

Chapter 4. Measuring business innovation activities

This chapter deals with the measurement of innovation activities, complementing the measurement of innovations as outcomes. It identifies eight major types of activities that firms may undertake in pursuit of innovation, namely research and experimental development; engineering, design and other creative work; marketing and brand equity activities; intellectual property; employee training; software development and databases; acquisition or lease of tangible assets; and innovation management activities. Acknowledging that these activities may be carried out for purposes other than innovation, this chapter provides guidelines for identifying the innovation-related content of resources dedicated to these activities. It also makes proposals for identifying follow-on activities to innovations as well as planned innovation activities and expenditures shortly after the reference year.

4.1. Introduction and main features of innovation activities

4.1. This chapter provides a framework for measuring business innovation activities, which are defined in Chapter 3 as “all developmental, financial and commercial activities, undertaken by a firm, that are intended to result in an innovation” carried out during the observation period for data collection. Therefore, this chapter deals with the measurement of innovation *efforts*, complementing the measurement of innovations as *outcomes* which were covered in the previous chapter.

4.2. Business innovation activities have the following features:

- Firms can perform innovation activities in-house or source goods or services for innovation activities from external organisations.
- Innovation activities may be postponed or abandoned during the observation period due to multiple reasons.
- Innovation activities can create knowledge or information that is not used to introduce an innovation during the observation period. This includes knowledge from activities that fail to meet their primary innovation goals.
- Firms can use the results of their innovation activities, including innovations, new knowledge, and new information for their own benefit within the observation period, they can retain the results for their own use until a later date, or they can transfer, sell or license the results to other firms or organisations.

4.3. Different innovation activities are typically linked to each other as part of a goal-oriented process that can require multiple recursive steps before resulting in an innovation. Innovation activities can be undertaken informally or follow a systematic approach comprising organised and formal processes to evaluate opportunities for introducing changes, for example through the use of analysis, creativity and problem-solving methods.

4.4. Many activities of potential relevance to innovation can be conducted for other purposes that serve to enhance business performance without necessarily being intended for innovation. Indeed, some firms may not be aware of the innovation potential of their activities. It is recommended in this chapter to collect data on a range of innovation-relevant activities, for all types of firms, including non-innovative firms. This recommendation is in recognition of the value of such data for research into the performance (e.g. productivity) effects of expenditures that are not directly related to innovation compared to those that are. In addition, data on expenditures for knowledge-based capital (KBC) (intellectual property [IP], know-how, skills, etc.) and tangible capital (equipment, buildings, machinery, etc.) are useful for analysing embodied technological change.

4.5. Qualitative data on business involvement in different activities of potential value to innovation can provide evidence on the capabilities of all types of firms – whether innovative or innovation-active (see subsection 3.5.1) –, the specific activities that firms undertake to develop innovations, and the types of activities that are conducted internally versus acquired from external sources. This information can be used to create different profiles of how firms innovate and identify the different types of knowledge and other assets that are used to develop innovations.

4.6. Innovation activities can be managed as separate “innovation projects” or undertaken as an ad hoc addition to other business functions. All activities for innovation exhibit some degree of overlap or close interrelationship and can be conducted sequentially or concurrently for one or more innovation projects.

4.7. This chapter is structured as follows. Section 4.2 of this chapter identifies eight types of activities that are relevant for innovation. Section 4.3 contains guidance on collecting qualitative data on the incidence of innovation activities in firms. Two methods for collecting expenditure data on innovation activities are described in section 4.4. Section 4.5 provides suggestions for additional data collection on innovation activities. Section 4.6 summarises the recommendations of this chapter.

4.2. Types of activities of relevance to innovation

4.8. This chapter identifies eight broad types of activities that firms can undertake in pursuit of innovation:

1. research and experimental development (R&D) activities
2. engineering, design and other creative work activities
3. marketing and brand equity activities
4. IP-related activities
5. employee training activities
6. software development and database activities
7. activities related to the acquisition or lease of tangible assets
8. innovation management activities.

4.9. While these activities may be part of business innovation efforts, they may not be carried out with that explicit goal. The measurement of these generic activities complements the characterisation of firms as innovation-active or non-active, as defined and explained in Chapter 3. This section describes these eight activities and gives guidance on how to assess whether they constitute innovation activities.

4.2.1. Research and experimental development activities

4.10. Research and experimental development (R&D) comprises creative and systematic work undertaken in order to increase the stock of knowledge and to devise new applications of available knowledge. According to the *Frascati Manual 2015* definition (OECD, 2015: § 2.5 to 2.7), R&D activities must meet five criteria: (i) novel; (ii) creative; (iii) address an uncertain outcome; (iv) systematic; and (v) transferable and/or reproducible. R&D comprises basic research, applied research, and experimental development.

4.11. **R&D as an innovation activity:** by definition, applied research is directed towards a specific practical aim or objective, while experimental development seeks to produce new products or processes or to improve existing products or process. Hence, there is an intention for innovation. Although basic research to enlarge a firm's knowledge stock may not be used to pursue specific innovations during the observation period, for practical reasons, all types of R&D carried out or paid for by business enterprises are considered by definition as innovation activities of those firms. Sections 4.3 and 4.4 below provide further clarification.

4.2.2. Engineering, design and other creative work activities

4.12. Engineering, design and other creative work cover experimental and creative activities that may be closely related to R&D, but do not meet all of the five R&D criteria. These include follow-up or auxiliary activities of R&D, or activities that are performed independently from R&D.

4.13. Engineering involves production and quality control procedures, methods and standards. Activities include the planning of technical specifications, testing, evaluation, setup and pre-production for goods, services, processes or systems; installing equipment, tooling up, testing, trials and user demonstrations; and activities to extract knowledge or design information from existing products or process equipment (“reverse engineering”).

4.14. For many service firms, design and other creative work constitutes their main creative activity for innovation. While these activities often result in knowledge, they seldom meet the functional novelty and uncertainty requirements for R&D, or are conducted on an ad hoc basis.

4.15. Design includes a wide range of activities to develop a new or modified function, form or appearance for goods, services or processes, including business processes to be used by the firm itself. The goal of product design is to improve the attractiveness (aesthetics) or ease of use (functionality) of goods or services. Process design, which can be closely linked to engineering, improves the efficiency of processes. Common features of product design activities include involving potential users in the design process (through surveys of potential users, ethnographic research, co-creation, or project user groups), pilot testing on a sample of potential users, and post-implementation studies to identify or solve problems with a particular design. Product design capabilities and design thinking methods are discussed in greater detail in Chapter 5.

4.16. Other creative work includes all activities for gaining new knowledge or applying knowledge in a novel way that do not meet the specific novelty and uncertainty (also relating to non-obviousness) requirements for R&D. Other creative work includes ideation (the creative process of generating new ideas), the development of concepts for innovations, and activities related to organisational change as part of product or business process innovation activities.

4.17. **Engineering, design and other creative work as an innovation activity:** most design and other creative work are innovation activities, with the exception of minor design changes that do not meet the requirements for an innovation, such as producing an existing product in a new colour. Identifying the use of design thinking methodologies by firms can help to differentiate minor design changes from innovation activities. Many engineering activities are not innovation activities, such as day-to-day production and quality control procedures for existing processes. Engineering activities for reverse engineering, or to alter or introduce new production processes, services or delivery methods, may or may not be an innovation activity, depending on whether these activities are conducted for innovation or for other reasons.

4.2.3. Marketing and brand equity activities

4.18. Marketing and brand equity activities include market research and market testing, methods for pricing, product placement and product promotion; product advertising, the promotion of products at trade fairs or exhibitions and the development of marketing strategies. They also include advertising for trademarks that are not directly related to a specific product, such as advertising linked to the firm’s name, as well as public relations activities that contribute to a firm’s reputation and brand equity. Sales and distribution activities are not part of marketing and brand equity activities.

4.19. **Marketing and brand equity activities as an innovation activity:** marketing activities for existing products are only innovation activities if the marketing practice is itself an innovation. For many companies only a small fraction of marketing expenditures

is likely to be linked to product innovations introduced within the observation period. Relevant innovation activities include preliminary market research, market tests, launch advertising, and the development of pricing mechanisms and product placement methods for product innovations. In some cases, the advantages of a business process innovation could also be marketed, for instance if the business process innovation has environmental benefits or improves product quality.

4.2.4. Intellectual property related activities

4.20. IP related activities include the protection or exploitation of knowledge, often created through R&D, software development, and engineering, design and other creative work. IP activities include all administrative and legal work to apply for, register, document, manage, trade, license-out, market and enforce a firm's own intellectual property rights (IPRs), all activities to acquire IPRs from other organisations such as through licensing-in or the outright purchase of IP, and activities to sell IP to third parties. IPRs include patents, utility patents, industrial designs, trademarks, copyright, integrated circuit designs, plant breeder's rights (new plant varieties), geographical indications and confidential information such as trade secrets (WIPO, 2004).

4.21. **IP- related activities as an innovation activity:** IP activities for ideas, inventions and new or improved products or business processes developed during the observation period are innovation activities. Examples include activities to apply for IP rights for an innovation or for an invention, licensing-in the right to use an invention or an innovation, or licensing-out IP for inventions and innovations. All IP activities for inventions made before the observation period and for products and business processes that existed before the observation period should be excluded.

4.22. Respondents to data collection exercises may find it difficult to differentiate IP activities for innovation from IP activities for existing products or business processes, particularly if IP is managed in a separate division with its own budget and there is a large IP portfolio under management.

4.2.5. Employee training activities

4.23. Employee training includes all activities that are paid for or subsidised by the firm to develop knowledge and skills required for the specific trade, occupation or tasks of a firm's employees. Employee training includes on-the-job training and job-related education at training and educational institutions.

4.24. **Employee training as an innovation activity:** employee training activities for the use of existing products or business processes, the upgrading of general skills, or language training are not innovation activities. Examples of training as an innovation activity include training personnel to use innovations, such as new software logistical systems or new equipment; and training relevant to the implementation of an innovation, such as instructing personnel or customers on the features of a product innovation. Employee training that is required to develop an innovation, such as training for R&D or for design, are respectively part of R&D activities or part of engineering, design and other creative work.

4.2.6. Software development and database activities

4.25. Software development and database activities include:

- The in-house development and purchase of computer software, programme descriptions and supporting materials for both systems and applications software (including

standard software packages, customised software solutions and software embedded in products or equipment).

- The acquisition, in-house development and analysis of computer databases and other computerised information, including the collection and analysis of data in proprietary computer databases and data obtained from publicly available reports or the Internet.
- Activities to upgrade or expand the functions of information technology (IT) systems, including computer programmes and databases. This includes statistical data analysis and data mining activities.

4.26. Costs associated with the use of and access to computer and other information and communication technology (ICT) services, such as cloud storage and processing services, can be part of software development and database activities if incurred with that purpose. However, computer and IT services to maintain hardware systems are generally not a software development and database activity.

4.27. Software development and database activities include activities that may be unrelated to innovation, such as minor upgrades to existing software (either developed in-house or purchased) and the purchase and analysis of databases for accounting and other routine business functions.

4.28. **Software development and database activities as innovation activity:** software development is an innovation activity when used to develop new or improved business processes or products, such as computer games, logistical systems, or software to integrate business processes. Database activities are an innovation activity when used for innovation, such as analyses of data on the properties of materials or customer preferences.

4.2.7. Activities related to the acquisition or lease of tangible assets

4.29. These activities include the purchase, lease, or acquisition through a takeover of buildings, machinery, equipment, or the in-house production of such goods for own-use. Equipment includes items such as instruments, transport equipment and computer hardware for IT systems. Tangible assets owned by the firm remain in corporate balance sheets for more than one year. The acquisition of tangible assets is covered within the category of gross fixed capital formation in national accounts for the relevant asset categories. A firm's financial statements will provide information on expenditures for additions to property, plant and equipment. Balance sheets will reflect the overall value of the stock of assets. In addition to acquiring or developing on own account such assets, firms may secure their services by leasing or renting them from external parties. This includes payments for cloud services to use assets such as servers. Such costs represent an indirect measure of use.

4.30. **Acquisition or lease of tangible assets for innovation:** the acquisition or lease of tangible assets can be innovation activities in their own right, such as when a firm purchases or leases equipment with significantly different characteristics than the existing equipment that it uses for its business processes. The acquisition of tangible capital goods is generally not an innovation activity if it is for replacement or capital-widening investments that are unchanged, or if it consists of only minor changes compared to the firm's existing stock of tangible capital.

4.31. The lease or rental of tangible assets is an innovation activity if these assets are required for product or business process innovations. The measurement of innovation activity should be robust to business decisions on whether to own outright or rent an asset

to be used for innovation. For example, leasing additional building space for a design lab may be an innovation activity. Likewise, the use of third-party cloud services for transforming and making operations more efficient may contribute to a business process innovation or support the delivery of new products to customers.

4.2.8. Innovation management

4.32. Innovation management includes all systematic activities to plan, govern and control internal and external resources for innovation. This includes how resources for innovation are allocated, the organisation of responsibilities and decision-making among employees, the management of collaboration with external partners, the integration of external inputs into a firm's innovation activities, and activities to monitor the results of innovation and to support learning from experience. Innovation management includes activities for establishing policies, strategies, objectives, processes, structures, roles and responsibilities to deal with innovation in the firm, as well as mechanisms to assess and review them. Information on innovation management is relevant to research on the efficiency of expenditures on innovation activities to generate sales or other innovation outcomes (see Chapter 5 for further details on innovation management).

4.33. Innovation management practices are relevant to innovation-active firms, although the degree of formality and the complexity of these practices can differ considerably between firms. Respondents from firms with only ad hoc innovations based on the acquisition or lease of tangible assets may not recognise that their firm has innovation management practices. As innovation management activities are not relevant to non-innovative firms, it is recommended to collect qualitative data on innovation management practices for innovation-active firms only. Subsections 4.3.2 and 5.3.4 discuss the type of data that can be collected on firms' innovation management activities and capabilities.

4.34. An innovation management practice that is potentially relevant to all firms is searching external sources for ideas for innovation. Firms that search external sources for ideas will not be innovation-active if they decide not to develop an idea during the observation period. It is recommended to collect data on search activities in questions on knowledge sources for innovation (see subsection 6.3.3) for all types of firms if possible.

4.3. Collecting qualitative data on the incidence of innovation activities

4.35. The guidance in this section concerns the collection of qualitative data on the incidence of specific activities of potential relevance to innovation within firms, identifying those that are explicitly conducted in pursuit of innovations.

4.3.1. Internal and externally sourced activities

4.36. Many innovation activities can be conducted in-house, procured from external organisations, or based on a combination of intramural and extramural activities. Furthermore, inputs to the innovation process can be obtained from other enterprises or from organisations outside the Business enterprise sector. Other enterprises include affiliated enterprises linked by ownership to the respondent firm, either located in the same country or abroad. Firms that belong to an enterprise group should be instructed to consider other enterprises of their group as external organisations. Procurement typically includes activities that are contracted-out for a fee to an external organisation that conducts a series of activities as a service to the firm that may be pursuing an innovation. There may be other arrangements for sourcing activities externally (see Chapter 6).

4.37. Firms can provide a series of knowledge-based services, such as design, training, marketing, consulting, software or IP services, to other firms or organisations on a contractual basis. However, the firms that provide these services are not considered to be innovation-active (see Chapter 3) unless they conduct innovation activities with the intention to introduce an innovation themselves. This restriction is necessary from a measurement perspective because the firm that provides these activities as a service may not know if the contractor intends to use their services for innovation or not.

4.38. An exception to this restriction is for firms that provide R&D services to other firms or organisations. By convention, all R&D is an innovation activity and consequently it is generally not necessary to determine if R&D services are for innovation. Applied research and experimental development are directed towards producing specific outcomes. Even basic research may be ultimately aimed towards innovation even though, as defined, it may not have a specific immediate commercial application or use in mind (OECD, 2015: § 7.47).

4.39. Data on the incidence of activities and expenditures for innovation activities other than R&D (design, training, software, etc.), that are conducted by external organisations, should be collected from the firm that procured such services. The firm that purchases these activities will know if the activities were intended to support its innovation efforts or not. However, data on extramurally performed R&D can be collected from firms that perform R&D as a service and from firms that procured R&D. Data from both groups can be of interest in countries where specialised R&D firms conduct a considerable amount of R&D for foreign firms. However, when aggregating R&D expenditure data at the national level, it is important to avoid double counting R&D reported by both the procurer and the service provider.

4.40. One consequence of the division of labour for innovation (see Chapters 3 and 6) is that firms providing services that generate knowledge of potential value to the innovation activities of other firms or organisations can represent an important input to an economy's total innovation performance. Consequently, it may be of interest for research on the division of labour for innovation to collect data on the prevalence of such firms.

4.3.2. Qualitative data on specific activities related to innovation

4.41. It is recommended to collect qualitative data on the performance of activities listed in section 4.2 above for all types of firms (innovative and non-innovative as defined in Chapter 3). Questions on innovation management should only be addressed to firms that report one or more activities for innovation. For all firms, qualitative data should be collected on:

1. whether each activity was conducted, regardless of its purpose
2. whether each activity (other than R&D) was conducted in pursuit of one or more innovations.

4.42. It may also be of interest to collect additional data on whether the identified innovation activities were conducted in-house or procured from external organisations, as shown in Table 4.1.

Table 4.1. Collection of qualitative data on activities relevant to innovation

Type of activity	Any activity (either in-house or procured)	Activity conducted in-house for innovation	Activity procured from external sources for innovation
R&D activities			
Engineering, design and other creative work activities			
Marketing and brand equity activities			
IP-related activities			
Employee training activities			
Software development and database activities			
Activities related to the acquisition or lease of tangible assets			
Innovation management activities			

4.43. Although each type of innovation activity is distinct, there are areas of overlap. For example, some software development, design, and employee training activities can be part of R&D (see below). It is recommended that qualitative data collection on the use of each activity should accept possible overlaps and avoid the use of detailed instructions aimed at preventing them.

4.44. Additional information can be collected for specific activities. Examples are if in-house R&D activities are conducted continuously or occasionally, if investment in tangible assets includes ICT equipment or not, or if IP-related activities include acquiring different types of IPRs (patents, industrial designs, trademarks, etc.). In addition, it may be of interest to further disaggregate data collection for specific innovation activities. For instance, it could be of interest to collect separate data for “engineering activities” and for “design and other creative work”, or for “software development” and “database activities”.

4.4. Collecting expenditure data on innovation activities

4.45. Data on the cost of activities of relevance to innovation are in high demand for both research and policy purposes. This section describes two methods for collecting expenditure data: collecting data for specific activities and collecting data by accounting categories.

4.4.1. Conceptual issues in measuring innovation expenditures

4.46. Expenditures on most innovation activities, other than expenditures on tangible assets, are closely related to the measurement of capital formation on what the System of National Accounts (SNA) defines as intellectual property products (IPPs) and comprise (EC et al., 2009; OECD, 2010):

- research and experimental development
- mineral exploration and evaluation
- computer software and databases
- entertainment, literary and artistic originals; and other IPPs.

4.47. **Capital expenditures** are the annual gross amount paid for the acquisition of fixed assets and the costs of internally developing fixed assets. These include gross expenditures

on land and buildings, machinery, instruments, transport equipment and other equipment, as well as IPPs such as computer software and databases, R&D-based assets and other IP assets. Fixed assets must have a useful life of greater than one year (EC et al., 2009). **Current expenditures** include all costs for labour, materials that last for less than one year, and the costs for leasing fixed assets.

4.48. Other types of knowledge-based assets are still not considered to be within the SNA production boundary and are therefore excluded from official estimates of capital formation. The scope of measurement efforts to capture an enlarged category of **intangible or knowledge-based assets** (see Corrado, Hulten and Sichel 2006; Awano et al., 2010; Goodridge, Haskel and Wallis, 2014) is very close to the list of activities in Table 4.1. In addition to the SNA's IPPs, the concept of knowledge-based assets also includes efforts to invest in brand equity, design, and organisational capital (see also subsections 2.4.2 and 5.2.2).

4.49. The measurement of capital formation in IPPs or extended KBC focuses on capturing additions to the asset stock of the relevant IPP, and therefore excludes activities which are not expected to deliver benefits for more than one year. Expenditures on activities of relevance to innovation include capital and current expenditures. On the other hand, not all capital formation is aimed at innovation.

4.50. Although there are slight differences in the way in which IPP capital formation and innovation expenditures are accounted for in general and the way in which specific items are conceptualised, it is useful to compare any figures collected for consistency.

Reference period

4.51. While collecting data for a multi-year observation period is feasible for qualitative indicators on activities, it is recommended that data collection should **focus on the survey reference year** in order to reduce the response burden and thereby improve data quality. An exception is when the object method is used to collect data on the resources used for an individual innovation project (see Chapter 10), which could cover several years. In case the firm's fiscal year deviates from the reference year, data on expenditures should be requested for the fiscal year that best matches the reference year.

Challenges

4.52. The quality of data on expenditures on innovation activities can be impaired by several factors. For example, many types of expenditure by activity are not directly available from a firm's accounting systems. A firm may collect data for all training expenditures, but it might not divide these into general training and training for innovation. Furthermore, information may be dispersed across different parts of the firm in a manner that it is difficult for respondents to bring together consistently.

4.4.2. Expenditures for specific innovation activities

4.53. It is recommended to collect total expenditure data for each of seven activities for all firms, as shown in Table 4.2. Additional data on expenditures for each (innovation) activity can be collected for innovation-active firms only in order to determine the share of innovation-related expenditures within each activity. Details on the assignment of innovation expenditures to each activity are given below. Although there is an eighth type of innovation activity relating to innovation management (see subsection 4.2.8), it is only recommended to collect qualitative data on this category (see subsection 4.3.2) and not expenditure data, hence why it is excluded from Table 4.2.

Table 4.2. Collecting expenditure data on specific activities of relevance to innovation

	Type of activity	Total expenditures (all firms)	Expenditures for innovation (innovation-active firms only)
1.	R&D activities (include definition)		
2.	Engineering, design and other creative work activities		
3.	Marketing and brand equity activities		
4.	IP-related activities		
5.	Employee training activities		
6.	Software development and database activities		
7.	Activities related to the acquisition or lease of tangible assets		

4.54. The overlap between some innovation activities can cause respondents to incorrectly assign expenditures to the wrong activity or, in some cases, to double count expenditures in two or more activities. The assignment of expenditures is based on a hierarchical structure that gives preference to creative activities such as R&D over supporting activities such as IP-related activities, marketing and brand equity activities, and employee training. In addition, there is a hierarchy within creative and supporting activities. For creative activities, R&D is given preference over software development and database activities, which in turn is given preference over engineering, design and other creative work. For supporting activities, the category of IP and related activities is given preference over the category of marketing and brand equity activities, which is then given priority over employee training.

4.55. Details on what is included as an innovation expenditure for each innovation activity are as follows:

- **R&D expenditures** are described in subsection 4.2.1 above. These should include expenditures on IP licenses for generic research tools for use in R&D and expenditures on tangible goods for R&D purposes; as well as expenditures on design activities or software development activities that meet the five criteria for R&D activity as defined above. Design and software development activities can also be part of R&D if the results are incorporated in an R&D project and if the outcome is uncertain (OECD, 2015: § 2.62). Firms that perform R&D or other innovation activities as a service to other firms can be instructed to include these expenditures under the column “Total expenditures” and to only include their expenditures for their own innovations in the (second) column “Expenditures for innovation”.
- Expenditures for **engineering, design and other creative work** activities include all activities identified in subsection 4.2.2, except for the costs of design and engineering activities that meet the criteria for R&D and which should be reported under R&D. Expenditures to train employees in design, engineering or creative methods should in principle be included here. Data on expenditures for the acquisition of external design services can usually be obtained from a firm’s income statement.
- Expenditures for **marketing and brand equity** activities include all activities identified in subsection 4.2.3, including expenditures for training for marketing and brand marketing activities. Expenditures for trademarks should be reported under IP activities. Data on expenditures for the acquisition of external marketing and advertising services can often be obtained from a firm’s income statement.
- Expenditures for **IP-related activities** include all current expenditures for the activities identified in subsection 4.2.4. These should include expenditures on training for

managing IP and on the acquisition of trademarks for marketing and brand equity activities. The cost of purchasing external IP for R&D should be reported under R&D. Data on expenditures for managing IPRs can often be obtained from the cost of the respective department in the firm (in the case of larger organisations) or by combining the labour costs of in-house personnel, application and registration costs, and costs for external services. Data on expenditures for the acquisition of external IP often can be obtained from balance sheet data (additions to the respective categories of intangible assets). It is advisable, whenever possible, to break down this category by different types of IP.

- Expenditures for **employee training** include all direct and indirect costs related to training for a firm's employees, as identified in subsection 4.2.5. Direct costs include fees for external courses, travel and subsistence payments while attending training courses, teaching materials, labour costs for in-house training of personnel, and administrative and other costs for in-house training centres. Indirect costs refer to the labour costs of employees for time spent on training, including time for on-the-job training. Two activities should be excluded from expenditures on employee training: (i) expenditures for training customers or other persons not employed by the firm; and (ii) expenditures for initial vocational training (e.g. training of apprentices). Data on the direct costs for employee training often can be obtained from a firm's human resources department.
- Expenditures for **software development and database** activities include all expenditures on the activities identified in subsection 4.2.6. Data on software development and database activities should be available from balance sheet data (additions to capitalised software and databases), although some additions for non-capitalised costs will need to be made. There are two exclusions for this activity: expenditures on computer software that is used to perform R&D should be reported under R&D, and data collection costs for market research should be reported as part of marketing expenditure.
- Expenditures for the acquisition or lease of **tangible assets** include the costs of all activities listed in subsection 4.2.7 obtained through purchase or lease, plus the costs of in-house production of such goods for own-use as a capitalised service, but excluding capitalised expenditures for R&D. This expenditure category consists of capital expenditures on the purchase of tangible assets and current expenditures for leasing tangible assets. Data on capital expenditures can be obtained from a firm's balance sheet (additions to property, plant and equipment). Data on leasing costs can be obtained from a firm's income statement.

4.56. Respondents may find it difficult to assign the resources for innovation to the correct activity, even when provided with instructions. For example, respondents in service sector firms that perform design work but do not have an R&D department could fail to recognise that some of their design activities may meet the criteria for R&D. This could result in underestimates or overestimates of the amount of resources given to specific activities, but it should not substantially affect estimates of total innovation expenditures

4.57. The sum of expenditures for specific innovation activities in Table 4.2 may not equal a firm's total innovation expenditure since firms may conduct innovation activities other than those listed, e.g. activities related to business process innovation in administration and management. The following section provides an alternative means for collecting data on total innovation expenditure.

4.4.3. Expenditures by accounting categories for innovation-active firms

4.58. The accounting method collects data on innovation expenditures for five standard accounting categories that are widely used by firms: R&D, personnel costs, purchases of external services, purchases of materials, and expenditures on capital goods.

4.59. Firms that perform R&D usually maintain records about their R&D expenditures for a range of possible statistical and administrative reporting requirements. At the same time, some R&D-performing firms might only report R&D expenditure when asked for their total innovation expenditure, for instance if they do not use the concept of innovation in their internal accounting and reporting system and therefore believe that R&D is the accounting category that comes closest to the concept of innovation. In order to collect data on total innovation expenditure that is as accurate and complete as possible, it is recommended to clearly separate between R&D and non-R&D expenditure and to include guidance to help firms identify the latter. Table 4.3 shows the categories to be used for collecting total innovation expenditure. The data should be collected for the reference year.

Table 4.3. Accounting method for collecting expenditure data on activities for innovation

	Expenditure on	Total expenditures for innovation (innovation-active firms only)
1.	R&D (include definition)	
1.a	Intramural R&D (include personnel cost, materials and other supplies and purchase of capital goods for R&D activities)	
1.b	Extramural R&D (purchase of R&D services from other parties)	
2.	Innovation activities other than R&D	
2.a	Own personnel (excluding cost of R&D personnel)	
2.b	Services purchased from other parties (excluding purchase of R&D services)	
2.c	Materials and other supplies (excluding materials/supplies for R&D)	
2.d	Capital goods (purchased tangible and intangible assets) (excluding purchase of capital goods directly related to R&D activities)	

4.60. Firms should be instructed to provide their best estimates for non-R&D expenditure, for example by estimating the share on non-R&D personnel conducting innovation activities and using this share to determine “own personnel costs for innovation activities other than R&D”. Similar guidance can be given for the other three categories of non-R&D expenditure. Extramural innovation expenditures are captured by the items “purchase of R&D services” and “services purchased from other parties (excluding purchase of R&D services)”.

4.61. Additional details on each accounting category for innovation expenditures are as follows:

- **R&D expenditure data** can be collected following the recommendations in Chapter 4 of the *Frascati Manual 2015* (OECD, 2015). **Intramural R&D expenditures** are all current expenditures plus gross fixed capital expenditures for R&D. Intramural R&D costs on capital items should also be included, whereas any depreciation costs on capitalised R&D or physical assets used in R&D should be excluded. **Extramural R&D expenditures** cover the purchase of R&D services from other parties.
- **Expenses for own personnel** include all wage and salary expenses for employees engaged in innovation activities other than R&D. The personnel costs of employees that spent only a part of their time on non-R&D innovation activities should be covered proportionally. An alternative method, based on person-months, can be offered to respondents that cannot estimate personnel costs.

- **Expenditures for services** purchased from other parties include all expenses for services that are used in innovation activities and not already part of R&D (extramural R&D).
- **Expenditures for materials and other supplies** include all expenses for material inputs that are used in innovation activities and have not been included in R&D.
- **Capital expenditures** include the costs of the acquisition of tangible and intangible capital goods, such as machinery, equipment, buildings, land, capitalised software and other externally purchased capital goods. The acquisition of capital goods that are included in intramural R&D expenditure should be excluded. Capitalised own-produced assets (e.g. in-house produced capitalised software, capitalised development costs) that are not for R&D should be included.

4.62. Respondents should be instructed to include both capital and current expenditures for innovation activities under the relevant headings. No depreciation provisions for tangible or intangible assets should be included in the current expenditure data to avoid double counting with related capital expenditures.

4.63. When using the accounting method for collecting innovation expenditure, special instructions need to be given for firms with R&D expenditure to report only non-R&D expenditure in the categories 2.a to 2.d listed in Table 4.3 and not to include any R&D expenditure on personnel, materials, capital goods or purchased R&D services in these categories.

4.4.4. Sources of funds for innovation activities

4.64. Expenditures on innovation activities can be disaggregated by the source of funds. Collecting data on the funding source is useful for assessing the role of government investments and financial markets in the innovation process. There are many potential sources of funding for innovation including:

- own funds (retained profits or income from asset disposal)
- transfers from affiliated firms (holding, subsidiary or associated companies located in the domestic country or abroad)
- customer orders (including procurement contracts from domestic or foreign governments or international organisations)
- shareholder loans
- debt funding from commercial loans (banks, credit cards etc.), overdraft facilities or suppliers' credit
- loans from governments
- loans from international organisations
- equity from private equity or venture capital firms, business angels or other individuals (family and friends)
- grants or subsidies from domestic or foreign governments, international organisations, non-governmental organisations, etc.
- bonds and obligations
- other sources (e.g. crowdfunding).

4.65. Data collection can aggregate the above categories, for instance by creating one category for all internal sources of finance and a second category for all external sources of finance. Alternatively, data collection can focus on specific sources, such as funds provided by governments, or divide external sources into domestic and international sources of funds.

4.66. It may be sufficient for a variety of policy and research issues to collect information on whether or not each source is used, instead of seeking an estimate of the amount (either in monetary or percentage terms) contributed by each source.

4.5. Other data on innovation activities

4.5.1. *Collecting data on human resources for innovation activities*

4.67. For specific innovation activities, managers can find it difficult to estimate expenditures that are not performed by a separate reporting unit within the firm and which mainly involve internal labour costs. This can result in poor quality expenditure estimates for innovation activities that mostly consist of labour costs, such as training; engineering, design and other creative work; and marketing and brand equity activities.

4.68. For these activities, requesting estimates of the number of person-months (on a full-time equivalent [FTE] basis) allotted to each activity could improve data quality. Person-month data on innovation activities should only be collected for activities that mostly involve labour costs, or in industries where firms are unlikely to be able to provide accurate expenditure data, such as small firms in service industries. If other data are available on average hourly wages or monthly salary costs, expenditures could be estimated by combining person-month estimates with wage and salary data.

4.5.2. *Data on innovation projects*

4.69. Many innovation-active firms organise their innovation activities as innovation projects, defined as a set of activities that are organised and managed for a specific purpose and with their own objectives, resources and expected outcomes (see Chapter 3). Respondents can be asked if their firm organises some or all of its work to develop innovations into recognised projects, or they can be asked about a specific innovation project (see Chapter 10).

4.70. Information on innovation projects can complement other qualitative and quantitative data on innovation activities. Data on the number of projects for innovation can provide indicators on the variety and diversity of innovation activities. Disaggregated data on the number of projects for product and for business process innovations can be used to determine the relationships between innovation goals, firm capabilities, and business strategies (see Chapter 5).

4.71. Collecting data on a single innovation project can provide detailed information on innovation investments, using the “object approach” discussed in Chapter 10. Cognitive testing indicates that respondents find it easier to provide expenditure or FTE data for innovation activities relating to a single innovation project than for all innovation activities combined (the “subject approach”).

4.72. For firms that organise their innovation activities on a project basis, it can be useful to obtain the following information, either for all innovation projects combined or disaggregated into projects for product and business process innovations:

- the number of innovation projects undertaken during the observation period
- the number of innovation projects completed during the observation period

- the number of innovation projects ceased before completion during the observation period
- the number of ongoing innovation projects at the end of the observation period.

4.73. The number of completed, ceased, and ongoing innovation projects should equal the total number of innovation projects during the observation period. The exact definition of what constitutes an innovation project should be left to the firm's actual practice, allowing the respondents to collect the required information from the firms' project management tools or similar sources.

4.74. Information on the number of innovation projects is not primarily intended to produce an aggregate figure of the total number of projects for a firm or industry, but rather to derive indicators at the firm level, such as the share of completed projects, the share of projects stopped before completion, or the share of projects to develop product vs. business process innovations.

4.5.3. Follow-on activities

4.75. Innovation activities occur before and up to the date of introduction of a product innovation or implementation of a business process innovation. Firms can also conduct marketing activities, employee training, demonstrations and other services for users of an innovation after its implementation, but within the observation period. These follow-on activities can be critical for the success of an innovation, but they are not included in the definition of an innovation activity.

4.76. Data collection can obtain qualitative data on three particular follow-on activities:

- **Follow-on marketing** comprises all efforts to promote the sale of a product innovation in the market, including advertising, sales promotion at trade fairs, altering distribution channels, etc.
- **Follow-on training** includes all in-house training of employees related to the use of product or business process innovations during the observation period. It also includes activities to familiarise potential and current users with a firm's product or process innovations, e.g. through demonstration activities or the training of users.
- **After-sales services** include all services provided by an innovative firm to improve the utility of an innovation for its users. These can include installation, updating and repair services, guarantee and return schemes (which can reduce uncertainty for users), and information services (including websites or other forums to facilitate communication among users).

4.77. Collecting information on follow-on activities can be particularly useful if the information is collected for specific innovations, as in the object-based approach discussed in Chapter 10.

4.5.4. Planned innovation activities and expenditures

4.78. Data on a firm's future plans for innovation activities can provide information about the possible development of innovation in an economy or industry in the near future. Data on planned innovation activities can also be useful for producing more timely indicators that help assess the likely impact of recent changes in the innovation environment of firms, for instance changes in innovation support programmes or innovation-related regulation.

4.79. Given the uncertain nature of innovation, collecting data on planned innovation activities should refer to the immediate present and the very near future. Information on planned activities can be collected for the year in which data are being collected (nowcasting), which is usually the year after the reference year, and for no more than two years after the reference year.

4.80. If data on planned activities are collected, it is of interest to ask respondents if their firm plans to conduct any innovation activities in the one or two years after the reference year on a “yes” or “no” basis and if the total innovation expenditures compared to the reference year (if any) are expected to increase, stay the same, or decrease. Questions on planned expenditures should immediately follow questions on innovation expenditures in the reference year to ensure that the same definitions of innovation expenditures are used.

4.81. Additional questions could query the types of innovations that are planned for the near future (using the innovation typology in section 3.3) or the types of planned innovation activities outlined in this chapter.

4.82. Since many firms will not have decided on whether or not to invest in innovation activities in the near future or how much they will spend, a separate “Don’t know” response category must be provided. This information can be useful in its own right because it provides information on the level of uncertainty about future innovation activities and expenditures.

4.6. Summary of recommendations

4.83. This chapter identifies innovation activities of value to policy and for research. Recommendations of questions for general data collection are given below. Other types of data covered in this chapter are suitable for specialised data collection exercises.

4.84. Key questions for general data collection include:

- qualitative data on whether or not each of the eight activities were conducted, identifying in each affirmative case whether the activity was conducted for innovation (subsection 4.3.2)
- whether or not each activity was conducted in-house or procured from external organisations (subsection 4.3.1)
- total expenditures for each of seven activities (subsection 4.4.2)
- total innovation expenditures using the accounting method (subsection 4.4.3)
- funding sources for innovation (subsection 4.4.4).

4.85. Supplementary questions for general data collection (given space or resources) are:

- additional information for specific activities, such as whether R&D activities are conducted continuously or on an occasional basis (subsection 4.3.2)
- innovation expenditures by funding source (subsection 4.4.4)
- follow-on activities (subsection 4.5.3)
- planned innovation activities and expenditures (subsection 4.5.4).

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