

Chapter 1. Introduction to innovation statistics and the *Oslo Manual*

Innovation is central to improvements in living standards and can affect individuals, institutions, entire economic sectors, and countries in multiple ways. Sound measurement of innovation and the use of innovation data in research can help policy makers better understand economic and social changes, assess the contribution of innovation to social and economic goals, and monitor and evaluate the effectiveness and efficiency of their policies. Since 1992, the Oslo Manual has been the international standard of reference for conceptualising and measuring innovation. It has since been revised on three occasions to account for growing levels of adoption and address evolving user needs. The manual provides the basis for a common language to discuss innovation, the factors supporting innovation, and innovation outcomes. This chapter sets out the rationale for measuring innovation and summarises the objectives pursued by this edition of the manual. The chapter outlines the contents of the manual and highlights the main definitions and other major novelties introduced in this edition. The chapter concludes with an overview of the main implementation challenges amidst a context of digital transformation of our economies and societies.

1.1. Objectives and background of the *Oslo Manual*

1.1.1. *The origins of the Oslo Manual*

1.1. Innovation is central to improvements in living standards and can affect individuals, institutions, entire economic sectors, and countries in multiple ways. Policy can contribute directly and indirectly to setting the direction of innovation and shaping how its effects are distributed. Sound measurement of innovation and the use of innovation data in research can help policy makers better understand economic and social changes, assess the contribution (positive or negative) of innovation to social and economic goals, and monitor and evaluate the effectiveness and efficiency of their policies (OECD, 2010).

1.2. Measurement requires an understanding of what needs to be measured and awareness of what can be reliably measured. In response to strong policy demand for empirical evidence on innovation, the *Oslo Manual* addresses both requirements, and supports further experimentation to improve and extend innovation data. The manual identifies best practices for data collection on innovation, facilitates international comparability, and provides a platform for research on innovation measurement. The manual plays a key role in communicating that innovation often does not require research and experimental development (R&D) and that innovation also involves the diffusion of existing technologies and practices across an economy.

1.3. The first edition of the *Oslo Manual* was issued in 1992 (OECD, 1992) and covered innovation in manufacturing industries. “Oslo” in the title of the manual is a reference to the city where the guidelines were first approved by the OECD Working Party of National Experts on Science and Technology Indicators (NESTI). Innovation surveys based on the 1992 edition included the European Community Innovation Survey (CIS) and comparable surveys in Australia and Canada. These surveys showed that it was possible to develop and collect data on complex and differentiated innovation phenomena.

1.4. The second edition (OECD/Eurostat/EU, 1997) updated the concepts, definitions and methodology to incorporate accumulated survey experience as well as greater understanding of the innovation process. This edition included guidelines for measuring innovation in several service industries in addition to manufacturing. It expanded the guidance for developing internationally comparable innovation indicators for OECD countries and discussed analytical and policy problems that could be addressed using innovation data and indicators.

1.5. Both the first and second editions limited innovation to new or significantly improved “technological” products and processes. This reflected a focus on the technical development of new products and new production techniques and their diffusion to other firms. The measurement of “non-technological” innovation, however, was discussed in an annex to the second edition.

1.6. The third edition (OECD/Eurostat, 2005) built on a large amount of data and experience gained from the rapid adoption of innovation surveys worldwide, including in economies at very different levels of economic development. The third edition expanded the innovation measurement framework: it gave greater emphasis to the role of linkages with other firms and institutions in the innovation process, recognised the major importance of innovation in traditionally less R&D-intensive industries, and modified the definitions of innovation and innovation activities to accommodate innovation in market-based service industries. The identification of product and process innovation with technological change was abandoned in order to include service innovations that significantly improved user experiences without necessarily having a technological component. The definition of

innovation was extended to include two additional and complementary types: organisational and marketing innovation. The third edition also included an annex on measuring innovation in developing countries, reflecting widespread interest in this topic.

1.7. The revisions to the *Oslo Manual* over time reflect continual evolution in expert consensus on what can and should be measured. This evolution is due to ongoing changes in economic and social factors, such as the nature of innovation and how it occurs, as well as the accumulation of measurement experiments and the sharing of experiences among experts interested in measuring innovation. Increasing societal awareness of innovation-related phenomena has also expanded interest in new targets for measurement. Yet despite these advances, there are still major gaps in evidence and questions about the role of innovation and what policies can do to influence it. One of the main objectives of this fourth edition of the *Oslo Manual* is to address some of these gaps and outstanding questions.

1.1.2. Main objectives of the fourth edition

1.8. Published 13 years after the release of the manual's third edition, this fourth edition seeks to strengthen its relevance as a source of conceptual and practical guidance for the provision of data, indicators and quantitative analyses on innovation. The role of the *Oslo Manual* as a key guideline for policy analysis and discussion was highlighted in the Group of Twenty (G20) Innovation Action Plan (G20, 2016) endorsed by G20 Leaders in Hangzhou, the People's Republic of China, in September 2016. The summit demonstrated high-level interest by the governments of the world's largest economies in good innovation measurement to assist policy, as well as reaffirming the OECD's role in supporting this objective.

1.9. The 2016 OECD Blue Sky III Forum (<http://oe.cd/blue-sky>) stressed the need to extend the measurement of innovation to the broader economy and society. With this in mind, NESTI proposed that this fourth edition also become a platform for future experimentation and guidance by discussing key innovation concepts in a broader sense and by providing a general definition of innovation, as requested by many stakeholders. Consequently, despite the *Oslo Manual's* focus on measuring innovation in the Business sector, the fourth edition includes a framework for measuring innovation in all sectors using a common definition. This explains why the title of the fourth edition does not refer explicitly to business innovation.

1.10. At the outset of the revision process, participants agreed that the fourth edition of the *Oslo Manual* should incorporate the following substantial extensions and improvements:

- Include general definitions and concepts of innovation applicable to all four economic sectors (Business, Government, Non-profits serving households, and Households). These are necessary for developing future guidelines for measuring innovation in sectors other than the Business sector.
- Ensure that the recommendations are relevant to both developed and developing countries so that the manual provides effective global guidance.
- Ensure consistency with the 2015 edition of the *Frascati Manual* for measuring R&D (OECD, 2015) and major statistical frameworks and guidelines, including the System of National Accounts (SNA) (see EC et al., 2009).
- Address the ongoing digitalisation of the economy and society, as identified in the OECD project "Going Digital" (www.oecd.org/sti/goingdigital.htm). The manual covers digital perspectives in several chapters and provides guidance on measuring innovation in digital products, platforms, and data capabilities.

- Fully reflect changing models of innovation, including those relating to open innovation, global value chains and global innovation networks.
- Apply the evidence and experience accumulated over the past decade to address long-standing challenges (subjectivity and international comparability, interpretation of the novelty and improvement requirements for innovation, quantitative measurement of innovation inputs and outputs, coverage of non-R&D-based innovation, etc.).
- Promote the collection of a broader set of data of relevance to both non-innovative and innovation-active firms, for instance on investments in knowledge-based capital (KBC) and on the internal and external conditions in which firms operate and decide to undertake innovation-relevant practices. This is required for analyses of the drivers and enablers of innovation.
- Provide in-depth discussion of survey methodology, plus the implications of data collection methodologies on data quality, timeliness, and international comparability.
- Discuss how statistical data on innovation can be used to support research, management, and policy, including indicator development and how to assess the effectiveness of policies to support innovation.

1.1.3. Scope and approach of the fourth edition

1.11. With the exception of the introductory chapter, this fourth edition of the *Oslo Manual* focuses on innovation in the Business enterprise sector, including, in many cases, government-owned enterprises. The approach of the fourth edition is as follows:

- Collect innovation data using statistically representative samples of firms in the Business sector. Although new data sources are available, such as from the Internet, many of them do not share the desirable features of representative samples from the population of interest. Consequently, the manual recommends the use of representative surveys as the preferred method for data collection. Where feasible, these can be complemented with additional representative surveys or by linking surveys to administrative data.
- Highlight how responses to survey questions are influenced by survey methods and questionnaire design. In particular, it is advised not to combine an innovation survey with an R&D survey.
- Primarily collect data using a subject-based approach that captures all of a firm's innovation activities. This can be complemented with additional information on the firm's most important innovation (or the most important innovation activity, or change for non-innovative firms), also known as an object-based approach.

1.12. While anchored in accumulated experience, this fourth edition provides ample discussion and suggestions to support necessary experimentation in the measurement of business innovation. It also highlights instances where advanced digital tools can be used for data collection and analysis, both to provide new types of data that can result in additional insights and to reduce respondent burden in surveys.

1.13. This manual is designed as a freely accessible open standard that provides guidance on what innovation statistics should be collected, how they should be compiled and how they can be used. Adherence to the guidelines will improve the uniformity and comparability of innovation data collected by a large number of organisations. Although not designed with this purpose in mind, the manual can provide a reference for policy or

regulatory uses, for instance linking policies to specific innovation activities and outcomes described in the manual. In addition, the adoption of its concepts and definitions by innovation managers and practitioners would facilitate data collection.

1.1.4. The Oslo Manual and other statistical standards

STI measurement standards

1.14. The OECD produces a series of measurement manuals under the title “The Measurement of Scientific, Technological and Innovation Activities”. Each manual presents internationally agreed methodological guidelines and proposals for the collection, reporting, and use of data and indicators on science, technology and innovation (STI). The OECD commenced its activities on setting STI statistical standards with the *Frascati Manual*, first published in 1963. While relatively recent compared to other manuals, the *Oslo Manual* is a central component of the OECD family of statistical guidelines on the measurement of STI.

1.15. Over time, additional manuals have been added, such as the OECD Patent Statistics Manual (OECD, 2009a). Manuals in this series are periodically revised to take into account new challenges and developments. The scope of the series will also continue to expand in line with developments in the field.

Links to general statistical standards and statistics

1.16. The *Oslo Manual* makes extensive use of and pursues full alignment with United Nations’ statistical classifications. These include the SNA 2008 (EC et al., 2009) and the International Standard Industrial Classification of All Economic Activities (ISIC) (UN, 2008).

1.17. External classifications are regularly updated by the relevant organisations in charge. The references in this manual to other statistical documents are for the editions at the time of this manual’s publication (printed edition and electronic file). An updated set of references is maintained on line as an annex.

1.18. This manual follows the recommendations in the SNA 2008 to treat expenditures on R&D, as well as on other forms of knowledge, as investments in capital assets, rather than as an expense. This affects how gross domestic product (GDP) is measured and how growth accounting exercises interpret the contribution of innovation-related activities to economic growth.

1.19. While the SNA does not currently recognise many types of innovation activities as capital formation (other than R&D and software), the development of satellite innovation accounts is part of the measurement agenda in many countries that is also converging with an interest in satellite accounts that map the extent of digital economic activities. Further progress on integrating innovation data in economic statistics will require sustained efforts to improve the measurement of innovation activities and their costs and benefits to businesses, as well as documenting the lifespan of innovations in order to contribute to the measurement of obsolescence and depreciation.

1.20. Furthermore, the SNA is used to define the Business enterprise sector (the primary scope of this manual, see Chapter 2) and to define other sectors where innovation has been measured by researchers and statisticians.

Links to other standards

1.21. In parallel with work to produce the fourth edition of the *Oslo Manual*, the OECD established a relationship with the International Organization for Standardization's (ISO) technical committee on Innovation Management, responsible for developing standards for the innovation management ISO 50500 series. The exchange between the two expert groups of the OECD and ISO covered different perspectives on the definitions of innovation and innovation management, with the OECD requiring definitions suitable for innovation measurement and the ISO requiring definitions for standardisation. The discussions led to an alignment of the definitions, taking into account the different objectives of the *Oslo Manual* and of the ISO standards.

1.2. Structure and contents of the *Oslo Manual 2018*

1.22. The 2018 edition of the *Oslo Manual* comprises three Parts that provide a general presentation of innovation measurement (Part I), a framework and guidelines for measuring business innovation (Part II), and practical guidance on methodologies for collecting and using innovation data (Part III).

1.2.1. Introduction to the measurement of innovation (Part I)

Concepts for measuring innovation (Chapter 2)

1.23. Chapter 2 explains the purpose of the manual and what makes innovation distinctive from other related phenomena such as invention or R&D. It sets out the basic concepts of innovation, including in sectors other than the Business enterprise sector.

1.24. The chapter uses internationally accepted statistical frameworks to identify the boundaries of the Business enterprise sector (the focus of this manual) and other sectors of an economy. However, actors in other sectors also play a role in the innovation system and can contribute to innovation in the Business enterprise sector. The chapter identifies connecting elements that link sectors to allow for future guidance to refer to the same underlying phenomenon. The requirement for measurability is an essential criterion for selecting the concepts, definitions and classifications in this manual. This feature sets the manual apart from other documents that conceptualise and define innovation.

1.25. The chapter concludes with a general definition of innovation that is relevant to all sectors and discusses the potential measurement of innovation in other sectors of an economy. The general definition of an innovation for all types of units is as follows:

*An **innovation** is a new or improved product or process (or combination thereof) that differs significantly from the unit's previous products or processes and that has been made available to potential users (product) or brought into use by the unit (process).*

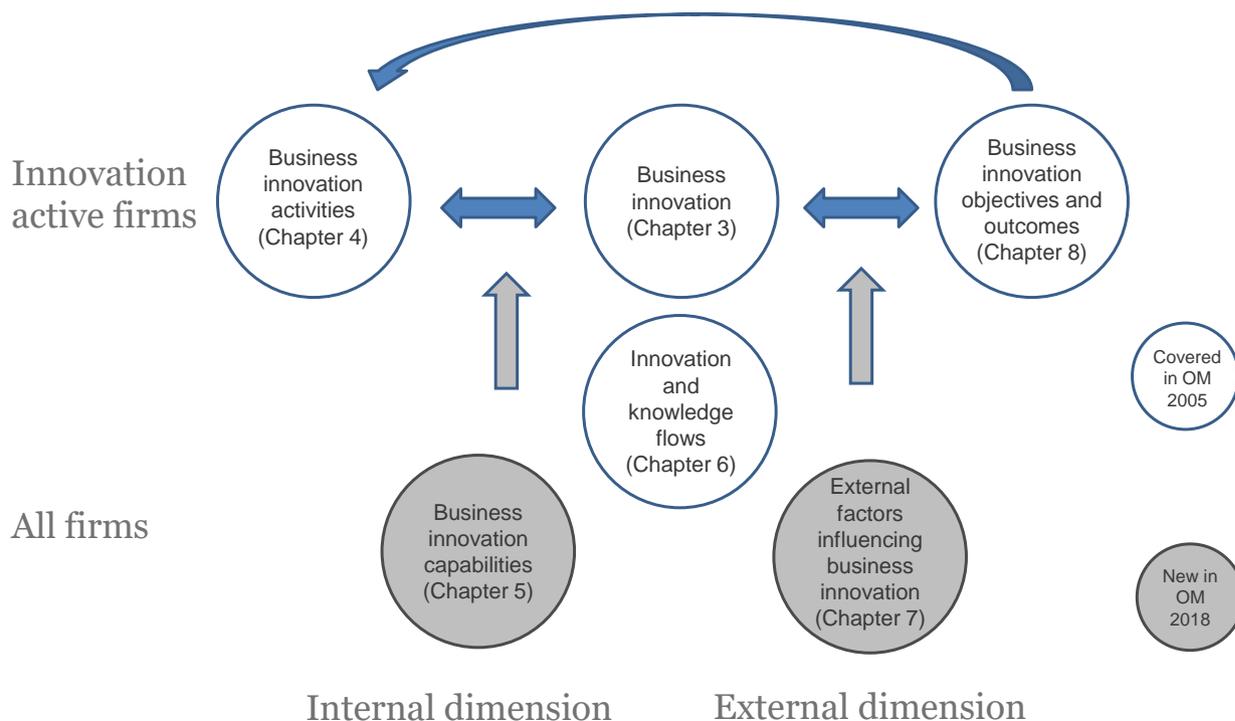
1.26. The general definition uses the generic term "unit" to describe the actor responsible for innovations. It refers to any institutional unit in any sector, including households and their individual members. The definition is appropriate for measuring innovation developed by individuals, a key goal identified at the 2016 Blue Sky Forum.

1.2.2. Framework and guidelines for measuring business innovation (Part II)

1.27. Part II of the *Oslo Manual* describes the innovation process in firms and the relationship between firms, their competitive environment, and the innovation system in

which they are embedded. Compared to the third edition, this edition contains an extensive discussion of the external environment of firms. This complements chapters on the definition of innovation, the measurement of innovation activities, internal capabilities, knowledge-based linkages for innovation, and innovation outcomes. Figure 1.1 provides a schematic representation of the relationship between the chapters in Part II of this manual.

Figure 1.1. General representation of the relationship between chapters in Part II



1.28. This manual emphasises the value of collecting data on all firms, regardless of their innovation activities and outcomes, as this can help improve understanding of the key drivers and potential implications of innovation.

Concepts and definitions for measuring business innovation (Chapter 3)

1.29. Chapter 3 provides a set of definitions to guide statistical surveys of innovation within the Business sector. The definitions in this chapter facilitate the collection and reporting of comparable data on innovation and related activities for firms in different countries and industries and for firms of different sizes and structures, ranging from small single-product firms to large multinational firms that produce a wide range of goods or services.

1.30. The chapter resolves the duality of “innovation” as a *process* and as an *outcome* by providing separate definitions for both concepts:

***Innovation activities** include all developmental, financial and commercial activities undertaken by a firm that are intended to result in an innovation for the firm.*

*A **business innovation** is a new or improved product or business process (or combination thereof) that differs significantly from the firm's previous products or business processes and that has been introduced on the market or brought into use by the firm.*

1.31. Compared to the third edition, a major consideration in revising the definition of business innovation was the decision, based on cognitive testing work, to reduce the complexity of the previous list-based definition, comprising four types of innovations (product, process, organisational and marketing), to two main types: product innovations and business process innovations. The revised definition also reduces the ambiguity of the requirement for a “significant” change by comparing both new and improved innovations to the firm’s existing products or business processes. The chapter provides detailed explanations of the definition of business innovation and provides guidance on what does not constitute an innovation. The basic definitions of a product and business process innovation are as follows:

*A **product innovation** is a new or improved good or service that differs significantly from the firm’s previous goods or services and that has been introduced on the market.*

*A **business process 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 by the firm.*

1.32. Business process innovations concern six different functions of a firm, as identified in the business management literature. Two functions relate to a firm’s core activity of producing and delivering products for sale, while the others concern supporting operations. The six main business functions have a reasonable match with the third edition’s categories of process, marketing and organisational innovations.

1.33. The definitions for innovation and innovation activity lead to guidance on how firms can be characterised:

*An **innovative firm** reports one or more innovations within the observation period. This applies equally to a firm that is individually or jointly responsible for an innovation.*

*An **innovation-active firm** is engaged at some time during the observation period in one or more activities to develop or implement new or improved products or business processes for an intended use. Both innovative and non-innovative firms can be innovation-active during an observation period.*

1.34. In common usage the term “innovative” can refer to a potential ability or propensity to innovate in the future, creativity, a type of product or process, etc. In contrast, the term “innovative” is only used in this manual for a specific meaning: to identify whether a firm has an innovation over a given time period. The meaning of this adjective is restricted to a single purpose to avoid misunderstanding. Adaptations of this manual to different languages should replicate the precision in definitions. This also applies to innovation indicators, which should be given labels or headings that do not mislead users.

1.35. A non-innovative firm is innovation-active if it had one or more ongoing, suspended, abandoned or completed innovation activities that did not result in an innovation during the observation period. A number of activities, such as an experiment or co-creation exercise, can be completed without resulting in an innovation within the observation period.

Business innovation activities (Chapter 4)

1.36. Chapter 4 provides a framework for measuring business innovation activities. The chapter identifies eight types of activities that firms can undertake in pursuit of innovation, although many of these largely knowledge-based activities can also be carried out for other, more general purposes:

- R&D activities
- engineering, design and other creative work activities
- marketing and brand equity activities
- intellectual property (IP) related activities
- employee training activities
- software development and database activities
- activities relating to the acquisition or lease of tangible assets
- innovation management activities.

1.37. The chapter recommends collecting data on whether or not firms conduct each of these activities and whether they do so in pursuit of innovation. Similarly, data collection on expenditures for these activities should first determine all expenditures on each activity, for any purpose, followed by a question, for innovation-active firms only, on expenditures specifically for innovation. Data for all firms on each activity can provide useful information on the role of investment in KBC (intangible investment) on the propensity to innovate and economic performance. It is also useful to determine if activities are conducted in-house or procured from external sources.

1.38. The chapter proposes that questions on expenditures for innovation should make a distinction between R&D expenditures, for which records exist in most firms, and expenditures for other innovation activities. Expenditures can also be collected for personnel costs and for other major accounting categories. The measurement of expenditures on innovation activities other than R&D is an ongoing challenge. The chapter proposes several alternative approaches to innovation activity measurement. Experiments with these methods should lead to improvements in the accuracy of collected data.

Business innovation capabilities (Chapter 5)

1.39. Chapter 5 is a new chapter that was not included in previous editions of the *Oslo Manual*. Business capabilities include the knowledge, competencies and resources that a firm accumulates over time and draws upon in pursuit of its objectives. Collecting data on business capabilities is of critical importance for analyses of the effect of innovation on firm performance and why some firms engage in innovation activities and others do not.

1.40. Numerous business capabilities can potentially support innovation activities, the development of product or business process innovations, and the economic impact of these innovations. The chapter provides measurement options for four types of capabilities that are relevant for research on the innovation performance of all firms:

- the resources controlled by a firm
- the general management capabilities of a firm
- the skills of the workforce and how a firm manages its human resources
- the ability to design, develop and adopt technological tools and data resources, with the latter providing an increasingly important source of information for innovation.

Business innovation and knowledge flows (Chapter 6)

1.41. Chapter 6 focuses on the measurement of inward and outward information and knowledge flows and linkages between firms and other actors in the innovation system and extends the third edition's coverage of these topics. The chapter provides an introduction to theories of knowledge flows and open innovation that describe innovation in the Business sector as a distributed process based on managed knowledge flows across organisational boundaries.

1.42. The chapter builds on previous experience with capturing knowledge flows in innovation surveys. Mapping knowledge flows and the diffusion of innovations would benefit from the use of non-survey data sources to identify the linkages between actors, outputs and outcomes. The chapter recommendations cover data collection on the role of other firms or organisations in the development and adoption of innovations by a firm (extending Chapter 3), collaborative activities for innovation, the main sources of ideas and information for innovation, and the role of IP in knowledge flows. Additional guidance is provided on measuring the linkages between firms, universities, and public research organisations and the barriers and challenges for engaging in knowledge exchanges with external parties.

External factors influencing business innovation (Chapter 7)

1.43. Chapter 7 is new to the fourth edition of the manual and complements Chapters 5 and 6 by promoting the measurement of the firm's external environment as well as the associated challenges and opportunities that managers need to consider when making strategic choices, including for innovation. These factors include customers, competitors and suppliers; labour markets, legal, regulatory, competitive and economic conditions, and the supply of technological and other types of knowledge of value to innovation.

1.44. The chapter identifies the main elements of the external environment and provides priorities for data collection. Markets are a leading contextual factor that is often shaped by the firm's own decisions. The chapter also provides guidance on measuring the direct and indirect effects of public policy on innovation activities, social and environmental factors, and external factors that can hinder innovation.

Objectives and outcomes of business innovation (Chapter 8)

1.45. Chapter 8 reviews different approaches to measuring innovation objectives and outcomes. It discusses a number of qualitative measures of the variety of innovation objectives and outcomes pursued by firms. This is followed by an evaluation of quantitative measures of innovation outcomes for product and business process innovations. This chapter also discusses limitations in the measurement of outcomes that are further developed in Chapter 11.

1.2.3. Methods for collecting, analysing and reporting statistics on business innovation (Part III)

Methods for collecting data on business innovation (Chapter 9)

1.46. Chapter 9 provides guidance on the methodologies for collecting data on business innovation. The chapter focuses on the use of surveys, discussing the different steps for producing data, from setting objectives and priorities with stakeholders to data release and microdata storage. Compared to previous editions of the manual, there is considerably more

guidance on methods for assessing question items and the implications of using different survey methods. The importance of the length of the observation period is highlighted and discussed.

1.47. Survey questions need to be carefully formulated to be correctly understood by potential respondents. All respondents must interpret questions as intended by the concepts and definitions in this manual. Many concepts and definitions cannot be used verbatim in a question, but require careful adaptation. Key terms often need to be adapted to match the language used by potential respondents in different cultural, regional and national contexts. In some cases, more than one question item may be needed to obtain data that matches a definition or a concept (see Chapter 3). The chapter also covers several practical issues that were included in the third edition's Annex on "Innovation Surveys in Developing Countries".

Object-based approaches for measuring and analysing business innovation (Chapter 10)

1.48. Chapter 10 is a new chapter that discusses the use, in innovation surveys, of the object approach to innovation – namely collecting data on a single, "focal" innovation (the object of study). This method can complement data collected through the subject approach, which covers all of a firm's innovation activities. The main purpose of the object approach is to support analytical and research uses, as well as helping data producers assess statistical quality (e.g. potential over or under-reporting of innovation). Under some conditions, the object approach can also be used to construct indicators.

Using innovation data: statistical indicators and analysis (Chapter 11)

1.49. Chapter 11 is a new chapter that addresses the use of statistical data to construct indicators and for multivariate analyses. These are key outputs of data collection that can describe and shed insights into business innovation phenomena. This final chapter provides guidance not only to those producing indicators in an official capacity, but also to other interested users of innovation data, including academics, policy analysts or managers. Other users could draw on the manual to guide their own data collection, analysis, and construction of innovation indicators.

1.50. The first half of the chapter discusses the concept of indicators, major available resources, and methodologies for constructing statistical indicators of innovation, both from a micro and a macro perspective. It also discusses approaches for summarising aggregate information on innovation into dashboards, scoreboards and composite indexes. It presents a blueprint for the production of statistical indicators of innovation by thematic areas, drawing on the recommendations in previous chapters.

1.51. The second half of the chapter describes methods for analysing innovation data, with a major focus on the analysis of innovation impacts and the empirical evaluation of innovation policies. This includes an introduction to the distributed, multi-country analysis of innovation microdata as featured in OECD (2009b).

1.2.4. Cross-cutting issues covered within this manual

1.2.5. Digitalisation and innovation

1.52. Digitalisation entails the application of digital technologies to a wide range of existing tasks and enables new tasks to be performed. Digitalisation has the potential to transform business processes, the economy and society in general. Although this manual

only provides a few concrete examples of digitalisation processes, due to their rapid obsolescence and replacement, it introduces several new elements that can contribute to a better understanding of digitalisation, both as an innovation process in its own right and as a key factor driving innovation. Examples include:

- Recognition of the role of information from both a product and business process innovation perspective (Chapter 3). The definition of product innovation comprises intellectual products that exhibit features of both goods and services, as is often the case for digitised information. This is of particular importance for industries that specialise in developing and selling information content. The definition of business process innovation adopts a business function typology that separates innovations within the firm's information and communication function. Innovation in data-based business models is also discussed.
- Recognition of data development activities, along with software, as a potential innovation activity (Chapter 4). Data accumulation by companies can entail significant direct or indirect costs, for example when a firm gives away for free, or at a discounted price, the use of goods or services that generate a stream of information of value for advertising existing products. In addition, the information could also be used to improve business decision processes that result in product or business process innovations.
- Data management competences are highlighted as key potential innovation capabilities that innovation surveys should capture, directly or indirectly, in order to assess the factors influencing innovation and related outcomes within firms (Chapter 5). This chapter provides a basis for analysing the interrelationships between data-based competences and other competences such as skills, general management and design. The chapter also promotes the measurement of advanced technology development and use, in close co-ordination with surveys on information and communication technology use in firms.
- The analysis of knowledge flows related to innovation (Chapter 6) is relevant to digitalisation, with decentralised collaboration models supported by digitised knowledge.
- Digitalisation is also relevant to the discussion on external factors influencing innovation (Chapter 7), such as the nature of a firm's markets and the extent to which a firm uses digital platforms. Consumer and societal perspectives such as trust are also relevant to digitalisation.

1.53. Digitalisation is also a key driver of measurement opportunities. Digital sources and tools can be used:

- To collect information on innovation outside the Business sector, even though these digital sources and tools were not originally developed for statistical purposes (Chapter 2).
- In identifier technology in combination with available sources to reduce respondent burden, such as identifying a most important business partner (supplier or customer) or innovation collaborator, thus avoiding complex matrix-based questions (Chapter 6).
- To obtain statistical data on innovation and business characteristics and to reduce respondent burden (Chapter 9).

- To implement leaner and more secure electronic methods for collecting survey data from respondents, minimising potential sources of bias and facilitating the collection of inputs from different divisions within a firm (Chapter 9).
- To collect qualitative information from respondents on their most important innovations or changes (Chapter 10) and apply semantic analysis tools in a semi- or entirely automated fashion to determine if the description is consistent with the responses obtained on key items, such as whether innovation has been under- or over-reported.
- To analyse and visualise data on innovation (Chapter 11).

1.2.6. Globalisation and innovation

1.54. This manual provides a number of tools aimed at supporting the analysis of globalisation and its relationship with innovation. As in the previous edition, the measurement of knowledge flows aims to make a distinction between domestic flows and those with the rest of the world (Chapter 6). The importance of identifying the role of multinational enterprises (MNEs) is for the first time highlighted for measuring innovation capabilities (Chapter 5), characterising knowledge flows with other parts of the business group (Chapter 6) as well as describing the position of the firm in the value chain (Chapter 7) through questions on the location of business functions. Furthermore, the methodological discussion in Chapter 9. also addresses some of the specificities associated with collecting data from MNEs.

1.3. Implementing the guidance in this manual

1.3.1. Nature of the guidance in this manual

1.55. The purpose of this manual is to guide innovation data collection and reporting efforts through a common vocabulary, agreed principles and practical conventions. These can enhance the comparability of statistical outputs and support the progressive development of a global statistical information infrastructure on innovation that is relevant and useful for researchers and decision makers alike.

1.56. The manual is a statistical resource that contains guidelines for applying concepts, definitions, classifications, taxonomies and statistical methods for collecting innovation statistics about the Business sector. The manual makes recommendations and identifies possible approaches for experimentation. Within the OECD context, the recommendations are not mandatory, but member countries are nonetheless expected to conform to recommendations to the best of their ability. This is required in order to produce internationally comparable data that can provide a global public information good on innovation.

1.57. The manual allows for a significant degree of discretion on how different countries or groups of countries undertake their surveys. As measurement results are sensitive to the choice of survey methods, it is difficult to obtain international comparability without uniformity in data collection and reporting practices. Although uniformity is not feasible in an OECD or global setting, greater convergence in methods should be possible and aimed for. To this end, the OECD works with other international organisations and networks that support statistical capability development and the sharing of experiences on collecting innovation data.

Glossary of terms and online annex material

1.58. Definitions represent one of this manual's major contributions. As an additional resource, a glossary is included for the first time in this edition of the *Oslo Manual*, following the example of the latest edition of the *Frascati Manual* (OECD, 2015). The glossary of terms facilitates translation efforts to different languages as well as reference checks.

1.59. Online annex material is expected to be developed and evolve to complement guidance in the printed edition of the *Oslo Manual*, following the example of the latest edition of the *Frascati Manual*. Relevant resources, including links to updated classifications, can be found at <http://oe.cd/oslomanual>.

1.3.2. Transition and implementation

1.60. The revision of this manual entails a number of changes that require implementation and adaptation over a transition period for both the producers and users of innovation statistics. Implementing recommendations for surveys can take time. Throughout a transition period, the wording used in survey forms, databases and reports needs to be tested and adapted to the local context in which it is used. Cognitive testing with potential respondents and consultation with key stakeholders is strongly recommended.

1.61. The continuity with previous innovation data is of great importance and has been an overarching consideration throughout the fourth edition. Changes in practices have been introduced that will or might imply breaks or discontinuities in data series. Therefore, it is important for practitioners to identify possible breaks in series and to work collectively to build bridges between previous and new data, especially on the incidence of generic types of innovation for which an approximate correspondence has been established in Chapter 3. This will facilitate the enhanced maintenance and use of innovation data on a time series basis.

1.62. Burdens on data producers and respondents should also be considered. There is no expectation that all recommendations for new questions will be introduced at once. The manual provides suggestions for assigning priority to different questions. Some questions can also be rotated on a two, four or six-year cycle in order to minimise respondent burden. Other questions can be included in surveys as experiments to collect evidence on key knowledge gaps outside the traditional core set of questions.

1.63. Experience shows that unilateral country-level experimentation may fail to yield the expected results due to a lack of historical information or international benchmarking opportunities. It is therefore useful to engage in multilateral collaboration efforts across national statistical organisations and agencies in charge of innovation surveys to co-ordinate the content and timing of experimental questions. This will contribute to a more valuable set of statistical resources for users in the years to come.

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