterprises in and of themselves.

The implementation strategy for the statistical unit “enterprise” in the Innovation Survey in terms of sample design and information collection is based on three points:

- **The basic information unit is still the Legal Unit.**

This point is based on the fact that it is at this level that it is easier for the informant to obtain the required information on the Innovation activities. While it does not provide all the information necessary to generate the Innovation Survey, this information is the main basis for it.

The information at the Statistical Enterprise level will be derived from a process of grouping and consolidating information from the Legal Units that comprise it.

- **The statistical burden on informants must be neutral.**

That is, in no case should the statistical burden on enterprises be increased.

- In view of the needs of the National Statistical Plan (PEN), it must be possible to provide information both from the perspective of the Legal Units and the Enterprises as a statistical unit.

It must be considered that there are PEN operations, such as those related to National Accounts, which require information at a level other than that of the Statistical Enterprise, and therefore the procedure established should allow for these estimates to be obtained.

This new approach to Business Statistics has been implemented in the Innovation Survey for the 2022 period and will continue in subsequent years. Since the statistical results of the Innovation Survey and its distribution by activities and enterprise size are affected by the change, both data from the traditional approach (based on Legal Units) and the new approach (based on Statistical Enterprises) **are disseminated for the 2022 reference year**, so that users of these statistics are able to compare them.

3 Analysis of the innovation process through surveys

In order to have a deeper understanding of the innovation process, resolve some issues that remain unsolved even with available information and eliminate the data gaps necessary for an adequate scientific-technological policy, it is necessary to become acquainted with the structure of the innovation process and the factors that cause the process to speed up or slow down.

In addition, it would be desirable to be able to show the relations between the innovation process and three other fields:

- a) The enterprise's strategy and plans.
- b) The factors that influence its ability to innovate and its performance (including the actions of the Public Administrations).
- c) The results of innovation and the enterprise's profitability.

Therefore, five areas of study are used, which are described below.

Objectives of innovative enterprises

An enterprise's strategy can be considered to be a set of commercial objectives that it intends to achieve through various combinations of the innovative activities described above. The enterprise can decide if it wants to:

- a) Try to develop entirely new products that will open up new markets.
- b) Try to imitate the leaders regarding innovation.
- c) Try to adapt technologies developed outside of the enterprise to fulfil the enterprise's needs.
- d) Strive to progressively develop existing techniques.
- e) Change the production methods for existing products.

With the aim of:

- Replacing products that have been discontinued.
- Extending the range of products.
- Maintaining a market share.
- Opening up new markets.
- Improving flexibility of production.
- Lowering production costs.
- Improving working conditions.
- Reducing damage to the environment.

These strategies may differ depending on the branch of activity and, within each branch, depending on the enterprise. Given that these results are of some interest regarding possible actions, it would be useful to include a question on this topic.

The structure of the innovation process

An analysis of innovation could begin with R&D because, despite the abundance of available data, little is known about the activities and organisation of R&D within enterprises.

Thus, it should be determined whether enterprises' R&D activities are permanent or temporary and whether those that do not do R&D have a systematic R&D plan in place for the future or if they only expect to carry out R&D activities in the coming years.

Information should also be obtained on the existence of official R&D organisations (department, laboratory, centre...) within enterprises and on the percentage of total expenditure on R&D within enterprises. Questions could also be asked about the

distribution of R&D between enterprises' different research units (R&D, design, production, marketing departments, etc.).

In addition, it is clearly desirable for the innovation survey to include a measurement of R&D. However, it is essential to supplement these data with a description of the funds contributed to the innovation process for innovative activities other than R&D in order to determine the relative weight enterprises give to the two types of activities, as well as their distribution by branch of activity and within each branch. A better knowledge of this distribution and its variation by branch of activity would be very useful in determining an innovation policy.

The action of public authorities regarding industrial innovation

As R&D financed by public funds represents, as a general rule, a significant percentage of total expenditure on R&D in OECD countries, it is necessary to have a more precise idea of how this affects enterprises. However, in addition to R&D there are fields of governmental action that also encourage or hinder innovative activity, such as:

- The education and training of specialised personnel.
- Fiscal policy and accounting regulations.
- Industrial regulations (understood to be regulations concerning the environment, hygiene standards, quality control, standardisation...)
- The legal framework applicable to intellectual property rights (and therefore to issues relating to patents and their use and copyrights).
- Capital market operations.

These elements of public authorities' activity can be studied through questions relating to the degree of importance of certain obstacles to innovation.

It would also be interesting to study business innovations that have utilised the results of basic research carried out by universities or public research organisations.

Origin of innovative ideas and obstacles to innovation

The ultimate objective of research in this area would be to establish a relation between enterprises' technological strategies on the one hand and the origin of their innovative ideas and the obstacles that they face, on the other.

The origin of an innovation project is usually an innovative idea that may come from a variety of sources external or internal to the enterprise. Once the project has been implemented, various factors contribute to its success. These can also be internal or external to the enterprise.

The majority of enterprises have numerous potential sources of technical information and innovative ideas available to them, but the value of these sources varies according to the technological means available to them and the strategy that has been adopted.

Obstacles to innovation are very significant in the activity of public authorities, as much of this activity is aimed at overcoming these. These can be economic obstacles or obstacles relating to the enterprise's capacity for innovation.

Outcomes and effects of innovation

One of the fundamental objectives of any innovation survey is to determine the results of innovation. The problem is defining what are considered to be results of innovation activities or, more concisely, innovations. In general, and although they will be defined in more detail below, various types of change have been differentiated:

- Total innovations of products, which relate to an entirely new product.
- Incremental innovations of products, which consist of marginal improvements or of improvements of a product's components or subsystems.
- Process innovations, which consist of the adoption of new or significantly improved production methods.

Innovation implies novelty, but this novelty may be within the enterprise or at the national or global level. This distinction has different effects depending on whether these are considered from the point of view of the enterprise's performance, national competition or the global rate of technical progress.

The most simple indicator, which approximately describes the significance of innovation, is the number of enterprises that have introduced innovations in products, processes or both in relation to the total number of enterprises in the different branches of activity.

Although innovations are impossible to compare from one enterprise to another, it is possible to use the definitions of innovation to determine the number and type of innovations in an enterprise or, even more interestingly, the number of new products introduced into the market and the proportion of sales and exports that are due to these new products.

On the other hand, the number of innovations is difficult to interpret. This figure varies considerably from one branch to another and within each branch of activity. One enterprise's R&D activities may only produce one innovation in two years, whilst another enterprise may put many new products onto the market each year.

Therefore, the number of innovations will not be a significant indicator if it does not relate to the total number of products or processes marketed or used, respectively, in the enterprise studied.

From the point of view of political action, indicators of the consequences of the innovation process are perhaps the most interesting results of an innovation survey.

CONCLUSION

Including all of the aforementioned questions in an innovation survey will provide a better understanding of the innovation process. The answers to these questions would resolve some of the problems to which a satisfactory solution has not yet been found and would cover data gaps that need to be filled for successful decision-making by public authorities.

However, in practice it is very difficult to include all the indicators noted and any other indicators that may be necessary in the future in one survey, as the operation's cost would be too high. In addition, an excessively long questionnaire may reduce enterprises' response rate.

The Innovation Survey, as it has been planned, is understood to be a survey framework that, along with some basic indicators such as the proposed list that would allow the necessary time series for a dynamic analysis of innovation to be obtained, can include more detailed specific studies on subjects that relate, or that may relate in the future, to innovation (e.g. research on patents, use of technology in manufacturing, technological payments and revenues...).

Since 2002 the Innovation Survey has been characterised by its coordination with the R&D Statistics for the business sector. This coordination has taken place at two levels: the first relates to the sample design, which takes into account both the enterprises that develop R&D activities a priori, analysed thoroughly, and those that are not known to do R&D, which are analysed using samples; the second relates to the use of a single, appropriately organised questionnaire that allows questions relating to both studies to be included.

4 Problems relating to the survey methodology

Choice of survey method

The methods used by the OECD countries for this type of study can be classified into two groups:

1. Those that begin by creating a list of successful and unsuccessful innovations, frequently set out in expert evaluations. Once the list has been created, various related factors are explored by surveying those enterprises that introduced these innovations.
2. Those that are not interested in a group of innovations but rather in the innovative attitudes and activities of the set of enterprises. In this case, there is interest in exploring the factors that influence the enterprise's behaviour in this field (strategies, incentives and obstacles to innovation), the field of the different innovative activities and, above all, getting an idea of the results and the effects of innovation. These surveys are representative of the whole economy meaning that comparisons between branches of activity can be made.

This second method, which lends itself better to international standardisation, has been chosen as the basis of the OECD's innovation manual and is therefore the method used in this study.

Problems related to data collection

The method used to carry out this type of study is surveying via post, via website or interview. Most innovation surveys carried out in OECD countries to date have used the method of surveying via post or website. However, taking the complexity of the concept of innovation into account, experience has shown that the interview method is preferable as it produces more reliable and coherent results. The disadvantage is that it is very expensive.

Therefore, a combination of all methods has been chosen for this study as the optimal solution, although, to reduce costs, the use of telephone interviews rather than interviews in person has been encouraged.

Frequency of the survey

Enterprises' innovation activities seem to be continuously progressing. Continuous time series are indispensable for a dynamic analysis of innovation.

Starting with the 2020 reference data, this will be done on a biennial basis as recommended by the OECD and Eurostat, with odd-numbered years being collected.

5 The European Innovation Scoreboard

The European Innovation Scoreboard (EIS) is a benchmarking exercise prepared by the European Commission's Directorate-General for Research, which provides a summary of the results obtained in the European Union regarding innovation through data on a series of indicators that relate to the innovation process. It was developed as a result of the objectives set at the Lisbon European Council in 2000, and has remained within the strategy developed by the European Commission to promote economic growth and job creation.

The EIS annually provides comparative results concerning innovation, both at a national level for different European Union countries and at the international level for other countries within a broader territorial scope. This comparative analysis exercise is based on a series of internationally comparable indicators, which cover various aspects of the innovation process. A series of specific works based on the EIS is published annually, which complements it. Amongst others, this includes: The Regional Innovation Scoreboard (RIS), the Global Innovation Scoreboard, sectoral analyses and updated methodologies.

The EIS is based on a new methodology, implemented for the first time in 2008, that gives a greater weight to the services sector, non-technological innovation and the results obtained from innovation. It consists of 29 indicators that have been designed to evaluate:

- conditions that are conducive to the development of innovation (human resources, finance and support)
- innovation activities in enterprises (investments, business links and initiative, and results obtained, such as patents)
- productivity (innovations and economic impact)

The EIS includes data from 33 European countries, including the 27 EU Member States. A Summary Innovation Index (SII) is prepared for each of the countries, obtained from the 29 indicators, which allows European countries to be ranked.

II Methodology

1 Objectives

This study's main objective is to try and offer direct information on the innovation process in enterprises, preparing indicators that allow us to identify the different aspects of this process (economic impact, innovative activities, cost...).

As well as providing rich and varied information on the innovation process, this large-scale study may serve as the base framework for various specific studies on other aspects related to science and technology.

Finally, the use of a methodology that is widely accepted on an international level will help us achieve the objective of international comparability of the results and contribute our national experience in the study of innovation.

2 Scope

POPULATION

This statistical research extends to all agricultural, industrial, construction and services enterprises with at least ten remunerated employees whose main economic activity corresponds to the following CNAE-2009 activity groups:

- Agriculture, livestock, forestry and fishing (01 to 03)
- Extractive industries (05 to 09)
- Manufacturing industry (10 to 33)
- Electricity, gas, steam and air conditioning supply (35)
- Water supply, sewerage, waste management and remediation activities (36 to 39)
- Construction (41 to 43)
- Trade (45 to 47)
- Transport and storage (49 to 53)
- Hospitality (55 to 56)
- Information and Communications (58 to 63)
- Financial and insurance activities (64 to 66)
- Real estate activities (68)
- Professional, scientific and technical activities (69 to 75)
- Administrative and support service activities (77 to 82)
- Human health and social work activities (86 to 88)
- Arts, entertainment and recreational activities (90 to 93)
- Other services (95 to 96)

Note: Agriculture has been included since 2006.

Note: After the R&D Statistics and the Community Innovation Survey have been collected in a coordinated manner, the enterprises that indicated they had carried out R&D activities are selected with probability 1 and, for the purposes of information collection for R&D, enterprises with fewer than 10 remunerated employees from all branches of activity are included, except CNAE 84 and 854.

TERRITORIAL

The statistics cover the entire Spanish territory.

FREQUENCY

It is carried out every two years on the basis of the 2020 baseline data.

There are two reference periods in the Community Innovation Survey.

The survey's main reference period is the year immediately prior to its conduction. However, the variables related to innovations implemented by the enterprise refer to the three years prior to the execution of the survey, in order to facilitate international comparability.

3 Statistical unit and reporting unit

3.1 STATISTICAL UNIT

The **statistical unit** of analysis may be defined as the element or component of the target population to which the tabulation of data and the aggregated statistics obtained as a result of the surveys refer.

The basic statistical unit for these operations is **the enterprise**, which is understood as the *“smallest combination of legal units that forms an organizational unit producing goods or services and that enjoys certain decision-making autonomy, particularly when using the resources available to it. The enterprise can carry out one or more activities in one or several places. A business can correspond to a single legal unit”*. (definition of the Regulation of the European Union 696/93).

As explained in section I, a new operational concept for “Enterprise” is applied for the 2022 Innovation Survey, which we will hereinafter call the “Statistical Enterprise” and which differs from previous years in that, beginning this year, the Enterprise = Legal Unit analogy will no longer always be true. In other words, some Statistical Companies may be made up of two or more Legal Units.

3.2 REPORTING UNIT

The reporting unit, or rather, the unit from which the basic information is obtained, is the Legal Unit, as the response is facilitated due to it being perfectly defined and located and having accounting and employment data, and homogeneous information is

obtained. Legal Units can be companies with legal personality (limited companies) or natural persons (individual entrepreneurs).

Obtaining the information from the Legal Units proceeds from direct collection by completing the questionnaire.

Thus:

- When using the Legal Unit as a statistical unit, information is obtained from the Legal Units, and statistics are compiled under said Legal Units.
- Upon using the Statistical Enterprise as a statistical unit, information is obtained from each Legal Unit that makes up the Enterprise, and statistics are compiled by grouping (and in the necessary cases, consolidating) variables for all the Legal Units that form the Enterprise.

3.3 DELINEATION OF STATISTICAL ENTERPRISES USING THE *PROFILING* METHODOLOGY

This process - essential for Innovation Survey preparation in Statistical Enterprise terms - was developed by the INE Board of Directors Unit. The rules agreed upon in the European Statistical System working groups were applied, based on which the *Profiling* methodology (*delineation of companies*) was established as the best procedure for identifying companies when analysing Legal Units operating in group settings.

The delineation of companies within groups is carried out using a series of criteria whose final result is not only the definition of the Enterprises that operate within a group, but also the links between the Legal Units that comprise them and their primary characteristics.

Details can be found in the Methodology available on the INE website, at the following link:

https://www.ine.es/metodologia/t37/t3730200_profiling.pdf

Some of the principles and criteria used for enterprise delineation are highlighted below, especially those that affect the subsequent preparation of the Innovation Survey.

To start with, *Profiling* takes into account the following questions:

- **Market/non-market criteria.** All the Legal Units that make up market-producing statistical enterprises must also be market-based. The Institutional Sector Code is, therefore, a critical variable in the enterprise creation processes. A unit is defined as market if it is classified as S11, S12 or S14 in terms of its Institutional Sector (non-financial corporations, financial institutions and Households as individual entrepreneurs, respectively). If it is classified as S13, S15 or S2, it will be considered non-market.
- **Holdings and Headquarters.** These are units with very specific functions within company groups (codes CNAE-2009 6420 and 7010). Given the needs of various users, these activities are considered *productive*.

Through the *Profiling* methodology, each of the Legal Units of a company group is perfectly assigned to the enterprise of which it is part. The following relationships occur:

- A company group can have a single enterprise or be made up of several enterprises.

- Each enterprise can contain a single Legal Unit or several Legal Units.

When a market-producing enterprise (institutional sectors S11, S12 or S14) is made up of several Legal Units, *Profiling* also identifies certain relationships between these Units, such as:

- **Progressive vertical integration.** This type of integration occurs when different Legal Units carry out different stages of the same production process. The outputs of the early stages are the inputs for the later ones, with the particularity that only the final stage output is sold to the market. For example, Activity 29.3 (manufacture of components, parts and accessories for motor vehicles) is considered an *upstream* activity of activity 29.1 (manufacture of motor vehicles) which is the *downstream* activity.

The following types of Legal Units arise from this relationship:

- U for the *Upstream* at the beginning of the chain (in the previous example, the Legal Unit with Activity 29.3)
- D (or X if also integrated in an industry-commerce chain, which will be described in the subsequent point) for the *Downstream* at the end of the chain (in the previous example, the Legal Unit with Activity 29.1)

To identify these Legal Units, we start from a predefined list of activity combinations and verify certain non-relevant conditions in the affected Legal Units.

- **Backward Integration Industry-Wholesale Trade** This type of integration occurs when several Legal Units in the same Statistical Enterprise are in charge of different phases of a chained industrial-commercial process; that is, when a trade unit is in charge of selling products from the industrial unit with which it is connected within the Enterprise to the market. For example, activity 45.1 (motor vehicle trade) and activity 29.1 (Manufacture of motor vehicles)

The following types of Legal Units arise from this relationship:

- C for the Legal Unit that markets the product (in the example, the Legal Unit whose activity is 45.1)
- I (or X, if it also forms part of a progressive Industrial chain, already explained in the previous point) for the Legal Unit that manufactures the product (in the example, the Legal Unit whose activity is 29.1)

To identify these Legal Units, we start from a predefined list of activity combinations and verify certain non-relevant conditions in the affected Legal Units

- **Auxiliary units (A):** Auxiliary Legal Units that provide services to other Legal Units in the Statistical Enterprise.
- **Productive units.** Legal Units that have not been identified with the aforementioned characteristics (U, D, I, X, C, A) are classified as productive

In summary, the Legal Units that make up a Statistical Enterprise will always be classified into one of the following types:

- U: Legal Units with *Upstream* activity in vertical integration (these can be considered the industrial auxiliary unit).

- D: Legal Units with *Downstream* activity in vertical integration (these can be considered the industrial productive unit).
- I: Industrial Legal Units that make up the Industry-Trade chain.
- C: Trade Legal Units that make up the Industry-Trade chain.
- X: Industrial Legal Units that are part of both a vertical integration and an industry-trade chain.
- A: Auxiliary Legal Units that provide services to other Legal Units in the Statistical Enterprise.
- P: Productive Legal Units that are not part of *Upstream-Downstream* or Industry-Trade chains

These typologies of market enterprise Legal Units, defined in the enterprise delineation process according to the Profiling methodology, will facilitate the subsequent task of consolidating the Statistical Enterprise variables.

4 Variables and their definition

ENTERPRISE'S MAIN ECONOMIC ACTIVITY

The economic activity carried out by an enterprise is defined as the creation of added value through the production of goods and services.

The main economic activity is understood to be that which generates the greatest added value. Considering the difficulty of this for enterprises that carry out different added value activities, the main activity is considered to be that which creates the highest turnover or, failing this, which employs the greatest number of employees.

DIMENSION OR SIZE OF THE ENTERPRISE

The size of enterprises is one of the most important variables when it comes to identifying enterprises' behaviour. The size can be identified by both considering the size of the turnover and the number of people who constitute the enterprise's workforce. For this reason, the Innovation Survey questionnaire includes two questions that allow for the quantification of both variables.

STAFF EMPLOYED IN THE ENTERPRISE

This corresponds to the number of people who work in the enterprise, as well as the number of people who, working externally, are part of the staff and are paid by the enterprise (for example, sales representatives and delivery, repair and maintenance staff who work on behalf of the enterprise). This includes both remunerated and non-remunerated staff.

A worker from a temporary employment agency is an agency employee and not an employee of the unit (enterprise) where they work.

The *remunerated staff* includes those workers linked to the enterprise through a work contract and who are paid with fixed or regular amounts in the form of a salary, wages, commission, piecework pay or payment in kind.

This may be permanent staff (with an indefinite contract or contract relationship) or temporary staff (with a fixed-term contract).

Remunerated staff are also considered to be: owners paid for their work; students with a formal commitment through which they contribute to the enterprise's production process in exchange for payment and/or educational services; employees hired through a contract that is specifically intended to encourage the hiring of unemployed people; homeworkers where an explicit agreement exists stating that they are paid for the work that they do and they are included on the payroll.

Remunerated staff also includes part-time workers, seasonal workers and people on strike or who have been granted short-term leave but excludes those who have been granted long-term leave.

Those people who actively manage or participate in the enterprise's work activities but do not receive fixed remuneration or a salary constitute *non-remunerated staff*. This includes owners, autonomous partners who are active within the enterprise and family assistance. Exclusively capitalist partners and owner's relatives that do not actively participate in the enterprise are excluded, along with people who are on the payroll of other enterprises in which they carry out their main activity.

TURNOVER

This comprises the amounts invoiced by the enterprise during the reference year for the provision of services and sale of goods that are the object of the enterprise's activity.

These are considered including the applicable taxes on goods and services excluding the VAT paid by the client. They are recorded in net terms after deducting sales refunds, as well as volume discounts over sales. Cash discounts and discounts for prompt payment are not deducted.

Turnover does not include the sale of fixed assets nor the production subsidies received. The amount of turnover is calculated as the sum of net sales of goods and the rendering of services.

GROSS INVESTMENT IN TANGIBLE GOODS

Investment in tangible goods during the reference period includes new and existing tangible capital goods, whether bought from third parties or produced for own use (i.e. capitalised production of tangible capital goods) that have a useful life of over a year, including non-produced tangible goods such as land.

All investments are valued prior to (i.e. gross of) value adjustments, and before the deduction of income from disposals. Purchased goods are valued at the purchase price, i.e. including transport and installation costs, fees, taxes and other costs of transferring ownership. Self-produced goods are valued at the production cost. Goods acquired through restructuring process (such as mergers, take-overs, break-ups, spin-off) are

excluded. Purchases of small tools that are not capitalised are included as current expenditure.

All additions, reforms, improvements and renovations that prolong or increase the useful life of tangible goods are included.

INNOVATION

An innovation is a product, or a business process which is either new or upgraded (or a combination of both) which differs significantly from prior products or processes by the same enterprise, and which has been introduced in the market or implemented in the enterprise.

- It has to be an innovation for the enterprise, but not necessarily for its sector or market. Therefore, it is enough with being a novelty or an upgrade for the enterprise.
- This innovation has been developed by the same enterprise, or altogether with other organizations, or else other enterprises and organizations developed the innovation.
- Changes of an aesthetic nature, as well as simple management or organization changes must not be included.

As defined in this survey, an innovation can be a product innovation or a business process innovation.

A **product innovation** is an asset or a service that is either new or upgraded, which differs significantly from prior assets or services by the same enterprise and that has been introduced in the market.

A **business processes innovation** is a new or improved business process for one or more business functions that differs significantly from the firm's previous business processes and that has been brought into use in the firm.

Regarding the Innovation Survey, innovation is studied with reference to the years t , $t-1$ and $t-2$.

Functional categories for identifying the type of business process innovations

1. Production of goods or services: Activities that transform inputs into goods or services, including engineering and related technical testing, analysis and certification activities to support production.
2. Distribution and logistics: This function includes: transportation and service delivery, warehousing and order processing.
3. Marketing and sales This function includes:
 - a) marketing methods including advertising (product promotion and placement, packaging of products), direct marketing (telemarketing), exhibitions and fairs, market research and other activities to develop new markets
 - b) pricing strategies and methods
 - c) sales and after-sales activities, including help desks other customer support and customer relationship activities.

4. Information and communication systems: The maintenance and provision of information and communication systems, including:
 - a) hardware and software
 - b) data processing and database
 - c) maintenance and repair
 - d) web-hosting and other computer-related information activities.

These functions can be provided in a separate division or in divisions responsible for other functions.

5. Administration and management: This function includes:
 - a) strategic and general business management (cross-functional decision-making), including organising work responsibilities
 - b) corporate governance (legal, planning and public relations)
 - c) accounting, bookkeeping, auditing, payments and other financial or insurance activities
 - d) human resources management (training and education, staff recruitment, workplace organisation, provision of temporary personnel, payroll management, health and medical support)
 - e) procurement
 - f) managing external relationships with suppliers, alliances, etc.
6. Product and business process development: Activities to scope, identify, develop, or adapt products or a firm's business processes. This function can be undertaken in a systematic fashion or on an ad hoc basis, and be conducted within the firm or obtained from external sources. Responsibility for these activities can lie within a separate division or in divisions responsible for other functions, e.g. production of goods or services.

PROBLEMS OF DELIMITING THE DETERMINATION OF INNOVATIONS

Determining what is new and important

The main criteria that allow a distinction to be made between an innovation and a less significant change in products and processes are novelty and importance. The difference between old and new, and important and not important is, without a doubt, very difficult to define and must be determined by those who respond to the survey.

One of the innovation criteria should be that the product has been introduced into the market as a new product or as a significant improvement of an old product. Aesthetic or stylistic innovations (such as changes in colour or decoration) constitute a marketing innovation. The differentiation of a product (such as minor changes in its design or presentation that do not entail changes in its construction or features) is also a marketing innovation.

Product differentiation

Some minor technical or aesthetic changes do not constitute a product innovation. The differentiation of a product may or may not constitute an innovation depending on whether the changes notably modify the features, properties, cost, or use of materials and components of a product.

For example, in the field of textiles, a change in the mixture of synthetic or natural fibres could be considered to be an innovation, as opposed to a new colour or design. Food products prepared with new ingredients, or with a different composition, or using new food preservation methods, could be considered to be product innovations. The introduction of a new flavour into an existing range (for example, a new fruit essence in a line of yoghurts) constitute a marketing innovation but not a product innovation. This is an area where there are evidently many difficulties defining innovations, which can only be resolved by those who respond to the survey.

The case of customised production

Enterprises that have a customised production sector or that manufacture unique products (often complex) at customers' request must analyse each product to determine if it corresponds to the conditions necessitated by the aforementioned definitions.

The fact that the product planning stage involves the construction and testing of a prototype or other R&D activities aimed at changing at least one of the aforementioned product's features could be considered to be an innovation criterion. If the attributes of the unique product do not differ from those of products previously manufactured by the enterprise, this does not constitute a product innovation.

Organisational change

The computerisation of the sales of an enterprise's financial department should count as an organisational change. Similarly, the complete reorganisation of an enterprise or the reorganisation of workshops constitute an organisational innovation. In contrast, the introduction of just-in-time systems should be considered to be a process innovation (reorganisation of the production process where, at every stage from production to delivery to the customer, the process conforms to customer demand, avoiding storage costs).

Machinery and equipment

Innovation, particularly process innovation, frequently involves the installation of new machines and equipment. There are three possible cases:

The installation of *machines and equipment that improve an enterprise's production methods* constitutes a process innovation. The cost of the equipment is counted as expenditure on innovation.

The installation of *machines and equipment needed for the manufacturing of a new product* but that do not improve production methods (for example a new moulding or packing machine) does not constitute a process innovation. The cost of equipment, however, counts as expenditure on innovation.

Other machine and equipment purchases should not be considered as a process innovation nor counted as expenditure on innovation. For example, increasing production capacity by adding more machines of a model that is already used or replacing outdated machines with a newer model does not constitute an innovation.

INNOVATIVE ENTERPRISE

An innovative enterprise is an enterprise that has introduced one or more innovations during the observation period, whether the enterprise was the sole responsible for that innovation or if it was a shared responsibility with another enterprise.

INNOVATION ACTIVITIES

Innovation activities are financial, development and marketing activities carried out by the enterprise that have generated an innovation or have the objective to do so.

- Innovation activities can result in an innovation, be delayed or abandoned.
- Can be carried out inside the enterprise, contracting third parties or a combination of both.
- Can generate knowledge or information even if no innovation is introduced during the period.

These are the set of activities leading to the development or introduction of innovations. The following seven activities are considered: Research and internal experimental Development (R&D), engineering, design and other creative activities; marketing and brand creation; activities related with intellectual property rights; activities related with staff training; software development and activities related with database work, and activities related with the acquisition or rental of tangible property. Research and internal experimental development (R&D) include current and capital expenditures made within the enterprise, irrespective of the source of the funding. Expenditure made outside the enterprise that does not constitute R&D but support internal R&D activities are also included. This definition matches that included in the Research and Experimental Development (R&D) Activities Statistic.

Expenditure on external R&D is made up of the expenditure incurred through the outsourcing of R&D through a contract or agreement.

Engineering, design and other creative works as an innovation activity: the majority of the design and other creative works are innovation activities, with the exception of small design changes that do not meet the requirements for an innovation, such as producing an existing product with a new colour. Identifying the use of design methodologies by enterprises can help to differentiate minor design changes in innovation activities. Many engineering activities are not innovation activities, such as daily production and quality control procedures for existing processes. Engineering activities for reverse engineering, or for modifying or introducing new production processes, services, or delivery methods, can be an innovation activity or not, depending on whether these activities are carried out by innovation or due to other reasons.

Marketing and brand value activities as an innovation activity: marketing activities for existing products are only innovation activities if the marketing practice is an innovation by itself. For many enterprises, it is possible that only a small fraction of the marketing expenditures is linked to the innovation of products introduced during the observation period. Relevant innovation activities include preliminary market research, market testing, advertising release and developing price fixing mechanisms and product placement methods for innovative products. In some cases, the advantages of a

business innovation process can also be marketed, for example, if the business process innovation has environmental benefits or if it enhances the quality of the product.

Activities related with Intellectual Property (IP) as an innovation activity: IP activities for ideas, inventions and new or upgraded products or business processes developed during the observation period are all innovation activities. Examples include activities for requesting IP rights for an innovation or an invention, acquiring patent licenses or other IP rights and using them in an invention or innovation, or granting IP rights licenses for inventions and innovations. All IP activities for inventions made before the observation period, as well as for commercial processes that existed before the observation period, must be excluded.

Staff training as an innovation activity: training activities for employees concerning the use of existing products or commercial processes, improving general skills or language training are not innovation activities. Examples of training as innovation activities include staff training for using innovations, such as new software logistical systems or new equipment; and relevant training for implementing an innovation, such as instructing clients and staff about the innovation features of a product. The staff training required for developing an innovation, such as R&D training for design, are part of the R&D activities or else engineering, design and other creative work.

Software development and database activities as an innovation activity: software development is an innovation activity when it is used to develop processes or new/upgraded commercial products, such as computer games, logistic systems, or software for integrating business processes. Database activities are an innovation activity when they are used for innovation, such as data analyses about the material properties or customer preferences.

Acquisition or rental of active tangibles for innovation: acquiring or renting active tangibles can be innovation activities by their own right, such as when an enterprise buys or rents existing equipment that it uses for its commercial processes. The acquisition of tangible capital assets is generally not an innovation activity if consists of a replacement investment or a capital extension that does not contribute to creating innovations, or if it only consists in minor changes compared with the enterprise's existing tangible capital stock.

INTERNAL RESEARCH AND DEVELOPMENT (R&D) ACTIVITIES

Research and development (R&D) activities comprise creative and systematic work undertaken in order to increase the volume of knowledge, including knowledge of humanity, culture, and society, and to develop new knowledge applications.

R&D activity is characterised by its:

- novelty
- creativity
- uncertainty
- systematic approach
- transferability and/or reproducibility (aimed at obtaining results that can be reproduced by others)

The term R&D encompasses three activities: basic research, applied research and experimental development.

Basic research consists of original experimental or theoretical work undertaken primarily to gain new knowledge about the foundations of phenomena and about observable facts, without being directed at a particular application or use.

Applied research also consists of carrying out original work with the aim of acquiring new knowledge. However, it is mainly directed towards a specific practical objective.

Experimental development consists of systematic work based on existing knowledge derived from research and/or practical experience, aimed at manufacturing new materials, products or devices, establishing new processes, systems and services, or substantially improving existing ones.

All staff who are directly engaged in R&D, as well as those people who provide services directly related to R&D activities, e.g. managers, administrators and office staff, should be accounted. The guidelines for collecting and reporting data on research and experimental development, better known as the Frascati Manual, classifies R+D staff according to their occupation: researchers, technicians and/or associated staff and other supporting staff (auxiliary).

Researchers are professionals who work on the conception or creation of new knowledge. They are responsible for investigating and improving or developing concepts, theories, models, equipment and instruments, software or operational methods.

Technicians and/or associated staff are people whose main tasks require technical knowledge and experience in one or more fields of engineering, physical and biological sciences, social sciences, humanities and the arts. They participate in R&D by carrying out scientific and technical tasks that require the application of concepts and procedures, generally under the supervision of researchers.

Auxiliary staff (other support staff) includes qualified and unqualified workers and administrative, secretarial and office staff who take part in the implementation of R&D projects, or who are directly related to the realisation of these projects.

Starting from 2008, the year of reference, external staff must be included as R&D staff in a disaggregated way, understanding by external staff all the people who, without belonging to the enterprise's own staff, are currently performing internal R&D tasks and are fully integrated in completing those tasks.

Internal R&D expenditure includes current expenditure (staff and other current expenditure) and enterprises' capital expenditure on R&D programmes (instruments and equipment along with land and buildings, acquisition of software specifically for R&D and other intellectual property products specifically for R&D).

REGIONALISATION OF RESOURCES

To determine the spatial distribution of resources, regionalisation of expenditure and staff is carried out according to Autonomous Community. For this, enterprises who have carried out the aforementioned R&D and innovation activities (expenditure is only measured in terms of technological innovation) in several establishments located in

different Communities are asked to divide expenditure and staff between those Communities in which the activities were carried out. To this end, expenditure that may be shared between the enterprise's different units is distributed geographically according to the percentage that the enterprise estimates corresponds to each unit.

COLLABORATION ON INNOVATION

Collaboration on innovation is understood to mean active participation in joint innovation projects (including R&D) with other organisations. These organisations can be enterprises or non-commercial institutions. It does not necessarily mean that both sides obtain immediate commercial benefits from the collaboration. Simple recruitment from outside the enterprise, without active collaboration by the enterprise, is not considered to be collaboration.

It is valuable to collect data relating to collaboration on research with other institutions, both in our own country and abroad, or with different countries or groups of countries. For this reason, the Innovation Survey differentiates collaboration according to the type of partner and the country in which it is located.

- Collaboration partner types:
 - Private enterprises outside its enterprise group
 - Consultants, commercial laboratories or private research institutes
 - Providers of equipment, materials, components or software
 - Enterprises that are users or clients
 - Rival enterprises
 - Other enterprises
- Other enterprises from its same group
- Universities or other superior education centres
- Public Administration or public research institutes
- Users or clients from the public sector
- Non-profit institutions

PATENTS

A patent is a deed that recognises the exclusive right to exploit the patented invention, preventing others from manufacturing, selling or using it without the owner's consent.

The patent can refer to a new procedure, apparatus or product, or a refinement or improvement of these. The term of the patent is 20 years from the date when the application is filed. For the patent to remain in force, it is necessary to pay annual fees from the date of issue.

Requested or obtained patents are not indicators of innovation results, but rather indicators of product innovation. However, it is essential to study these to better understand the innovation process.

LICENCES

In its simplest form, a licence is a contractual agreement between two or more parties where one party authorises the other to use its intellectual property (IP). Licensing is one of the most important instruments for the transfer of technology, which makes it necessary to collect certain information about this type of activity. Information is collected on:

Licences IN: Acquisition of a licence or usage right of a product or technology for industrial and commercial R&D purposes.

Licences OUT: Granting of a license or usage right of a product or technology for industrial and commercial R&D purposes.

5 Sample design

In order to give data at the level of the Statistical Enterprise Unit (SEU), indirect sampling is applied, in the sense that results are given by SEU from the sample of Legal Units (LU). This is the reason for difference between the design based on SEU and the one based on LU.

As a result of the coordination of the R&D Statistics and the Innovation Survey, the directory of potentially research enterprises has been included within the target population.

This directory is formed by the enterprises that potentially carry out R&D activities, either because this is the case of previous years through the survey itself, or because they have requested public funding to carry out R&D in the survey's reference year. Information on units receiving public funding for R&D is requested annually from State Administration bodies and all Autonomous Communities in order to update this directory. The information is cross-checked with that of the previous year directory, incorporating registrations, changes and cancellations.

For the sample part that is extracted from the DIRCE, a stratified design is carried out, similar to that of other years, based on a LU sample. All the LUs with 200 or more employees are exhaustively investigated. Smaller LUs still relevant to the survey are also exhaustively; while the rest are stratified by autonomous community, main branch of economic activity and size group, according to number of employees. In each stratum, a random sample is obtained, of a size between proportional and uniform, maintaining the elevation factors of the previous survey.

The estimators of the LU sample are those of expansion, simple, adjusted for the lack of response, changes in stratum and excess coverage. For the sample design based on SEU, indirect sampling is applied, applying the methodology set forth by Lavallée and Labelle-Blanchet in their article: "Indirect Sampling applied to Skewed Population", Survey Methodology, June 2013, Vol. 39, Statistics Canada.

We say that a SEU belongs to the sample of SEUs if any of its LUs belong to the sample of LUs.

Each of the stages of the design of the SEU sample and the indirect method followed for the estimates at the SEU level are detailed below.

5.1 SAMPLING FRAME

The DIRCE is the framework used for sample extraction. This is updated once a year with administrative sources - primarily tax and Social Security - and with information from the INE's statistical operations. It is a tiered integrated information system, in which the following are ordered, from least to greatest: establishment, Legal Unit, Statistical Business, and business group. For each one of these levels, the DIRCE contains information on territorial distribution, the main economic activity and on the number of employees, variables that are used in the sample design, and on identification and location data, which are necessary for correct information collection.

5.2 EXHAUSTIVE UNITS

Exhaustive units are those that enter the sample in a certain way, with probability 1, which is why they are also known as self-represented. The following exhaustive units are considered:

- All the units in the directory of possibly investigative units.
- From the DIRCE, all the LUs with 200 or more employees that are within the population scope of the survey and other smaller units but relevant to the survey.

5.3 STRATIFICATION

The framework of LU under the DIRCE is divided into groups, homogeneous with regards to what is intended to be studied and disclosed, called strata. Each stratum constitutes an independent population for sampling purposes.

Each stratum is formed by crossing autonomous community or city × main economic activity branches × size group, measured by the number of wage earners.

- Autonomous Community or City in which the SEU's headquarters are located.
- Main activity branch according to CNAE-2009: 59 sets of activity divisions are considered.
- The size groups are formed as follows:
 - Less than 10 employees (only for division 72).
 - From 10 to 49 employees
 - From 50 to 199 employees
 - 200 or more employees

Table 1. Activity grouping for stratification and correspondence with the National Classification of Economic Activities (CNAE-2009)

Activity divisions or groups	CNAE-2009
1. Agriculture, livestock farming, forestry and fishing	01, 02, 03
2. Anthracite, coal and lignite extraction	05
3. Crude oil and natural gas extraction	06
4. Metallic mineral extraction	07
5. Other extraction industries	08
6. Support activities to extraction industries	09
7. Food industry	10
8. Drink manufacturing	11
9. Tobacco industry	12
10. Textile industry	13
11. Clothing production	14
12. Leather Goods and footwear industry	15
13. Wood and cork industry, except furniture, basketry and plaiting	16
14. Paper industry	17
15. Visual Arts and reproduction of recorded media	18
16. Coking and oil refining	19
17. Chemical industry	20
18. Pharmaceutical products manufacturing	21
19. Rubber and plastic products manufacturing	22
20. Other non-metallic products manufacturing	23
21. Metalworking: manufacturing iron, Steel and ferroalloy products	24
22. Metallic products manufacturing, except machinery and equipment	25
23. Manufacturing IT, electronic and optical products	26
24. Electric material and equipment manufacturing	27
25. Electric equipment and machinery manufacturing	28
26. Motor vehicles, trailer and semi-trailer manufacturing	29
27. Other transport materials manufacturing	30
28. Furniture manufacturing	31
29. Other manufacturing industries	32
30. Machinery and equipment repairing and installation	33
31. Electric energy, gas, steam and air conditioning supply	35
32. Water supply, sanitation activities, waste management and decontamination	36
33. Wastewater collection and handling	37
34. Waste collection, handling and elimination; assessment	38
35. Decontamination activities and other waste management services	39
36. Construction, civil engineering, specialized construction activities	41, 42, 43
37. Motor vehicles and motorbikes selling and repair	45
38. Wholesale trade and trade intermediaries, except motor vehicles and motorbikes	46
39. Retail trade, except motor vehicles and motorbikes	47
40. Land transport and transport via pipeline	49
41. Sea and inner waterway transport	50
42. Air transport	51
43. Storing and activities related to transport	52
44. Mail and postal activities	53
45. Accommodation services and catering services	55, 56

Activity divisions or groups	CNAE-2009
46. Editing	58
47. Film, video and TV program activities, sound recording and musical editing activities. Radio and TV programming and broadcasting activities	59, 60
48. Telecommunications	61
49. Programming, consultancy and other IT related activities	62
50. Information services	63
51. Financial services, except insurances and retirement funds	64
52. Insurances, reassurances and retirement funds, except mandatory Social Security	65
53. Auxiliary activities for financial services and insurances	66
54. Real estate activities	68
55. Professional, scientific and technical activities; administrative activities and auxiliary services	69, 70, 74, 75, 77, 78, 79, 80, 81, 82
56. Technical architecture and engineering services; technical testing and analysis	71
57. Research and Development	72
58. Advertising and market research	73
59. Healthcare activities, social services; artistic, recreational and entertainment activities, reparation of computers, personal belongings and domestic items; other personal services	86, 87, 88, 90, 91, 92, 93, 95, 96

It should be borne in mind that this survey's results are published in accordance with a different activity group structure from that outlined in Table 1.

This structure is outlined below, in Table 2.

Table 2. Activity groups included in the Innovation Survey and their correspondence to the National Classification of Economic Activities (CNAE-2009)

Branch of activity	CNAE-2009
AGRICULTURE	01 a 03
1. Agriculture, livestock farming, forestry and fishing	01, 02, 03
INDUSTRY	05 a 39
2. Extraction and oil industries	05, 06, 07, 08, 09, 19
2.1. Extraction industries	05, 06, 07, 08, 09
2.2. Oil industries	19
3. Food, drinks and tobacco	10, 11, 12
4. Textile, clothing, leather goods and footwear	13, 14, 15
4.1. Textile	13
4.2. Clothing	14
4.3. Leather goods and footwear	15
5. Wood, paper and visual arts	16, 17, 18
5.1. Wood and cork	16
5.2. Cardboard and paper	17
5.3. Visual arts and reproduction	18
6. Chemistry	20
7. Pharmacy	21
8. Rubber and plastics	22
9. Diverse non-metallic mineral products	23
10. Metalworking	24
11. Metal manufacturing	25
12. IT, electronic and optical equipment	26
13. Electric material and equipment	27
14. Other machinery and equipment	28

Branch of activity	CNAE-2009
15. Motor vehicles	29
16. Other transport material	30
16.1. Naval construction	301
16.2. Aircraft and spaceship construction	303
16.3. Other transport equipment	30 (exc. 301, 303)
17. Furniture	31
18. Other manufacturing activities	32
19. Reparation and installation of machinery and equipment	33
20. Energy and water	35, 36
21. Sanitation, waste management and decontamination	37, 38, 39
CONSTRUCTION	41 a 43
22. Construction	41, 42, 43
SERVICES	45 a 96
23. Commerce	45, 46, 47
24. Transports and storing	49, 50, 51, 52, 53
25. Catering	55, 56
26. Information and communications	58, 59, 60, 61, 62, 63
26.1. Telecommunications	61
26.2. Programming, consultancy and other IT activities	62
26.3. Other IT and communication services	58, 59, 60, 63
27. Financial and insurance activities	64, 65, 66
28. Real estate activities	68
29. Professional, scientific and technical activities	69, 70, 71, 72, 73, 74, 75
29.1. R&D Services	72
29.2. Other activities	69, 70, 71, 73, 74, 75
30. Administrative activities and auxiliary services	77, 78, 79, 80, 81, 82
31. Healthcare and social service activities	86, 87, 88
32. Artistic, recreational and entertainment activities	90, 91, 92, 93
33. Other services	95, 96

Given that potential research units are thoroughly investigated, the following branches also are included within this survey's population scope:

CNAE-2009	Literal
85 (except 854)	Education (except for post-secondary education)
94	Activities of membership organisations

Note: Once coordinated collection with the R&D Statistics is carried out, the enterprises that indicate they have carried out R&D activities are selected with probability 1. For the purposes of R&D information collection, enterprises with fewer than 10 employees from all branches of activity except CNAE 84 and 854 are included.

5.4 SAMPLE SIZE

- The sample size for the possibly investigative units that exhaustively investigates the R+D statistics is 19,000 units.
- For the LUs of the DIRCE, the sample size is calculated using an allocation between uniform and proportional, requiring a minimum of 3 units per stratum and trying to respect the elevation factors (quotient between the population size and the sample size per stratum) over time. The theoretical sample size is around 26,052 SEUs.

The total sample size is around 45,000 units.

5.5 SAMPLE SELECTION

For the LUs of the DIRCE, in each stratum, a random sample is selected by applying the technique of Permanent Random Numbers and negative coordination with the rest of the random samples obtained from the DIRCE in a given year, with the aim of distributing the response burden as equitably as possible among the informants.

5.6 ESTIMATORS

Estimator of the total at the Legal Unit (LU) level:

The estimators applied are those of simple expansion, adjusted for the lack of response, changes in stratum and excess coverage.

The estimator of the total of a characteristic X in a domain d (any subgroup of the population, which does not have to coincide with the strata) is given by:

$$\hat{X}_d = \sum_{\substack{j=1 \\ j \in d}}^{n_{dr}} x_j F_j$$

Where:

- n_{dr} : number of sample LUs of the domain that respond to the survey.
- x_j : is the value of characteristic X of the LU j belonging to domain d .
- F_j : is the elevation factor of the LU j and for its calculation we proceed as follows:
 - a) If the LU j was selected in a stratum h and according to the questionnaire data it is found in a different stratum k , then the elevation factor F_j is the one initially associated with the LU j , that is:

$$F_j = \frac{N_h}{n_h}$$

Where N_h is the number of LUs in the initial population (DIRCE) of stratum h and n_h is the theoretical sample size in h .

- b) If LU j continues to belong to the same stratum h where it was selected, then the elevation factor F_j is estimated taking into account over-coverage, non-response and stratum changes as follows:

$$F_j = \frac{\hat{N}_h^*}{n_h^*}$$

Where:

- n_h^* : Number of LUs in the sample from stratum h that respond and have not changed stratum.

- $\hat{N}_h^* = N_h \left(1 - \frac{n_h''}{n_h}\right) - \sum_{\substack{j=1 \\ h \neq k}}^{n_h^k} F_j$

Being:

n_h'' : Number of LU samples from stratum h with a duplicate or out-of-scope incidence of the type.

n_h^k : Number of LUs selected in stratum h, and which are in a different stratum k, according to the questionnaire.

c) In general, for exhaustive or outlier LUs,

$$F_j = 1$$

Estimator of the total at the level of the Enterprise Statistical Unit (UEE):

The estimator of the total for characteristic Y in a domain d is given by the following expression:

$$\hat{Y}_d = \sum_{\substack{i=1 \\ i \in d}}^{n_{dr}^B} y_i w_i$$

Where:

- n_{dr}^B : number of SEU belonging to domain d that respond through some of their sample LU to the survey.
- y_i : is the value of characteristic Y of SEU i belonging to domain d.
- w_i : is the elevation factor of SEU i and is calculated, first applying indirect sampling as follows:

$$w_i' = \frac{m_i}{\sum_{j \in i}^{M_i} (F_j)^{-1}}$$

Being:

M_i : Number of LU j of SEU i contained in the Profiling

m_i : Number of LUs in the sample of SEU i

F_j : LU j elevation factor

And second, based on w_i' we obtain w_i by applying a calibration, so that the estimator of the total Innovation expenditure at the LU level coincides with the estimator at the SEU level.

5.7 SAMPLING ERRORS

Sampling errors for the estimator of the total at the LU level

Let the estimator of the total of X for a domain d be:

$$\hat{X}_d = \sum_{h=1}^H \sum_{j=1}^{n_{hr}} F_j x_j z_{dhj}$$

Where:

- n_{hr} : effective sample size of LUs (that have responded) in stratum h.
- F_j : Elevation factor associated with LU j.
- z_{dhj} : random variable that takes value 1 if unit j of stratum h belongs to domain d and 0 otherwise.
- X_j : value that X takes in LU j.

The relative sampling error, for the total estimator of X in domain d, is given by the following expression:

$$\widehat{CV}(\hat{X}_d) = \frac{\sqrt{\hat{V}(\hat{X}_d)}}{\hat{X}_d} \times 100$$

To calculate $\hat{V}(\hat{X}_d)$ the Raulin formula is used, which gives a good approximation to the direct method and is given as follows:

$$\hat{V}(\hat{X}_d) = \sum_h \frac{n_{hr}}{n_{hr} - 1} \sum_{j=1}^{n_{hr}} F_j (F_j - 1) (x_j z_{dhj} - \hat{X}_{dh})^2$$

Where

$$\hat{X}_{dh} = \frac{\sum_{j=1}^{n_{hr}} F_j x_j z_{dhj}}{\sum_{j=1}^{n_{hr}} F_j}$$

Sampling errors for the estimator of the total at the SEU level

To calculate the sampling errors at the SEU level, the estimator of the total of Y in domain d can be expressed as a Horvitz-Thompson estimator, in terms of LU, as follows:

$$\hat{Y}_d = \sum_{h=1}^H \sum_{j=1}^{n_{hr}} F_j \theta_j z_{dhj} \quad j \in i$$

Where:

- $\theta_j = \frac{(F_j)^{-1}}{\sum_{j=1}^{M_i} (F_j)^{-1}} y_i \quad j \in i$

- z_{dhj} : random variable that takes value 1 if LU j of SEU i of stratum h belongs to the domain d and 0 if otherwise.
- y_i : value that Y takes in SEU i

This estimator takes the same form as in the previous case and therefore Raulin's formula can be applied analogously to LU errors.

6 Information collection

The collection of the CIS-22 questionnaires has been carried out by the Large Enterprises Collection Unit (URCE- GE) and by an external company contracted for this purpose.

The monitoring of the fieldwork calendar and the quality control of the information has been carried out by the INE Central Services. The personnel involved in the survey work is obliged by law to preserve statistical secrecy.

Survey inspectors are responsible for the theoretical and practical training of these staff and the monitoring of information gathering tasks. For these purposes, the corresponding manuals and training and consultation documents are prepared.

Reporting units were sent a letter of introduction to the survey that included a username and password for its completion online. Since 2013, it has been possible to carry out online completion through the secure protocol page <https://iria.ine.es>.

Once this letter is received, legal units have 15 days to complete and submit the questionnaire.

Based on the collection units, an initial phone contact is established with the Legal Unit to check receipt of the questionnaire. If the completed questionnaire has not been received after the stipulated period has gone by, any phone and written complaints considered necessary will be made.

Completion of the Community Innovation Survey is considered to be compulsory in the National Statistical Plan.

From the collection units, an integrated information collection procedure is carried out, which consists of filtering and recording the data when information is received. If necessary, the legal unit may be requested to provide necessary clarifications on the data provided.

7 Processing of results

7.1 INFORMATION PROCESSING FOR THE REPORTING UNIT

The information processing stages were as follows:

- Manual control and filtering of the questionnaires by the units involved in information collection in order to recover information on any possible data gaps or to correct the errors in questionnaires prior to their recording.

- Interactive recording with filtering and error correction of the information obtained by the units involved in information collection.
- Control of the information received by the responsible department.
- Coverage control and processing of identification errors.
- Validation of information quality.
- Imputation of partial non-response.
- Interactive filtering and correction of inconsistencies in the validated information.
- Preparation of a first draft of tables analysing the results.
- Macro-editing of the main aggregates to correct errors that were not detected in the previous micro-filtering stage.
- Analysis of the data.
- Creation of a definitive data file.
- Obtaining definitive results tables by responsible departments, prepared using the definitive data file.

7.2 INFORMATION PROCESSING FOR THE STATISTICAL ENTERPRISE

7.2.1 Aggregation of the Legal Units that make up the sample Statistical Enterprises and study of the Legal Unit typology combinations

For this sub-process, we work with the sample Statistical Enterprises, that is, those for which at least some of the Legal Units are in the Innovation Survey sample.

For the Statistical Enterprises sample, complete information must be available on each and every one of the component Legal Units. This information comes either from the direct collection of questionnaires or from administrative information in the case of Legal Units which, due to their smaller size, have not been included in the direct collection. In the cases and variables required, assignment techniques are used to complete the required information.

Once all the information is available for all the Legal Units of the Statistical Enterprise, the consolidation is carried out according to the rules of section 7.2.2.

In addition, each Statistical Enterprise is typified according its combination of the different **types of Legal Units that comprise it** (see section 3.3 of this document). Statistical Enterprises may present any of the following combinations:

- a) P only. Formed only by productive units.
- b) P+A only. Formed by production and auxiliary units.
- c) P or P+A, and also with U+D chains and/or I+C chains

If the Statistical Enterprise is formed only by productive Legal Units (case a), it is not necessary to discount internal flows in the economic variables, it is only necessary to add said type of variables of all the productive Legal Units that form it.

In the remaining situations (cases b and c), the statistical enterprises contain Legal Units with linking relationships. It is thus necessary to identify the flows between them in order to cancel the Statistical Enterprise's internal transactions.

7.2.2 Consolidation

For this subprocess, we work with the sample Statistical Enterprises formed by more than one Legal Unit.

The objective of the consolidation is that, once it has been determined that there are Legal Units in the Statistical Enterprise with intra-company relations (that is, relations of vertical process integration, and/or industry-trade relations and/or relations of auxiliary) the servile Legal Units must be combined with the others which they support to identify and subtract these intra-company transactions. The corresponding variables must therefore be combined and consolidated.

The consolidation rules applied are based on documents provided by Eurostat and are the result of working groups and experiences from various countries.

7.2.2.1 Additive and non-additive variables

According to the criteria adopted by Eurostat, the quantitative variables are classified as **additive and non-additive**.

By way of example, the number of companies and employees are considered additive; while variables such as turnover are non-additive.

Qualitative variables are not additive.

7.2.2.2 Consolidation of variables by type of variable

Dichotomous variables (YES/NO): The variable of the Statistical Enterprise will have a value of "YES" if any legal unit had a value of "YES" in that variable.

Non-dichotomous qualitative variables: Ongoing/occasional research. If a Legal Unit carries out continuous research, the Statistical Enterprise will carry out continuous research; if, on the contrary, all the Legal Units carry out occasional research, the Statistical Enterprise will carry out occasional research.

Turnover: The internal flows of the legal units that do not have market activity are discounted and the business figures of the legal units that have market activity within the Statistical Enterprise are added.

Expenditure on Innovation, Personnel (in individuals or in FTE): these are considered additive variables.

7.2.3 Construction of statistics based on Statistical Enterprises

Once processing of the sample Statistical Enterprises formed by various Legal Units is completed, the files of the consolidated enterprises are integrated with those of Statistical Enterprises that are independent Legal Units to give the complete statistic, that is:

- Sampling set of independent Legal Units
- Sample set of Statistical Enterprises whose records condense information from one or more Legal Units of company groups

After that, we proceed to calculate the elevation factors for Statistical Enterprises. This will generate high statistical results which, after appropriate analysis, will form the Innovation Survey based on the Statistical Enterprise.

8 Tabulation of results

The exploitation of results that are presented in this publication has been structured as follows:

- Results by branch of activity (CNAE-2009)
- Results by Autonomous Communities and Cities
- Sampling errors

The tables are presented taking three classification variables into account:

- Main activity group, according to CNAE-2009 codes
- Size of the enterprise by employed staff
- Autonomous community

This publication presents the main results that provide an overview of innovation activities and that could be useful for the different users of this information. Current computerised tools allow for the information needs of international bodies (OECD, EUROSTAT, UNESCO), national agencies and private users to be met through custom requests for aggregate data, which may be provided in the medium or format chosen by the user, provided that statistical secrecy is safeguarded.

This publication is available on the National Statistics Institute's website (www.ine.es).