2 The *Oslo Manual*

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1. INTRODUCTION

Rules are needed to guide the measurement of innovation in ways that are reproducible over time and that give results comparable across jurisdictions. The *Oslo Manual* provides these rules. The *Oslo Manual* is used in countries belonging to the OECD, the EU, the African Union and in others. This chapter provides a history of the development of the *Oslo Manual* and reviews some of the consequences of its use.

Experts at the OECD have been discussing innovation, its place in policy, and the need to measure it and its impacts, for more than 30 years (OECD 1992a: 3, 1992b). In the 1990s, experts in the working groups of Eurostat, the European statistical office, joined in the discussion as part of managing the EU Community Innovation Survey (CIS), described in Chapter 3. While the policy imperatives change from day to day, the need to measure and understand the activity of innovation remains. Over the years of discussion, a common vocabulary and grammar have emerged that facilitate the discussion, and the rules for measuring innovation have been codified in manuals on three separate occasions.

As mentioned in Chapter 1, indicators are like technologies and practices;[1] they are produced and adopted, they diffuse and they can be changed by users or the users can communicate the need for change to the producers of the manuals. Users of manuals who feel that the manual does not solve their problem can develop a new manual. In this chapter, there are examples of all three activities.

The Role of Experts

The OECD Working Party of National Experts on Science and Technology Indicators (NESTI), as a group of experts, pre-dates the OECD. It goes back to the first meeting of experts in 1957 that gave rise to the first edition of the OECD *Frascati Manual* in 1963 (OECD 2002: 151). The *Frascati Manual* dealt with the collection and interpretation of data on R&D but, over the years, NESTI gave rise to the 'Frascati' family of manuals (OECD 2002: 16) of which the *Oslo Manual*, dealing with innovation, was one.

The OECD working party's membership consists of delegates from the 34 OECD member countries and the European Commission. There are also observers, such as Brazil, China, India, the Russian Federation and South Africa (BRICS), and other international organizations such as the UNESCO Institute of Statistics, the Latin American Ibero-American Network on Science and Technology Indicators (Red Iberoamericana de Indicadores de Ciencia y tecnologia (RICYT)) and the African Union and the NEPAD Planning and Co-ordinating Agency (NPCA). Delegates and observers are a mix of official statisticians or researchers, responsible for the development of statistical indicators, and policy analysts, responsible for the development of policy and for its evaluation once it is implemented. The mix of users and producers ensures that any outcomes of NESTI are grounded in the worlds of statistical measurement and the application of the results.

The OECD is a consensus organization, which means that the case must be argued until delegates are convinced or, at least, will not oppose a decision. Establishing consensus ensures peer learning, which is reinforced by OECD country peer reviews of innovation policy, managed by the OECD at the request of the countries under review. Recent examples are Slovenia (OECD 2012), Peru (OECD 2011a) and the Russian Federation (OECD 2011b). Peer learning, consensus building and peer review are characteristics that make the OECD unique as an international organization and they ensure that products of the committees and working parties are used by the countries that contributed to their creation. Chapters 9 and 12 discuss the role of the OECD in greater detail and Chapters 3 and 4 review measurement issues. This chapter deals with the history of the *Oslo Manual*.

2. THE *OSLO MANUAL* AND DEFINITIONS OF INNOVATION

The first *Oslo Manual* was prepared with support from the Nordic Fund for Industrial Development and presented to NESTI in November 1989, reviewed in 1990 and sent to the Committee for Scientific and Technological Policy (CSTP) for approval in 1991.[2] It appeared in 1992 (OECD 1992a) and it was used to guide the first European Community Innovation Survey (CIS) for reference year 1992. The Community Innovation Surveys, as means of implementing the *Oslo Manual*, are the subjects of Chapters 3 and 4. Those surveys and similar innovation surveys in other countries provided ongoing testing of the definitions and guidelines in the first edition and demonstrated the need for revision, giving rise to the second

edition (OECD/Eurostat 1997). The current manual (OECD/Eurostat 2005) is the third edition.

The review of the progress from the first to the third edition that follows illustrates the growth and importance of the common language introduced in Chapter 1, the role of statistical measurement, policy needs, peer learning in developing the language, and the need to go on developing the language and expanding the community of practice. The work began with technological product and process innovation in manufacturing and expanded to include non-technological innovation, and organizational and market development innovation. The *Oslo Manual* is the set of rules that guides the collection of innovation statistics in 34 OECD member countries, 27 EU member states and a number of other countries, including those that are NESTI observers.

The First Edition

All definitions of innovation in the Oslo manuals require a connection to the market. This has implications for innovation by consumers (Chapter 5), public sector innovation (Chapter 17) and social innovation (Chapter 18). These will be discussed after the third edition has been presented.

The definitions of technological innovation in the first edition were the following:

> 90.[3] Technological innovations comprise new products[4] and processes and significant changes of products and processes. An innovation has been implemented if it has been introduced to the market (product innovation) or used within a production process (process innovation). Innovations therefore involve a series of scientific, technological, organizational, financial and commercial activities. (OECD 1992a: 28)

> 92. *Product Innovation* can take two broad forms: – substantially new products: we call this *major product innovation*; – performance improvements to existing products: we call this incremental *product innovation*. (Ibid.: 29)

> 97. *Process innovation* is the adoption of new or significantly improved production methods. These methods may involve changes in equipment or production organization or both. The methods may be intended to produce new or improved products, which cannot be produced using conventional plants or production methods, or essentially to increase the production efficiency of existing products. (Ibid.)

The following were considered as a non-exhaustive list of innovative activities: R&D; tooling up and industrial engineering; manufacturing

start-up; marketing for new products; acquisition of disembodied technology; acquisition of embodied technology; and design. The point was made that not all innovative activities lead to innovation, as the definition of innovation requires a connection with the market. In addition, not all innovation activities have been measured by surveys, such as the CIS. Design, for example, has been in the *Oslo Manual* from the beginning, but it took some years to enter the CIS.

The manual went on to discuss topics to be probed by surveys, including sources of information for innovation, objectives of the firm, barriers to innovation, impacts and cost. It reviewed survey methods and classifications and observed that 'the population of innovation surveys usually consists of enterprises in manufacturing industry' (OECD 1992a: 57), but suggested that 'it may also be useful to include parts of the service sector, particularly those working directly with manufacturers'. This is a precursor to the revision leading to the second edition of the manual, which included the service sector and other goods-producing industries but not agriculture.

The first revision was also in process at a time when there was a debate about how productive the service sector was and whether its impact, such as it was, was due to manufacturing firms outsourcing some of their innovation activities, such as R&D and industrial design. This may be an explanation for the preoccupation with service firms working directly with manufacturers.

The first CIS, CIS 1, was carried out in Europe for reference year 1992 using the *Oslo Manual* guidelines. This was the beginning of the interaction between official surveys and the Oslo manuals, and it brought Eurostat and the OECD closer together. The second and third editions were joint productions of the two organizations.

Novelty and technology use

The first edition contained topics that would change or vanish in future editions. Examples are novelty of innovation and technology use surveys.

As the first edition dealt with technological innovation, it provided a classification of novelty based on aspects of technology in the innovation. It also provided the classification that would be retained in the third edition: new to the firm, the country or the market, or the world (OECD 1992a: 41), although its implementation in the CIS has been just new to the firm or to the market and the relevant questions have been revised over the years. Most recently, CIS 2012, approved in November 2012 and mandated in Commission Implementing Regulation (EU) No. 995/2012 of 26 October 2012, has a novelty question about innovations being 'A first in [your country]', 'A first in Europe', 'a world first'. The measurement of novelty continues to develop.

Technology use surveys, especially in manufacturing, were appearing while the manual was being developed (Ducharme and Gault 1992) and a section of the manual was devoted to them. These surveys consisted of a list of 'advanced' technologies (Statistics Canada 1987, 1989, 1991; US Department of Commerce 1989) and respondents were invited to say whether they were using or planning to use any of the technologies in the list provided. In the Canadian surveys there were questions initially on user modification of the technologies and later (Arundel and Sonntag 2001; Statistics Canada 2008a) on adoption of the technology by developing it in house. These questions followed the work of von Hippel (1988) and were a first probe by official statisticians of user innovation by firms. User innovation by firms and by consumers is discussed further in Chapter 5 and in Gault (2012).

The *Oslo Manual* took a producer perspective and presented technology use surveys as measures of the diffusion of technologies produced as products by other manufacturing firms. It would take some years before user innovation would become a research question in the measurement community. However, the seed was there in the first manual in paragraph 185 in the sentence: 'Questions about whether the technology was modified to improve productivity or ease of use give insight into the propensity to innovate on the factory floor'.

Before going on to the second edition of the *Oslo Manual*, and before the reader goes to the next chapter, the point is made that the definition of product innovation in all three editions of the *Oslo Manual* required only that the product be introduced to the market. The product did not have to 'generate a return on investment' (Chapter 3) and neither did it have to be 'good'. The introduction of new or significantly improved debt-based financial products by the US financial services industry in 2006 was a classic example of innovation that led to the most significant recession in 70 years from which the world is still recovering.

To discuss toxic financial products as innovations requires a review of the framework conditions in place at the time. Framework conditions, in this case the regulatory environment, can support or prevent innovation. However, this is a handbook on innovation indicators and measurement, not on the innovation system and long-term and shorter-term framework conditions that influence the activity of innovation in the firm. An introduction to the subject can be found in Gault (2010).

The Second Edition

While the first CIS focused on manufacturing, it soon became evident that understanding innovation in service industries was at least as important.

In most industrialized countries, 70 per cent of GDP comes from services and less than 20 per cent from manufacturing. The significant statistic is that half, or more, of GDP comes from marketed services and the remaining 20 per cent or so is in the public sector, education, government and health. Innovation, to be innovation, has to connect to the market, although work is being done on public sector innovation (OECD 2006a; Chapter 17 in this volume) and is being called for on consumer innovation (von Hippel 2005; Chapter 5 in this volume). These initiatives, which could have affected the definition of innovation, were not an issue for the innovation measurement community in 1995 when the revision of the *Oslo Manual* began.

Discussions on measuring innovation in services had been going on for years and reference to such measurement had already been made in the first edition of the *Oslo Manual*. However, there was not the same depth of experience to draw upon as had been built up for manufacturing. This required a widening of the community of discourse and led to the inclusion of innovation in services in the agendas of Eurostat committees and of the UN City Group working at the time on service industry statistics, the Voorburg Group (Gault and Pattinson 1994, 1995). In the revision of the *Oslo Manual*, innovation in services had its own working group, co-chaired by Australia and Canada.

The second edition was an improved version of the first edition, informed by survey experience and policy debate. It continued to deal with technological innovation and confined itself to product and process innovation. However, it had broader economic coverage, including construction, utilities, manufacturing and marketed services. It took advantage of new international classifications, such as the 1993 revision of the system of national accounts (EC et al. 1994), and it recognized the importance of a systems approach to innovation (OECD/Eurostat 1997: 15) and of learning in the transfer of knowledge for innovation (ibid.: 34). Both would have a larger role in the third edition.

While the definitions remained fundamentally the same as those in the first edition, they emphasized the technological aspect of innovation. This may have reflected a view that removing or weakening the reference to technology would admit an uncontrollable flood of non-technological innovations for which the community was not ready. Here is the summary definition, which can be compared with that used in the first edition.

> 130. *Technological product and process (TPP) innovations* comprise implemented technologically new products and processes and significant technological improvements in products and processes. A TPP innovation has been *implemented* if it has been introduced to the market (product innovation) or used within a production process (process innovation). TPP innovations involve

> a series of scientific, technological, organizational, financial and commercial *activities. The TPP innovating firm* is one that has implemented technologically new or significantly technologically improved products or processes during the period under review. (OECD/Eurostat 1997: 47; emphasis in original)

The definition provides an excellent example of why survey questionnaires should never take their definitions uncritically from the *Oslo Manual*. This should not be seen as a criticism of the sometimes arcane language used. It results from lengthy debate at the end of which the use of a word, or the position of the word, may be the only way consensus is achieved. When the questions are put into surveys, the language is, or should be, tested and revised before subjecting respondents to the questions. This is the subject of the cognitive testing project at the OECD (Chapter 9) and it is a practice for introducing new CIS questions (Chapter 3).

Reference to surveys of technology use appears in the second edition, again from a producer perspective as a measure of diffusion. The text is essentially unchanged from the first edition, including the reference to user modification of technologies, which is present in paragraph 259. The importance of learning, of knowledge, and of a systems approach to understanding innovation, reflected the academic literature of the time and the outcomes of the first OECD Blue Sky meeting on new science and technology indicators in 1996 (OECD 2001a).

Following the adoption in 1997 of the second edition of the *Oslo Manual*, and its use in the CIS, the research community worked a great deal on service industries and on innovation in services (Metcalfe and Miles 2000; Boden and Miles 2000; Gadrey and Gallouj 2002; Gallouj 2002). This was not a causal relationship. This was at a time when it was becoming clear that if marketed services accounted for over half of the economy, they should be better understood, and an important aspect of this understanding was how innovation in services worked.

The OECD was also engaged in innovation in services in this period, from a productivity perspective (OECD 2001b), and from the perspective of knowledge intensity and the importance of knowledge in service industries (OECD 2006b). In fact, knowledge (Foray 2007, 2004) attracted much attention in the period before the next *Oslo Manual* edition.

In particular, there was work on knowledge management in the business sector and its relation to innovation. A group working on this, as part of an OECD project, developed a questionnaire (OECD 2003) that had similarities to questionnaires dealing with the use and planned use of technologies. The point to make in this chapter is that the questionnaires used in the countries participating in the project worked. That is, they demonstrated

that information on the use of knowledge management practices could be collected, analysed and used to improve the understanding of firm activity. As a specific example, the use of knowledge management practices was shown to be correlated with innovation (Kremp and Mairesse 2002). This work influenced the second revision of the *Oslo Manual*; the development of innovation indicators and measurement for organizational practices is ongoing (Chapter 10).

By 2002, with the publication of the sixth edition of the *Frascati Manual* (OECD 2002), Eurostat and the OECD were ready to undertake the three years of work needed to produce the third edition of the *Oslo Manual*, although it was not foreseen that it would take as long as it did and be such a challenging process. The hope had been that the new manual could be used by Eurostat to guide the CIS 4. One of the lessons learned from this process was that it was difficult, if not impossible, for a consensus-based organization, with its expert group chaired by a delegate from a member country, to work to a timetable required by a supranational organization where the expert groups are chaired and directed by the Secretariat. As in all such things, it was the good will on both sides that ensured a positive outcome.

The Third Edition

The first thing to notice about the third edition is its title, *Oslo Manual: Guidelines for Collecting and Interpreting Innovation Data* (OECD/Eurostat 2005) and its comparison with the title of the second edition, *Proposed Guidelines for Collecting and Interpreting Technological Innovation Data – Oslo Manual*, (OECD/Eurostat 1997). The word 'technological' has gone and 'proposed' no longer appears in front of 'guidelines'. Both changes are important as non-technological innovation had now been admitted for the purposes of measurement and the *Oslo Manual* provided the guidelines for that measurement. Another influence, given that this was a joint OECD/Eurostat undertaking, was the European Commission Regulation 1450/2004, introduced in August 2004, amended in 2009, which made CIS compulsory for member states of the EU. The language had acquired new vocabulary.

The definition had been expanded.

> 146. An *innovation* is the implementation of a new or significantly improved product (good or a service), or process, a new marketing method, or a new organization method in business practices, workplace organization or external relations.

It was still linked to the market through 'implementation'.

> 150. A common feature of an innovation is that it must have been *implemented*. A new or improved product is implemented when it is introduced on the market. New processes, marketing methods or organizational methods are implemented when they are brought into actual use in the firm's operations.

The definition of an innovative firm remained the same.

> 152. An *innovative firm* is one that has implemented an innovation during the period under review.

The systems approach[5] and knowledge management activities were incorporated in a new chapter on linkages that also addressed networks and network capital. Network capital[6] describes the knowledge stored in the networks that contributed to innovation. While the linkages chapter was a major step forward in providing guidance for the measurement of innovation, it could not deal with the dynamics of change, but it could situate the change in an innovation system.

The classification of novelty in the third edition had nothing to do with technology but was new to the firm, to the market, or to the world (OECD/Eurostat 2005: 57). There was a reference to disruptive innovation (ibid.: 17), as developed by Christensen (1997), but also recognition that it was an impact measure that could not be measured easily by an innovation survey. Disruptive innovation was not a category used for classification in the manual.

Diffusion of innovation was treated in the chapter on linkages and questions were suggested on the developer of the innovation. Was it developed by: the firm; the firm in cooperation with other firms or institutions; or mainly by other firms or institutions (OECD/Eurostat 2005: 84)? This is a very important question when it comes to user innovation and it can be found in CIS 4, CIS 2006 and CIS 2008. In CIS 2010 the question was revised to add a question about whether it was developed by adapting or modifying processes originally developed by the firm or other institutions.

With the modification, three of the questions mirrored the same three questions used in surveys of use and planned use of technologies (next subsection), but there they were about the adoption of a technology and whether the firm adopted by developing the technology itself, by purchasing and modifying the technology or by purchasing an available technology and using it, which would be process innovation if the purchased technology were new to the firm. The collaboration question was not present in the technology use surveys, of which Schaan and Uhrbach (2009) provide an example.

Surveys of technology use

The third edition made no reference to surveys of technology use and planned use or the adoption of technologies by purchase (an innovation, if new to the firm), by purchase and modification (a user innovation by the firm), or by developing the needed technology in the absence of its being available on the market (user innovation by the firm).

This did not mean that technologies were neglected at the OECD. In 1997 the precursor of a new working party, the Working Party on Indicators for the Information Society (WPIIS), was established, under the chairmanship of a NESTI vice chair, to define the ICT sector for statistical purposes and there followed the collection of internationally comparable data on ICT use, but the question of user innovation was not pursued (OECD 2009a).

In the case of biotechnology, an *ad hoc* group established by NESTI produced definitions to support the collection of internationally comparable data (OECD 2009b) and was then dissolved. Definitions and statistics for nanotechnology have moved in the same direction (OECD 2009c).

The history of these initiatives is reviewed in Chapter 15, leading to a discussion of how to generalize the process of identifying emerging and enabling technologies.

However, measurement of the use and planned use of technologies was continued by Statistics Canada (Schaan and Uhrbach 2009) for the 2007 Advanced Technology Survey (Statistics Canada 2008a, 2008b; Chapter 5 in this volume) and a similar measurement was made in 2009 as part of the Survey of Innovation and Business Strategy (SIBS) (Industry Canada 2011). Schaan and Uhrbach found that about 20 per cent of firms adopted by developing their own technologies and another 20 per cent adopted by purchasing and modifying technologies. The finding from SIBS for adoption by developing the technology was comparable. The Schaan and Uhrbach figures suggest that about 40 per cent of firms in the Canadian manufacturing sector are user innovators. This is discussed further in Chapter 5.

User innovation in innovation surveys

CIS captures, in its measures of innovation, all of the user innovation by the firm but it does not identify explicitly that it is user innovation. That is a point discussed in Chapter 5. The situation is different for the individual consumer or end user (von Hippel 2005).

In the third edition of the *Oslo Manual*, the only place for the individual consumer, or end user, is as a source of information for the firm that engages in product innovation or perhaps as a collaborator with the

producing firm. Users as sources of information and as co-producers are significant in the findings of CIS, but this is user-driven innovation, not 'user innovation'. A user could provide a prototype of a new or improved product to a producer. If the user was a firm, the recipient of the product, if it was later introduced to the market, would report that it was developed by 'other enterprises or institutions'. If the user was a consumer, it is not clear what the answer would be to the question. Identifying consumers as 'innovators' remains an open question, which is discussed in Chapter 5.

3. USING THE *OSLO MANUAL* IN DEVELOPING COUNTRIES

Innovation is not the prerogative of developed countries. It happens in the developing world and it can be a driver of economic growth there as elsewhere. While it may be more incremental than radical and make more use of knowledge from sources other than R&D, it is still innovation.

Discussions took place in Latin America and in Africa about how best to measure innovation and how to produce guidelines to support the process. In Latin America, RICYT developed and published the *Bogotá Manual* (RICYT/OEC/CYTED 2001) and in Africa there were discussions about how to approach the need for guidelines for measuring innovation (NEPAD 2006). Returning to indicators as a technology, RICYT developed its own technology, while NEPAD decided to follow the path of acquiring and modifying the technology for its own benefit.

Experience with the *Bogotá Manual* gave rise to a proposal to the OECD to add an annex to the third edition of the *Oslo Manual* to interpret it for use in developing countries. This was accepted and the preparation of Annex A of OECD/Eurostat (2005) was coordinated by the UNESCO Institute of Statistics. The advantage of adding the annex to the *Oslo Manual* was that it could be revised, along with the rest of the manual, as experience was gained in developing countries of using both the manual and the annex. This ensured an ongoing dialogue within a broader community of practice.

In Africa, the first meeting of the African Intergovernmental Committee on Science, Technology and Innovation Indicators in Maputo in 2007 adopted the Oslo and the Frascati manuals for use in surveying innovation and R&D activities (NEPAD 2007) in Africa. The idea was that, over time, as experience was gained, African manuals could be developed to support the use of OECD manuals in African contexts (Ellis 2008; Gault 2008; Kahn 2008).

In developing countries, as in the developed, the innovation systems

approach plays a role in classifying and interpreting statistics on innovation activities and on the activity of innovation itself. Lundvall et al. (2009) provide an introduction to innovation systems in developing countries. There is also the World Bank (2010) guide to innovation policy for developing countries and a discussion of innovation and the development agenda by Kraemer-Mbula and Wamae (2010).

4. CONCLUSION

The last 30 years have seen considerable progress in the definition, measurement and interpretation of data on the activity of innovation as a result of the revisions of the *Oslo Manual* and its implementation through CIS. However, Chapters 3 and 4 make the point that measurement is still a work in progress and other chapters show that there is work to be done to understand the activity of innovation and the factors that influence it.

While the third edition adopted more of a systems approach and introduced organizational change and business practices, and market development, to the definition, there is more to be done to provide guidance on dealing with framework conditions that have long- and short-term effects on firms, on understanding the dynamics of the innovation process, especially the multiple time scales that are present, and a need to work more with microdata than with macro-aggregations. These issues are discussed in Chapter 9 and again in Chapter 19.

Finally, the *Oslo Manual* is not an isolated set of rules. The rules are set within the context of the guidelines for the system of national accounts (EC et al. 2009) and the business surveys, such as CIS, that measure innovation use common classifications that are part of the international infrastructure for business surveys. Some of these tools are presented in the appendix.

NOTES

1. In Chapter 1, the reference was to technologies, here it is to technologies and practices; the point is that practices are equivalent to technologies. In future references, technologies are assumed to include practices, such as knowledge management practices, or just-in-time delivery of inputs for production.
2. A more detailed history of the first edition of the *Oslo Manual* is given in the Preface by Robert Chabbal, then the Director of the OECD Directorate for Science, Technology and Industry (OECD 1992a: 3–4).
3. In all quotations from the Oslo manuals, the paragraph number is included. The page number is given in the citation.

4. Oslo manuals use vocabulary taken from the system of national accounts (EC et al. 2009). Product refers to a good or a service. The phrase 'products and services' should never appear in *Oslo Manual*-based discourse.
5. The systems approach is just that, the identification of actors (business, education, government etc.), engaged in activities (R&D, acquisition of knowledge, training, design etc.), linked by flows of data, information and knowledge, energy, material and finance, and people, giving rise to short-term outcomes and longer-term impacts. Classification and analytical devices such as national systems of innovation, local clusters, or global value or supply chains are applications of the systems approach.
6. Paragraph 260 of the third edition of the *Oslo Manual* states that 'building social capital may be a vital part of an enterprise's innovation strategies' and then goes on to observe that 'The term *social capital* has many meanings outside of economic analysis and this can lead to confusion. *Network capital* has been used as an alternative.' This does not mean that social capital is not important in the study of innovation, and the reader is referred to Ostrom and Ahn (2003) and Svendsen and Svendsen (2010) for an introduction to the subject.

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APPENDIX: CLASSIFICATION AND REGISTERS

This appendix provides a brief introduction to classification systems, starting with the system of national accounts. It then reviews business registers and industry classifications. These classifications are used for the business surveys and administrative data that provide the statistics that populate innovation indicators. Registers, classification systems and survey techniques are the tools used by statistical offices and research institutes that run surveys as a principal activity. This is meant to complement the material in Chapter 4, Institutional Classifications (OECD/Eurostat 2005: 64) and Chapter 8, Survey Procedures (ibid.: 117) of the third edition of the *Oslo Manual*. Following the discussion of business registers and classifications, other classifications are introduced that are used in current analysis related to innovation and which may be used more as the subject evolves.

System of National Accounts (SNA)

The current version of the system of national accounts is SNA 2008 (EC et al. 2009), which provides a framework for statistics in all parts of the economy, including the market economy, the public sector and households. In the EU, this is accomplished by the European system of national and regional accounts of 2010, referred to as ESA 2010.

Business Registers and Business Classifications

A business survey starts with the drawing of a statistical sample from a 'frame', which is a list of firms that are in scope for the survey. That list is found in a business register maintained by statistical offices or other government departments and the firms are assigned a standard industrial classification. It is the industrial classification that permits the scope of the sample to be specified.

There are many challenges in building a business register and all influence statistical measurement. Finding new firms and adding them to the register is important because, if they are not present in the sample, the survey cannot reflect current activities in the economy. Business registers make use of tax data, or other registration requirements, to note the appearance of new firms. Removing firms that are no longer active is also important, especially in an industry where firms are being created and terminated rapidly. If inactive firms are not removed, the survey sample will contain these firms and costs will be incurred as a result of identifying and removing them from the sample so that a realistic response rate can be reported.

For larger firms, there are questions of the unit of observation, and the business register should provide a profile of the structure of the firms so that the survey manager can draw a sample at the firm or enterprise level or at the 'establishment' level. The issue here is that a large firm may have many establishments that produce different goods and services and are classified under different industries. These establishments may be present in different regions of the country and their location is needed for geographical distribution of the statistics resulting from the survey. However, the recommendation in the *Oslo Manual* is that the enterprise is the most appropriate statistical unit (OECD/Eurostat 2005: 65, para. 234).

As business registers are important to all economic statistics, not just those for innovation, they are under constant review by statistical offices and they are the subject of a UN City Group, the Wiesbaden Group on Business Registers,[1] which meets regularly to discuss common problems.

Industry classifications

There are three main industrial classifications. They are the International Standard Industrial Classification (ISIC), the Statistical Classification of Economic Activities in the European Community (NACE) and the North American Industry Classification System (NAICS), which is used in Canada, the USA and Mexico. Countries may maintain separate industrial classification systems but for reporting to international organizations they will use ISIC or, to the supranational EU, NACE.

As economies change, and can change rapidly, these classifications are regularly revised by the UN (ISIC), Eurostat (NACE) or the statistical offices of Canada, Mexico and the USA (NAICS). Statistics Canada provides an overview of these classification systems.[2] The most recent versions are ISIC Rev. 4, NACE Rev. 2; NAICS, while providing a North American standard, is revised to reflect country issues at lower levels of aggregation. The current version in Canada is 2012, in the USA 2007 and in Mexico 2007.

Industrial classifications are not neutral activities, as they are, like any technology, used for purposes not originally intended and give rise to interest groups that influence their revision. For example, there is no biotechnology industry as biotechnology consists of a number of technologies that are used in production in some industries and are products in others. Biotechnology appears in bioremediation in environmental activities, human and animal health, plant research and food production. However, in the US version of NAICS there is a Research and Development in Biotechnology Industry, but not in Canada. This is found in Sector 54, Professional, scientific and technical services, Subsector 541, Professional, scientific and technical services, Industry Group 5417, Scientific research

and development services, Industry 54171, Research and development in the physical, engineering and life sciences, and then Canadian industry 541710, Research and development in the physical, engineering and life sciences. The US NAICS is the same until US industry level, where there are two entries, 541711, Research and Development in Biotechnology, and 541712, Research and Development in the Physical, Engineering, and Life Sciences (except Biotechnology). International comparisons can be made at the industry level but not at the country level.

Coverage and industry classifications

The *Oslo Manual* makes specific recommendations for industrial coverage (OECD/Eurostat 2005: 68) based on ISIC Rev. 3.1 and NACE Rev. 1.1. It is clear that the *Oslo Manual* in its next revision will have to take account of the changes in the industrial classifications already made by the European Commission for the classification of business statistics. However, as it is 'the most recent version of the *Oslo Manual*', it will continue to provide the definition of innovation used to govern the collection under Regulation (EC) No. 1450/2004, 13 August 2004, amended 22 June 2009.

Size classification

Innovation, like R&D, is very dependent on the size of firm measured by turnover or revenue. The *Oslo Manual* recommends that size be measured on the basis of number of employees and that the employment cut-off be ten or more employees. A size classification is proposed, 10–49, 50–249, 250 and above, for the presentation of the statistics. Some countries use a cut-off of 20 employees (Canada) and others five (USA). A common cut-off for the presentation of the data is important for international comparisons.

Other Classifications

Classifications of the functions of government (COFOG)[3]

Chapter 17 introduces COFOG as part of the analysis of public sector innovation.

Education and occupation classifications

As more work is done on employee–employer relations as part of examining innovation arising from organizational change and use of business practices (Chapter 10), there will be more applications in innovation research of international classifications of education and of occupations. These are supported by different parts of the UN system.

The International Standard Classification of Education (ISCED), supported by UNESCO, has completed a revision, resulting in ISCED 2011.

The current International Standard Classification of Occupations (ISCO), supported by the International Labour Organizations (ILO), is ISCO-08.

NUTS – Nomenclature of Territorial Units for Statistics

The NUTS classification is a hierarchical system for dividing up the economic territory of the EU. For this handbook, the principal application of NUTS is its use in the collection, development and harmonization of EU regional statistics. See http://epp.eurostat.ec.europa.eu/portal/page/portal/nuts_nomenclature/introduction.

Most countries have a similar geographical classification system for their territories.

Notes

1. http://unstats.un.org/unsd/methods/citygroup/wiesbaden.htm.
2. http://www.statcan.gc.ca/concepts/industry-industrie-eng.htm.
3. http://unstats.un.org/unsd/cr/registry/regcst.asp?Cl=4.