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New practices of entrepreneurship and innovation -
Taking stock for the OECD Innovation Strategy

Measures of innovation

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Introduction

The ways firms innovate are constantly changing. A core purpose of the Copenhagen workshop is to build a broader understanding of new forms of innovation and to analyse the key challenges posed to companies and policy makers by the emergence of these new forms of innovation.

Relatively little systematic analytical work has been done on these new forms for innovation, so the specific drivers of innovation are not yet fully understood, nor are the policies and factors that help shape these drivers.

Factor based policy requires reliable data so new innovation concepts and drivers have to be officially defined and new indicators have to be developed based on these definitions.

The purpose of this paper is to provide the participants at the Copenhagen Workshop with a common language/understanding of how innovation and research and development are currently defined and measured, as this will enable us to discuss what is needed to create better and more accurate measurements of innovation.

The paper provides an overview of the **Oslo Manual**, which is the key manual on innovation definitions. The **Frascati Manual**, which defines research and experimental development (R&D), is also described.

Finally, in order to highlight how international recommendations for data collection are applied in surveys, descriptions of the globally harmonised questionnaire on innovation and R&D are also included.

Part 1: Innovation

The official definitions of innovation concepts are presented in the **Oslo Manual** which is published by the OECD and Eurostat. This section provides an overview of the definitions included in the manual.

Since the 1960s governments across the world have shown interest in the area of innovation, but it was not until the 1980s that the OECD countries embarked on carrying out surveys. Prior to this, innovation was measured using proxies such as patents and industrial R&D expenditure.

The OECD itself introduced the concept of innovation in 1981 in the fourth edition of the **Frascati Manual**. Here, innovation was separated from R&D and categorised as related scientific activities (RSA)¹. RSA was explained to be those scientific activities that are not a part of R&D. However, as countries began to carry out innovation surveys, the OECD displayed a stronger interest in measuring innovation, which in turn resulted in the drafting and adoption of the Oslo Manual.

¹ B. Godin, *The Rise of Innovation Surveys: Measuring a Fuzzy Concept*, Project on the History and Sociology of S&T Statistics, Working Paper No. 16 (2002), page 13.

The first edition of the **Oslo Manual** was drafted in 1992 with the purpose of harmonising national statistics on business innovation activities. This edition focused on product and process innovation in manufacturing.

The first edition was revised in 1996 and published in collaboration with Eurostat in 1997. Although the first edition also centred on the technological aspect of innovation, this focus became more explicit in the revised edition. Thus, the term “technological” was now used in connection with innovation throughout the manual. Another important expansion of the second edition was the inclusion of the service sector as a target for measurement.

Results from surveys and changing policy needs resulted in another revision in 2005 developed jointly by OECD and Eurostat. The understanding of innovation was broadened and a new definition of the concept, which addressed non-technology innovation, was adopted. Other important changes included the expansion of knowledge flows related to company innovation and the role of linkages. Moreover, the ever growing recognition of innovation in services and low-tech industries meant that recommendations moved away from using the term “technological” in connection with innovation².

In the following section, focus will be on the 2005 Oslo Manual since it reflects the current measurement scheme of innovation. R&D is specifically dealt with in part 2 of the document.

1.1 Definitions and concepts of innovation in the Oslo Manual

The Oslo Manual provides concise definitions of innovation and innovation activities. Very detailed descriptions can be found in the manual, which also makes recommendations for data collection.

Some words related to innovation are more important than others. At first it is essential to understand what innovation really is, i.e. how is it defined and what does it embrace? Another concern is the contents of innovation activities by firms and the output which they create.

In that respect, it is relevant to look at the key elements of innovation as seen by the Oslo Manual and at how the potential output of innovation activities is defined.

1.1.1 Core definitions and output measures of innovation

The key definition of innovation in the Oslo Manual is given by:

² C. Bloch, *Assessing recent developments in innovation measurement: the third edition of the Oslo Manual*, *Science and Public Policy*, 34(1), February 2007, page 29.

Innovation

Definition³: "An innovation is the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organisational method in business practises, workplace organisation or external relations."

This encompasses several possibilities for specific innovations. The Oslo Manual distinguishes between four main types of innovations which are outlined below³:

A product innovation

Definition: "A product innovation is the introduction of a good or service that is new or significantly improved with respect to its characteristics or intended uses. This includes significant improvements in technical specifications, components and materials, incorporated software, user friendliness or other functional characteristics."

A process innovation

Definition: "A process innovation is the implementation of a new or significantly improved production or delivery method. This includes significant changes in techniques, equipment and/or software."

A marketing innovation

Definition: "A marketing innovation is the implementation of a new marketing method involving significant changes in product design or packaging, product placement, product promotion or pricing."

An organisational innovation

Definition: "An organisational innovation is the implementation of a new organisational method in the firm's business practices, workplace organisation or external relations."

The main types of innovation are distinguishable from each other, though it is also acknowledged that some innovations may encompass more than one type.

According to the Oslo Manual innovations must have been implemented. There are no requirements which stipulate that the innovation has created – or will create – new value to the firm or its customers.

Products (new or improved) are implemented when introduced on the market which is defined as³: "the firm and its competitors and it can include a geographic region or product line". New processes, marketing methods and organisational methods are implemented when brought into use by the firm.

³ OECD/Eurostat (2005), *Guidelines for Collecting and Interpreting Innovation Data – Oslo Manual 3rd Edition*, OECD, Paris.

Innovations are something new and must by definition contain a certain degree of novelty. Some innovations are new to one or a few actors while others are worldwide breakthroughs. The Oslo Manual offers three kinds of concepts for novelty:

- New to the firm
- New to the market
- New to the world

The minimum criterion for an innovation is that it must be **new to the firm**³: *"A product, process, marketing method or organisational method may already have been implemented by other firms, but if it is new to the firm (or in case of products and processes: significantly improved), then it is an innovation for that firm."*

A firm may be the driver of innovation on a certain market. **New to the market** is when³ : *"the firm is the first to introduce the innovation on its market."*

The highest possible degree of novelty is when the introduction of an innovation is new to the whole world. **New to the world** is when³ : *"the firm is the first to introduce the innovation for all markets and industries, domestic and international."*

There might be several different reasons for firms to engage in innovation. **Objectives of innovation** focuses on the various innovation motives. For instance, is it the entering of a new market or competition which leads a firm to be innovative? Or is it something else? The question is also if motives result in additional or other effects than originally planned. The concept **effects of innovation** deals with the observed outcomes of innovation.

The Oslo Manual makes recommendations on how to get information on the connection between objectives and realised effects. For all types of innovation, the manual mentions four factors related to the objective and effects of innovation:

- Competition, demand and markets
- Production and delivery
- Workplace organisation
- Other

The first factor relates to innovation efforts that are intended to increase or avoid a decline in market share or, for instance, the need for diversification of product portfolios. This factor is related to product and marketing innovations.

The second factor concerns changes in production and delivery, like for example improvement of quality or increased speed of delivery of goods or services. Product, process and organisational innovations are related to this factor.

The third factor, workplace organisation, is centred on the forces behind organisational change. This includes, for instance, improved communication and interaction among different business activities or stronger relationships with customers. Process, organisational and marketing innovations are all closely related to this factor.

Finally, the last factor captures other factors such as the reduction of environmental impacts and regulatory requirements.

The overall recommendation put forward in the manual is to collect data on the objectives or effects of innovations implemented by firms during the review period. Thus, a firm which introduces a product innovation that is new to the market might indicate that increased market share was one of the realised effects.

If a firm wants to develop innovations based on one or several motives it has to engage in innovation activities. These activities are crucial to improvements in a firm's innovation performance. The Oslo Manual defines innovation activities in the following manner:

Innovation activities

Definition³: *"Innovation activities are all scientific, technological, organisational, financial and commercial steps which actually, or are intended to, lead to the implementation of innovations. Some innovation activities are themselves innovative, others are not novel activities but are necessary for the implementation of innovations. Innovation activities also include R&D that is not directly related to the development of a specific innovation."*

The various activities may not result in the implementation of an innovation. Some activities are still underway and may or may not result in innovations. Others will never materialise into an innovation. Thus, during a given period a firm's innovation activities may be one of three kinds³:

- **"Successful** in having resulted in the implementation of an innovation (although the innovation need not have been commercially successful)."
- **"Ongoing**, for work in progress which has not yet resulted in the implementation of an innovation."
- **"Abandoned** before the implementation of an innovation."

How firms assess their effectiveness of innovation activities is an interesting aspect which has been put forward by an American advisory committee⁴. Development and testing of such measures are seen as crucial by the committee which also urges future data collection to focus

⁴ *Innovation Measurement: Tracking the State of Innovation in the American Economy*, A Report to the Secretary of Commerce by The Advisory Committee on Measuring Innovation in the 21st Century Economy, January 2008.

on outcomes of innovation activities to fully capture the impact of innovation on the economy.

The following section will discuss the processes and inputs which play an integral part in business innovation activities. Processes cover the sequence of changes of attributes which take place before a given innovation is implemented. Inputs are elements which are prerequisites for even contemplating starting the development of innovations.

1.1.2 Definitions and concepts for process and input measures of innovation

Firms can be innovative and the business processes for which innovations are created constitute an important part of measuring firm innovation activity. The Oslo Manual offers several definitions which are designed to categorise firms as innovative or not.

1.1.2.1 The innovative firm

The Oslo Manual offers the following definition of an innovative firm:

An innovative firm

Definition³: *"One that has implemented an innovation during the period under review."*

According to the Oslo Manual a firm can be innovative if it implements a single significant change. A firm is also innovative if it has implemented a series of smaller incremental changes that together constitute a significant change.

The definition of the innovative firm encompasses all types of innovation with the stipulation that the innovation has to be implemented. However, the manual provides examples of other definitions of the innovative firm. These can be useful in cases where it might be beneficial for policy purposes to 1) look at certain types of innovation or to 2) imply less strict requirements with regards to firm innovation activity.

Examples of other definitions include:

A product/process innovative firm

Definition³: *"A product/process innovative firm is one that has implemented a new or significantly improved product or process during the period under review."*

An innovation-active firm

Definition³: "*An innovation-active firm is one that has had innovation activities during the period under review, including those with ongoing and abandoned activities.*"

Thus, a firm can be innovation-active even if it did not implement an innovation during the period under review. Innovation activities are sufficient for firms to be categorised as innovation-active.

A particular subject of interest in developing countries is the **potentially innovative firm**. As such, innovation policies in developing countries may assist potentially innovative firms in overcoming obstacles and assisting them in converting their efforts into innovations.

Potentially innovative firms are a subset of innovation-active firms. The definition given in the Oslo Manual is:

A potentially innovative firm

Definition³: "*Innovation-active firm that have made innovation efforts (i.e. conducted innovation activities) but have not achieved results (innovations) during the period of analysis.*"

Firms might come into existence in the period under review. Newly established firms and firms that have emerged as the result of mergers are examples of this. Nevertheless, they are also covered by the definitions outlined above.

The innovative firm will rely on a broad variety of sources for its innovation activities. These include information, knowledge, technologies, practises and resources. The Oslo Manual applies the term *innovation linkages* to describe and capture firm activity in this area. Understanding the links to sources is essential to businesses in the innovation process.

1.1.2.2 Innovation linkages

The Oslo Manual devotes an entire chapter to innovation linkages. It makes recommendations on how to define and measure these linkages, with particular focus on links to sources outside of the firm. These are crucial to the innovating firm which is highly dependent on outside players for development of innovations. However, it is recognised that also internal sources of information are important.

The Oslo Manual addresses innovation linkages as follows:

Innovation linkages³

"Linkages act as sources of knowledge and technology for an enterprise's innovation activity, ranging from passive sources of information to suppliers of embodied and disembodied knowledge and technology to co-operative partnerships."

All types of innovation are related to innovation linkages. Linkages can be divided into: Inbound diffusion, outbound diffusion and knowledge management⁵. In the following, the subdivisions are described by including the different types of linkages they are associated with.

For **inbound diffusion**³ the Oslo Manual explicitly recommends focusing on the following linkages:

Open information sources: *"openly available information that does not require the purchase of technology or intellectual property rights, or interaction with the source."*

Acquisition of knowledge and technology: *"purchases of external knowledge and/or knowledge and technology embodied in capital goods (machinery, equipment, software) and services, which do not involve interaction with the source."*

Innovation co-operation: *"active co-operation with other enterprises or public research institutions for innovation activities (which may include purchases of knowledge and technology)."*

The linkage of innovation co-operation is distinct from the other two in that all parties concerned actively have to take part. Co-operation may involve suppliers or customers in the innovation process.

The manual proposes that additional information on co-operation should be obtained by asking for the geographical location of collaborative partners (local, national, foreign by region or country). This information may help clarify clustering or networking patterns.

Also related to inbound diffusion is the term **developer of an innovation**. Questions related to the developer of the innovation indicate how innovative enterprises are. The Oslo Manual recommends asking questions on each type of innovation, or the subcategories product and process innovations, on the developer of the enterprises' innovations. Specifically, the questions should at least address if³:

- *"The innovations were mainly developed by the enterprise itself."*
- *"The innovations were developed by the enterprise in co-operation with other enterprises or institutions."*

⁵ Diffusion is defined as: *"the spread of innovations, through market or non-market channels, from first implementation anywhere in the world to other countries and regions and to other markets and firms."*

- "The innovations were mainly developed by other enterprises or institutions."

Outbound diffusion examines the effects of innovations on other firms, consumers and the general public. Although it might be difficult for the company to assess the impacts of their own innovations, the Oslo Manual proposes that information may be gathered in relation to the main users' of implemented innovations. The identification of innovation users may be addressed for the consumer markets (domestic and/or foreign) and other firms (domestic and/or foreign). The manual does not go any further than this in its recommendations.

The last term related to innovation linkages is **knowledge management**. It involves activities related to the capture, use and sharing of knowledge by the organisation. Some information on knowledge management may be obtained by asking questions on organisational innovations, but the Oslo Manual recommends that any detailed examination of these activities may be obtained by conducting specialised surveys on knowledge management.

Another important concern for data collection is expenditures related to innovation. For instance, this information is a prerequisite if the aim is to compare costs incurred for different types of innovation activities. Innovation expenditures constitute the input to innovation processes and might play a crucial part in a firm's overall budget. The problem is that it is difficult to quantify all of the expenditures related to innovation.

1.1.2.3 Innovation expenditure

The Oslo Manual acknowledges the importance and the difficulties related to gathering information on innovation expenditures. While no specific definition of innovation expenditure is proposed, recommendations on which elements to include in the data collection process is adopted by the manual. Thus, the recommended breakdown of expenditure is by type of activity (see Annex I).

Another possible breakdown proposed in the manual is *current innovation expenditure* versus *capital expenditures* (for innovations). *Current innovation expenditure* includes labour costs and other current costs such as non-capital expenditure (materials, services and equipment). *Capital expenditure* may include land, buildings and computer software.

One important part of firm innovation expenditure is R&D. Measures of R&D have existed long before the term innovation saw the light of day. R&D is the subject of the following part.

Part 2: Research and experimental development (R&D)

The official definitions of R&D concepts can be found in the **Frascati Manual**, which is published by the OECD. This part is devoted to the core

definitions associated with R&D and how they relate to similar concepts. The aim is to specify what R&D is and to separate R&D from other industrial activities like innovation. Important measures of R&D input are also addressed.

The **Frascati Manual** describes the methodology for collecting and using R&D statistics. The first edition (1963) was the result of a meeting between the OECD experts and the NESTI group (National Experts on Science and Technology Indicators) which took place in Frascati, Italy. The core purpose was for the OECD to establish a set of guidelines on how R&D is measured. Since then, the manual has become the standard for R&D surveys worldwide. The last edition was published in 2002.

The Frascati Manual deals exclusively with the measurement of human and financial resources devoted to R&D, also referred to as *R&D input*. Changes in conditions and policy needs and experience gained from surveys since 1963 have materialised into six editions of the manual. The last revision was undertaken as a response to the acknowledgement that there was a need for improving R&D statistics in the service sector as well as a need for more detailed data on human resources related R&D.

The following section focuses on recommendations from the 2002 version of the manual, which current R&D surveys are based on.

2.1 R&D definitions and concepts in the Frascati Manual

The Frascati Manual aims to present recommendations and guidelines on the collection and interpretation of R&D data. It includes detailed descriptions of definitions and concepts related to measuring R&D.

The Frascati Manual is the main reference for the definition of R&D. This means that this definition is also adopted by other manuals, including the Oslo Manual, in the area of science and technology.

In the section below R&D definitions and concepts are described by using the manual as reference (as with the part on innovation, the purpose is at first to describe the core definitions of R&D).

2.1.1 Core definitions and concepts of R&D

The Frascati Manual defines R&D as⁶:

"Research and experimental development (R&D) comprise creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications."

R&D covers three activities⁶:

⁶ OECD (2002), *Proposed Standard Practice for Surveys for Research and Experimental Development, Frascati Manual 2002*, OECD, Paris.

Basic research

Definition: *"Is experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundations of phenomena and observable facts, without any particular application or use in view."*

Applied research

Definition: *"Is also original investigation undertaken in order to acquire new knowledge. It is, however, directed primarily towards a specific practical aim or objective."*

Experimental development

Definition: *"Is systematic work, drawing on knowledge gained from research and practical experience, that is directed to producing new materials, products and devices; to installing new processes, systems and services; or to improving substantially those already produced or installed."*

According to the Frascati Manual there are both conceptual and operational problems when separating R&D into basic, applied and experimental research. Thus, it may be difficult to separate them in real life. It might be the same research centre or staff that performs the different types of activities. Moreover, research in a given period might move from basic to applied research and then return to basic again.

However, basic research can be distinguished from the other activities in that it is directed towards general purpose research without any particular application or use in view. In the business enterprise sector the creation of a new project based on promising basic research is often categorised as applied research. The development and testing of a programme based on studies in this project is an example of experimental research.

2.1.2 R&D and other related activities

There is a broad range of activities with a scientific and technological basis and R&D is only one of them. If the purpose is to survey R&D then other related activities should be excluded to make sure that only R&D is captured. The Frascati Manual acknowledges that the following activities are closely related to R&D:

- Education and training
- Other related scientific and technological activities⁷
- Other industrial activities

⁷ A common expression for the following activities: scientific and technical information services, general purpose data collection, testing and standardisation, feasibility studies, specialised health care, patent and license work, policy-related studies and routine software development.

- Administration and other supporting activities

However, they are not a part of R&D and should be excluded whenever possible. All of the aforementioned activities excluded from R&D pose problems for measurement issues since they might be difficult to separate from R&D. The Frascati Manual examines the problems they might create at the cross section between them and R&D. In the following section the problems associated when separating R&D from other industrial activities are used as an example. The purpose is to examine cases where the distinction between R&D and other industrial activities might be unclear.

2.1.2.1 The cross section between R&D and other industrial activities

The Frascati Manual adopts the following rule originally laid down by the US National Science Foundation (NSF), which provides a basis for judgement in difficult cases⁶:

"If the primary objective is to make further technical improvements on the product or process, then the work comes within the definition of R&D. If, on the other hand, the product, process or approach is substantially set and the primary objective is to develop markets, to do pre-production planning or to get a production or control system working smoothly, the work is no longer R&D."

In the following some examples of borderline cases between R&D and other industrial activities are addressed:

- **Prototypes** which are original models constructed to include all of the technical characteristics and performances of the new product. For example, if a pump is being developed, a prototype is needed for testing as to see whether or not the new pump is successful. The Frascati criterion for including an activity as R&D is that the primary objective of the prototype is to make further improvements. When necessary modifications to the prototype have been made and testing satisfactorily completed, the end-point of R&D is reached.
- A **pilot plant** is considered to be R&D as long as the main purpose is to gain experience and to compile engineering and other data to be used in for instance evaluation of hypotheses, writing new product formulas or establishing new product specifications. As soon as the experimental phase is over and the pilot plant turns into a normal production unit, the activity is no longer regarded as R&D.
- According to the Frascati Manual, some elements of design work should be considered as R&D. Elements include plans and drawings whose purpose is to define procedures, technical specifications and operational features. **Industrial design** required during R&D should be included; it should be excluded, however, if used for production processes.

2.1.3 Definitions and concepts for input measures of R&D

Understanding the difference between R&D and related activities is a crucial element in the Frascati Manual. However, measuring R&D input is another key issue especially for survey purposes. Thus, adequate information on efforts devoted to R&D is very much in demand by statisticians. R&D inputs are specified in the Frascati Manual so that data can be collected from different performers and be aggregated to national totals. Two main R&D inputs are identified:

- R&D personnel
- R&D expenditure

Data on R&D personnel measures the resources going directly to R&D activities, while R&D expenditure data measure the total cost of carrying out R&D including indirect support. In the following section R&D input is described by its main characteristics as depicted in the Frascati Manual.

2.1.3.1 R&D personnel

The Frascati Manual adopts the following broad coverage of R&D personnel⁶:

"All persons employed directly on R&D should be counted, as well as those providing direct services such as R&D managers, administrators, and clerical staff."

For statistical purposes two approaches may be used to classify R&D personnel: Classification by occupation or by formal qualification. The most common categorisation is by occupation and this is also the approach recommended by the Frascati Manual. This is due to better international comparability since different levels and structures of national education systems make it difficult to use qualification series.

The following three definitions are specifically designed for surveying R&D personnel⁶:

Researchers

Definition: *"Researchers are professionals engaged in the conception or creation of new knowledge, products, processes, methods and systems and also in the management of the projects concerned."*

Technicians and equivalent staff

Definition: *"Technicians and equivalent staff are persons whose main tasks require technical knowledge and experience in one or more fields of engineering, physical and life sciences or social sciences and humanities. They participate in R&D by performing scientific and technical tasks involving the application of concepts and operational methods, normally under the supervision of researchers. Equivalent staff perform the*

corresponding R&D tasks under the supervision of researchers in the social sciences and humanities."

Other supporting staff

Definition: *"Other supporting staff includes skilled and unskilled craftsmen, secretarial and clerical staff participating in R&D projects or directly associated with such projects."*

2.1.3.2 R&D expenditure

R&D expenditure is important for measurement purposes. For instance, information on R&D expenditure by businesses can be interesting for analytical purposes. The Frascati Manual recommends that data on at least intramural expenditures should be collected. Moreover, information on extramural expenditures is desirable.

The following definition of intramural expenditures is adopted⁶:

Intramural expenditure

Definition: *"Intramural expenditures are all expenditures for R&D performed within a statistical unit or sector of the economy during a specific period, whatever the source of funds."*

Intramural expenditures include costs for R&D personnel and non-capital costs like purchases of materials, supplies and equipment. Moreover, capital expenditure must be included. The manual also introduces a corresponding definition for **extramural expenditures**. For survey purposes it is recommended to complement intramural expenditures with extramural.

As mentioned earlier the Frascati Manual also operates with national totals for R&D input. While there is no common expression for total personnel working on R&D, the manual defines the following national totals of R&D expenditure:

Gross domestic expenditure on R&D (GERD)⁶

Definition: *"GERD is total intramural expenditure on R&D performed on the national territory during a given period."*

Gross national expenditure on R&D (GNERD)⁶

Definition: *"The GNERD aggregate comprises total expenditure on R&D financed by a country's institutions during a given period."*

So far the focus has centred on important definitions and concepts for innovation and R&D. It is evident that the concepts are rather complex. Still, experience has shown that it is possible to develop and collect data in both cases. Implemented surveys on innovation and R&D are the subject of the last parts of the document.

Part 3: The Community Innovation Survey (CIS)

The Oslo Manual is the reference for large surveys examining innovation in the business sector. As mentioned earlier, the European Community Innovation Survey (CIS) is compiled using the measurement recommendations in the Oslo Manual. The focus in this part is on the CIS survey.

In some countries, including Denmark and the Netherlands, innovation and R&D are surveyed in the same business questionnaire⁸. However, most countries in the European Community separate R&D from CIS when surveying the area of science and technology. One of the reasons for separating the two areas is that it is not the same business sectors which are surveyed for innovation and R&D.

The first CIS was a pilot exercise and conducted in 1993. Traditionally CIS data has been collected every fourth year with an increase in frequency to once every second year from 2005.

On the basis of CIS the Commission Regulation (EC) No 1450/2004 makes the delivery of certain variables mandatory for European Union member countries. Before 2004, CIS surveys were carried out by a gentleman's agreement in the community. According to the Regulation, CIS4 (the 2004 survey round) and CIS2006 have been based on the 1997 version of the Oslo Manual, though in practise the harmonised questionnaire also follows as much as possible the latest edition of the Oslo Manual. CIS2008 will be fully based on the latest edition of the manual. Countries may choose to include additional questions if they wish to do so, and pilot modules are also introduced by the Commission or Member States.

The CIS questionnaire is structured around 11 sections. The first section is devoted to general information about the enterprise and the last section handles basic economic information on the enterprise. The remaining sections contain questions related to innovation, effects of innovation, innovation activities and expenditure and intellectual property rights. In the following section, the purpose is to see to what extent the definitions and concepts of innovation introduced earlier enter into the CIS 2006 questionnaire.

3.1 CIS: Questions related to core definitions and output measures of innovation

All types of innovation are included in the questionnaire. The respondent has to answer if the enterprise during three years introduced a product, process, organisational or marketing innovation. The definitions of the types of innovation are slightly modified for survey purposes and therefore differ from the ones found in the Oslo Manual. The specific question for product innovations is illustrated in the box below. The

⁸ In Denmark, a combined R&D and Innovation survey is conducted biannually, alternating with a full R&D survey in the other years.

corresponding questions for other types of innovation can be found in the questionnaire (*question 3.1 and 10.1*). They have a similar wording.

2.1 During the three years 2004 to 2006, did your enterprise introduce:		
	Yes	No
New or significantly improved goods. (Exclude the simple resale of new goods purchased from other enterprises and changes of a solely aesthetic nature.)	<input type="checkbox"/>	<input type="checkbox"/>
New or significantly improved services.	<input type="checkbox"/>	<input type="checkbox"/>

Source: The Community Innovation Survey 2006 (CIS2006). The harmonised survey questionnaire.

Most questions in the CIS are devoted to product and process innovations. Thus, organisational and marketing innovations are only included in a separate section at the end of the questionnaire.

New to the firm and **new to the market** are only applied for product innovations (*question 2.3*), i.e. the respondent has to answer if any of the goods or service innovations introduced between 2004 and 2006 were new to the market or new to the firm. Percentage of total turnover from goods and service innovations that were new to the market or only new to the firm also has to be indicated. **New to the world** is not a part of the CIS 2006 harmonised questionnaire.

Factors related to **effects of innovation** are included in the CIS questionnaire for three types of innovation: Product, process and organisational innovations. **Objectives of innovation** are not part of the questionnaire.

Effects of product and process innovations are specifically dealt with in section 7. The respondent has to indicate if the observed effects of product and process innovations are high, medium, low or not relevant.

Effects of product innovations may include 1) increased range of goods or services, 2) entering of new markets or increase in market share and 3) improvement of quality of goods or services.

Effects of process innovations may be 1) improved flexibility and increased capacity of production or service provision. Also 2) reduction of labour costs, materials and energy are effects related to process innovations. Reduction of environmental impacts and meeting regulatory requirements are possible other effects of both product and process innovations.

The questionnaire deals with effects of organisational innovations at the very end. In question 10.2 the degree of observed effect must be indicated as high, medium, low or not relevant for the following:

- Reduced time to respond to customer or supplier needs
- Improved quality of your goods or services
- Reduced costs per unit output

- Improved employee satisfaction and/or reduced rates of employee turnover

Question 5.1 of the questionnaire is devoted to innovation activities (see below). Seven activities have been selected but they do not necessarily cover all possible activities related to innovation. For instance, activities for marketing and organisational innovations are excluded.

5.1 During the three years 2004 to 2006, did your enterprise engage in the following innovation activities:		Yes	No
Intramural (in-house) R&D	Creative work undertaken within your enterprise to increase the stock of knowledge and its use to devise new and improved products and processes (including software development) If yes, did your firm perform R&D during 2004 to 2006: Continuously? <input type="checkbox"/> Occasionally? <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Extramural R&D	Same activities as above, but performed by other companies (including other enterprises within your group) or by public or private research organisations and purchased by your enterprise	<input type="checkbox"/>	<input type="checkbox"/>
Acquisition of machinery, equipment and software	Acquisition of advanced machinery, equipment and computer hardware or software to produce new or significantly improved products and processes	<input type="checkbox"/>	<input type="checkbox"/>
Acquisition of other external knowledge	Purchase or licensing of patents and non-patented inventions, know-how, and other types of knowledge from other enterprises or organisations	<input type="checkbox"/>	<input type="checkbox"/>
Training	Internal or external training for your personnel specifically for the development and/or introduction of new or significantly improved products and processes	<input type="checkbox"/>	<input type="checkbox"/>
Market introduction of innovations	Activities for the market introduction of your new or significantly improved goods and services, including market research and launch advertising	<input type="checkbox"/>	<input type="checkbox"/>
Other preparations	Procedures and technical preparations to implement new or significantly improved products and processes that are not covered elsewhere.	<input type="checkbox"/>	<input type="checkbox"/>

Source: The Community Innovation Survey 2006 (CIS2006). The harmonised survey questionnaire.

Innovation activities can be **successful, ongoing** or **abandoned** as stated in the Oslo Manual. This is also reflected in the questionnaire.

Question 8.1 address if any of the enterprises innovation activities or projects during the years 2004 to 2006 were

1. Abandoned in the concept stage
2. Abandoned after activity or project was begun

3. Seriously delayed

3.2 CIS: Questions related to process and input measures of innovation

Innovation linkages play a significant part of CIS 2006. For instance, **sources of information** for innovation activities are dealt with in section 6 of the questionnaire. Information sources can be internal sources, market sources, institutional sources and other sources like conferences or industry associations. The respondent has to state the degree of importance of each information source that is if it has high, medium or low importance. Not used is also added as an answering category.

Another important feature of the questionnaire is co-operation for innovation activities. In question 6.2 the respondent has to state if the enterprise during 2004 to 2006 co-operated on any innovation activities with other enterprises or institutions. If affirmative, the type of co-operation partner and location has to be indicated (see question 6.3 below).

6.3 Please indicate the type of co-operation partner and location <i>(Tick all that apply)</i>				
Type of co-operation partner	[Your country]	Other Europe*	United States	All other countries
A. Other enterprises within your enterprise group	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
B. Suppliers of equipment, materials, components, or software	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C. Clients or customers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
D. Competitors or other enterprises in your sector	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
E. Consultants, commercial labs, or private R&D institutes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
F. Universities or other higher education institutions	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
G. Government or public research institutes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

*: Include the following European Union (EU) countries, EFTA, or EU candidate countries: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Italy, Ireland, Latvia, Liechtenstein, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovenia, Slovakia, Switzerland, Turkey, Spain, Sweden and the United Kingdom.

Source: The Community Innovation Survey 2006 (CIS2006). The harmonised survey questionnaire.

Finally, the most valuable co-operation partner for the enterprise has to be indicated in question 6.4. This choice must be one of the seven possible types of co-operation partner mentioned in 6.3.

The concept **developer of an innovation** is included in the questionnaire for product and process innovations alone (*question 2.2 and 3.2*). It has

to be indicated whether the product and/or process innovation were developed by

- Mainly the enterprise or enterprise group
- The enterprise together with other enterprises or institutions
- Mainly other enterprises or institutions

Only the most appropriate option must be selected.

Regarding **innovation expenditures** the respondent is asked to indicate expenditures separately for activities related to intramural (in-house) R&D, acquisition of extramural R&D, acquisition of machinery, equipment and software and finally acquisition of other external knowledge (*question 5.2*):

5.2 Please estimate the amount of expenditure for each of the following four innovation activities in 2006 only. (Include personnel and related costs)	
<i>If your enterprise had no expenditures in 2006 please fill-in 0</i>	
Intramural (in-house) R&D (Include capital expenditures on buildings and equipment specifically for R&D)	<input type="text"/>
Acquisition of R&D (extramural R&D)	<input type="text"/>
Acquisition of machinery, equipment and software (Exclude expenditures on equipment for R&D)	<input type="text"/>
Acquisition of other external knowledge	<input type="text"/>
Total of these four innovation expenditure categories	<input type="text"/>

Source: The Community Innovation Survey 2006 (CIS2006). The harmonised survey questionnaire.

3.3 CIS: Other important areas covered in the questionnaire

Also included in CIS are factors hampering innovation activities (section 8). All enterprises have to state if the following factors had a high, medium or low importance for hampering innovation activities or projects or influencing a decision not to innovate:

- **Cost factors**
 - Lack of funds within you enterprise or group
 - Lack of finance from sources outside your enterprise
 - Innovation costs too high
- **Knowledge factors**
 - Lack of qualified personnel
 - Lack of information on technology
 - Lack of information on markets
 - Difficulty in finding cooperation partners for innovation
- **Market factors**
 - Market dominated by established enterprises

- Uncertain demand for innovative goods or services
- **Reasons not to innovate**
 - No need due to prior innovations
 - No need because of no demand for innovations

Furthermore, in section 9 the enterprise has to state whether it applied for a patent, registered an industrial design, registered a trademark or claimed a copyright during the years 2004 to 2006.

As mentioned earlier, the international community also makes specialised data collection with regards to R&D. The next part briefly describes these efforts.

Part 4: R&D surveys

Data on R&D are compiled worldwide in accordance with the Frascati Manual. For instance, the OECD and Eurostat collect data by using a common core questionnaire. Since both organisations have specific statistical needs for R&D measures, they also include specific modules in their own data collection.

The focus in this part is on the joint OECD-Eurostat questionnaire. The countries of the European Community are committed to deliver data on certain R&D variables through the Commission Regulation (EC) No 753/2004. These variables are included in the joint questionnaire. Before 2004, data in the European Community were collected under gentleman's agreement.

The core questionnaire is only available in Excel format and not attached to this document. Questions are only aimed at input measures. Thus, the questionnaire is structured around information for R&D personnel and R&D expenditure. Totals for each input should be provided along with several types of breakdown.

A short description of the data collected for R&D input is outlined below.

4.1 Questions related to definitions and concepts for input measures of R&D

Detailed information on R&D personnel and R&D expenditure should be provided for all sectors of the economy, i.e. business enterprise sector, higher education sector, government sector and private non-profit sector.

Regarding R&D personnel the following key information is collected:

- Number of R&D personnel in head count (HC)
- Number of researchers in head count (HC)
- Number of R&D personnel in full-time equivalent (FTE)
- Number of researchers in full-time equivalent (FTE)

Data must be provided in both HC and FTE. The reason is that some persons engaging in R&D might only do it part-time thus leading to an overestimate of R&D personnel when only counting the number of persons. Thus, HC must be complemented with FTE information.

Totals must be given for each of the four key numbers of R&D personnel. Moreover, several breakdowns of R&D personnel including sector of employment, occupation (alternatively by qualification) and sex, are included in the questionnaire.

R&D expenditure is covered by intramural R&D expenditure. Besides totals of intramural R&D, the questionnaire includes breakdowns by source of funds, type of R&D (optional), type of costs and for business enterprises, economic activity.

Annex I: Recommended breakdown of innovation activities for data collection purposes

Research and experimental development (R&D)

- Intramural (in-house) R&D: *Creative work undertaken on a systematic basis within the enterprise in order to increase the stock of knowledge and use it to devise new applications. This comprises all R&D conducted by the enterprise, including basic research.*
- Acquisition of extramural R&D: *Same activities as intramural R&D, but purchased from public or private research organisations or from other enterprises (including other enterprises within the group).*

Activities for product and process innovations

- Acquisition of other external knowledge: *Acquisition of rights to use patents and non-patented inventions, trademarks, know-how and other types of knowledge from other enterprises and institutions such as universities and government research institutions, other than R&D.*
- Acquisition of machinery, equipment and other capital goods: *Acquisition of advanced machinery, equipment, computer hardware or software, and land and buildings (including major improvements, modifications and repairs), that are required to implement product or process innovations. Acquisition of capital goods that is included in intramural R&D activities is excluded.*
- Other preparations for product and process innovations: *Other activities related to the development and implementation of product and process innovations, such as design, planning and testing for new products (goods and services), production processes, and delivery methods that are not already included in R&D.*
- Market preparations for product innovations: *Activities aimed at the market introduction of new or significantly improved goods or services.*
- Training: *Training (including external training) linked to the development of product or process innovations and their implementation.*

Activities for marketing and organisational innovations

- Preparations for marketing innovations: *Activities related to the development and implementation of new marketing methods. Includes acquisition of other external knowledge and other capital goods that is specifically related to marketing innovations.*
- Preparations for organisational innovations: *Activities undertaken for the planning and implementation of new organisation methods. Includes acquisition of other external knowledge and other capital goods that is specifically related to organisational innovations.*

Source: OECD/Eurostat (2005), *Guidelines for Collecting and Interpreting Innovation Data*
– Oslo Manual 3rd Edition, OECD, Paris.