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TECHNICAL PAPER NO. 11

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Guide to Conducting an R&D Survey: For countries starting to measure research and experimental development

GUIDE TO CONDUCTING AN R&D SURVEY: For countries starting to measure research and experimental development

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UNESCO

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The UIS is based in Montreal, Canada.

Published in 2014 by:

UNESCO Institute for Statistics
P.O. Box 6128, Succursale Centre-Ville
Montreal, Quebec H3C 3J7
Canada

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Email: uis.publications@unesco.org
http://www.uis.unesco.org

ISBN 978-92-9189-151-1
Ref: UIS/2014/STS/TD/5/REV
DataLink: http://dx.doi.org/10.15220/978-92-9189-151-1-en

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Foreword

Innovation is now universally regarded as an engine of economic growth for both developing and developed countries, thus acting as an important driver for poverty alleviation. To set effective innovation policies, reliable indicators are needed to benchmark and monitor progress. Research and experimental development (R&D) is an important component of a country's national innovation system (NIS), and R&D statistics are among the most widely-used indicators to monitor the NIS.

The Frascati Manual (OECD, 2002) outlines the methodology to measure R&D. The well-established practices provided in the manual have been applied for over 50 years. Nonetheless, many developing countries continue to face challenges in conducting an R&D survey and applying the Frascati standards to their particular situations.

In order to address this concern, in 2010 the UNESCO Institute for Statistics (UIS) produced a technical paper on *Measuring R&D: Challenges Faced by Developing Countries* (UIS, 2010), based on work carried out between 2006 and 2009. The paper provided guidance on a number of challenges that are relevant to contexts in developing countries. In 2012, this paper served as the basis for an annex to the *Frascati Manual – Proposed Standard Practice for Surveys on Research and Experimental Development (6th edition*) (OECD, 2012).

The current report continues to provide guidance to R&D survey practitioners in countries that are starting to measure this field. It is recognised that circumstances and practices vary greatly across countries and that there is no single way to achieve a sound and reliable survey. In order to assist countries in their efforts, this report presents the relevant R&D indicators, discusses the main issues facing each of the major sectors of performance, provides a simple project management template, and proposes generic model questionnaires for the government, higher education, business and private non-profit sectors.

While work continues to develop R&D measurement, the UIS welcomes suggestions from survey practitioners to make improvements to current methodology.

Hendrik van der Pol
Director
UNESCO Institute of Statistics

Acknowledgements

Content for this guide was developed using background papers commissioned by the UNESCO Institute for Statistics (UIS) and input from participants attending workshops in Montreal, Canada and Windhoek, Namibia. The report is based on two papers written by Michael Kahn, Professor Extraordinaire, Stellenbosch University, South Africa and Director, Research and Innovation Associates, Cape Town, South Africa.

Special gratitude is extended to numerous reviewers of the material presented in this guide:

- Prof. Aggrey Ambali, Head, NEPAD Agency Science, Technology & Innovation Hub (NSTIH), NEPAD Planning & Coordinating Agency;
- Dr. Parveen Arora, Advisor and Head NSTMIS Division, Department of Science and Technology (DST), New Delhi, India;
- Mr. Vinson Embaran, Assistant Director, Malaysian Science & Technology Information Centre (MASTIC), Ministry of Science, Technology and Innovation (MOSTI), Malaysia;
- Dr Almamy Konté, Senior Expert in Innovation Policy, African Observatory of Science, Technology and Innovation (AOSTI);
- Prof. Djuro Kutlaca, PhD, Scientific Counsellor, Head of Centre, “Mihajlo Pupin” Institute, Science and Technology Policy Research Centre, Belgrade, Serbia;
- Mr. Ari Leppälahti, Senior Adviser, Science, Technology and Innovation Statistics, Statistics Finland, Finland;
- Mr. Jorge Lucio, Senior Researcher, Colombian Observatory of Science and Technology (OCyT), Bogotá, Colombia;
- Mrs. Carolina Rivera, Senior Researcher, Colombian Observatory of Science and Technology (OCyT), Bogotá, Colombia;
- Dr. Monica Salazar, Director, Colombian Observatory of Science and Technology (OCyT), Bogotá, Colombia;
- Mr. Richard Lutalo, Senior Science Officer, Uganda National Council for Science and Technology (UNCST), Uganda;
- Prof. Hatem M'Henni, Laboratoire de recherche LARIME, Ecole Supérieure de Commerce de Tunis, Tunisia;
- Dr Neo Molotja, Research specialist: Knowledge Systems, Centre for Science, Technology and Innovation Indicators (CeSTII), South Africa;
- Prof. Luke Mumba, ASTII Programme Coordinator, NEPAD Agency Science, Technology & Innovation Hub (NSTIH), NEPAD Planning & Coordinating Agency;
- Mr. Lukovi Seke, ASTII Programme Research Assistant, NEPAD Agency Science, Technology & Innovation Hub (NSTIH), NEPAD Planning & Coordinating Agency;
- Dr William O. Siyanbola, Outgoing Director-General/CEO National Centre for Technology Management (NACETEM), Federal Ministry of Science and Technology (FMST), Nigeria;
- Mr. Remy Twiringiyimana, Ag. Director General, Science Technology and Research, Ministry of Education, Rwanda;
- Ms. Rosemary Uside Kongani, Statistician, Directorate of Population and Social Statistics, Kenya National Bureau of Statistics (KNBS), Kenya;
- Mr. Kavutse Vianney, Skills Development Analyst, National Science & Technology Commission, Rwanda.

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Abbreviations

ASTII	African Science, Technology and Innovation Indicators
BERD	Business expenditure on research and development
CeSTII	Centre for Science, Technology and Innovation Indicators
CIS	Community Innovation Survey
DBRI	Department-based research institute
FM	Frascati Manual
FoS	Fields of science
FTE	Full-time equivalent
GBAORD	Government budget appropriations or outlays for R&D
GDP	Gross domestic product
GERD	Gross domestic expenditure on research and development
GNERD	Gross national expenditure on R&D
GOVERD	Government expenditure on research and development
HC	Headcount
HEI	Higher education institute
HERD	Higher education expenditure on research and development
IFRS	International Financial Reporting Standards
ISCED	International Standard Classification of Education
ISIC	International Standard Industrial Classification of All Economic Activities
MNC	Multinational corporation
NESTI	National Experts on Science and Technology Indicators
NIS	National innovation system
NPO	Non-profit organization
NSO	National Statistical Office
NUTS	Nomenclature of Territorial Units for Statistics
OECD	Organisation for Economic Co-operation and Development
PNP	Private non-profit
PPP	Purchasing power parity
PRI	Public research institute
R&D	Research and (experimental) development
RICYT	*Red de Indicadores de Ciencia y Tecnología Iberoamericana e Interamericana* (Ibero-American and Inter-American Network on Science and Technology Indicators)
S&T	Science and technology
SEO	Socio-economic objective
SSH	Social sciences and humanities
STA	Scientific and technological activities
STET	Scientific and technological education and training
STI	Science, technology and innovation
STS	Science and technology services
TK	Traditional knowledge
UIS	UNESCO Institute for Statistics

1. Introduction

UNESCO has a long history in science and technology (S&T) statistics, dating back to the 1960s. In 1965, a Science Statistics section was created in the Division of Statistics in the UNESCO Office of Statistics with three main tasks: i) collection, analysis and publication of data; ii) methodological work to sustain the collection of statistical data; and iii) technical assistance to Member countries through missions and fellowships. The Division administered a questionnaire to Latin American countries, which served as the basis for the development of a second questionnaire to be distributed internationally. This questionnaire was published in the 1967 *UNESCO Statistical Yearbook* and marked the beginning of a recurring statistical series on science and technology at UNESCO (Godin, 2001).

From the start, UNESCO has strived to set the standard in science statistics. The first methodological documents produced were a guide published in 1968 to assist countries in data collection and one published in 1969 entitled *Measurement of Scientific and Technological Activities*. In 1978, the General Conference of UNESCO adopted the *Recommendation Concerning the International Standardization of Statistics on Science and Technology* (UNESCO, 1978) followed by a provisional Manual in 1980 and a final *Manual for Statistics on Scientific and Technological Activities* in 1984 (UNESCO, 1984a). UNESCO further issued a revised *Guide to Statistics on Science and Technology* (UNESCO, 1984b) to provide more detailed recommendations and practical advice to Member States that were still in the process of establishing their framework to collect science and technology (S&T) statistics.

After the mid-1980s, activity in S&T statistics at UNESCO started to decline due in large part to the significant budget reductions, which affected the organization as a whole. From 1992 on, UNESCO's S&T programme in the Division of Statistics entered into a consultation mode. Following an external evaluation, the decision was made to restart activity at a minimum capacity to prepare for future activities. From 1998 on, UNESCO S&T questionnaires adopted the OECD classification of sectors of performance. The formal establishment in 1999 of the UNESCO Institute for Statistics (UIS) and its subsequent move to Montreal (Canada) in 2001 marked a new turning point for S&T statistics at UNESCO. Data collection was once again interrupted following a 2001 survey and an intense process of consultation was launched, reaching experts and users from around the world. The strategy resulting from a consultation at the UIS in 2003 (UIS, 2003) sought to reposition UNESCO as a principal player in the field of S&T statistics. Based on this strategy, the 2004 S&T statistics survey was launched. It was designed with a bias towards capturing information on research and development (R&D) personnel (rather than on expenditure) using classifications harmonised with the OECD. This survey is now carried out every two years (Fernández Polcuch, 2006).

One of the main characteristics of the new UIS strategy in S&T statistics is a clear commitment to capacity building. Capacity-building activities were initiated through workshops to discuss methodologies and good practices for data collection in all regions of the developing world. The wealth of experience gathered at these workshops is now being documented and published for wider dissemination.

The first of these publications – *Measuring R&D: Challenges faced by Developing Countries: Technical Paper No. 5* (UIS, 2010) – arose from work carried out from 2006-2009. The work involved the preparation of background papers, workshops in Montreal, Canada and Windhoek, Namibia, as well as extensive discussions with numerous experts.

This work was then presented to the OECD Working Party of National Experts on Science and Technology Indicators (NESTI), which suggested that it could serve as the basis for an Annex to the *Frascati Manual – Proposed Standard Practice for Surveys on Research and Experimental Development* (OECD, 2002). The suggested Annex was prepared, tabled at NESTI, revised and adopted in March 2012 as an online adjunct to the 6th edition of the Frascati Manual (OECD, 2012).

This Technical Paper – *Guide on Conducting an R&D survey* – follows these contributions to practice and is intended to further assist R&D survey practitioners in their work. These guidelines take into account that circumstances and practices vary widely among countries and that there is no single way to achieve a sound and reliable survey. This Technical Paper is intended to support other activities in the field such as the African Science, Technology and Innovation Indicators (ASTII) Initiative by the African Union and the Ibero-American and Inter-American Network on Science and Technology Indicators (*Red de Indicadores de Ciencia y Tecnología Iberoamericana e Interamericana* or RICYT) by the Latin American Network on S&T Indicators. The UIS has worked closely with the ASTII Initiative and RICYT over the years.

R&D is located within the innovation systems approach and is recognised as one of the many activities that contribute to innovation. Central to this Technical Paper is the idea that despite the enhanced attention given to innovation, R&D matters. This forms the main topic of Section 2 of this Guide. Given that terminology is important, care is taken to distinguish the terms “S&T”, “R&D” and “innovation,” which are often incorrectly interchanged. R&D is important in and of itself, and for its role in the process of technology absorption and adaptation. This indirect contribution of R&D to the economy is difficult to measure and often under-appreciated.

Information on the financial and human resources available to R&D is needed for planning and monitoring, evidence-based decision-making and international benchmarking. This is addressed in Section 3 where the relevant R&D indicators are demarcated. After identifying why there is a need to measure something and what is to be measured, the next task – as laid out in Sections 4 and 5 – is to carry out the survey. Section 4 considers the issues facing each of the major sectors (higher education, government, business enterprise and private non-profit or PNP) while Section 5 provides a simple project management template. Finally, Section 6 introduces generic model questionnaires for the higher education, government, business enterprise and PNP sectors. These questionnaires are based on those developed by the Centre for Science, Technology and Innovation Indicators (CeSTII) to survey R&D in South Africa. They are compatible with the ASTII model questionnaires, which are also based on the CeSTII questionnaires. The questionnaires include examples on how to compile the data for capital expenditure, labour costs (based on the full-time equivalent cost of labour) and current expenditure.

2. Innovation policy and the role of R&D

There are signs that science, technology and innovation (STI) are increasingly recognised as fundamental to achieving sustainable development. A number of developed and developing countries have drawn on STI to improve production and productivity of agriculture and industries, meet health care needs and overcome environmental challenges (Bokova, 2012).

“Innovation” has become the new buzzword associated with the movement of economies and societies toward prosperity and well-being. In China, innovation is seen as central to the “green and harmonious development” of a socialist society (CCICED, 2008) while a hemisphere away in the United States, innovation was declared to be “more important than ever. It is the key to … good-paying, private-sector jobs for the American people” (The White House, 2011). Two very different economic systems yet innovation is hailed as vital to both.

Advocacy for innovation can be found across the international agenda as well as in the OECD Innovation Strategy that posits, “Future growth must … increasingly come from innovation-induced productivity growth. Innovation – the introduction of a new or significantly improved product, process or method – holds the key to boosting productivity” (OECD, 2010).

So, innovation is important and governments have responded by developing a set of policy instruments and interventions, ranging from financial incentives and the provision of incubation facilities to new modes of service delivery. Innovation is an inherently risky activity so care is needed to foster a climate in which innovation is encouraged. R&D is one among many innovation activities and carries its own risks.

A half century ago, “R&D” was the buzzword whereas today “innovation” has taken centre stage. This does not reduce the importance of R&D or its measurement. The last half-century has seen innovation policy move through three phases (World Bank, 2010). In the first science-led phase, innovation was believed to arise from the conversion of basic research and subsequent applied R&D into useful products. This linear model underpinned the emergence of numerous public research institutes (PRIs) in the wake of World War II. The linear model offers a simple way of thinking about the relationship between science and society (Godin, 2005).

The measurement of national R&D activity had already started in the 1930s but it took another three decades before sufficient agreement on a methodology was achieved (King, 2006). This turning point was marked by the publication of the *Frascati Manual* (OECD, 1963), which laid out guidelines for measuring industrial R&D.

This first phase of science policy peaked in the early 1970s at which point the onset of neo-liberalism and the energy crisis forced a radical reappraisal of the relationship between science and society. Sluggish growth coupled with high inflation became widespread in Europe yet Japan continued to surge ahead. Economic assumptions and theory were re-appraised, leading to the rise in status of evolutionary economics in direct challenge to equilibrium economic theory. With evidence accumulating from industry studies, the recognition grew that innovation was more complex than the linear model (e.g. the chain link model of Kline and Rosenberg, 1986). Freeman (following studies of Japan) and Lundvall (based on the Scandinavian experience) were instrumental in reviving appreciation for economist Josef Schumpeter’s work on innovation. This led to the first formulations of what came to be termed the “innovation systems approach,” in which firms are at the centre of innovation activity.

This second phase of innovation policy has since been codified in the various editions of the *Oslo Manual* (OECD, 2005), which provides guidelines for conducting innovation surveys. These surveys show that firms mainly obtain external information for innovation from their customers, suppliers and competitors. Universities and PRIs are not the prime source of information for firms. The former generate a reservoir of highly skilled labour while the latter perform public goods research, particularly in health, agriculture and security, and scientific and technological services (testing, mapping, breeding, disease control, vaccine production, standards). R&D is a prominent feature across this entire spectrum of activities and performers.

The third phase of innovation policy is a work in progress that builds on the understanding that innovation cuts across the whole socio-economic structure and government. So, effective innovation policy requires synergy between all sectors of government. As implied here, no clean-cut breaks exist between the three phases.

R&D is one among many innovation activities – innovation involves learning, copying, information sharing, training, the transfer of skills, selective hiring of staff, study visits, accessing codified knowledge, design, protecting intellectual property, business intelligence gathering, adaptation of technologies, prototyping, and reverse engineering.

Measuring R&D remains important for at least three very powerful reasons. The first and the most obvious is that one needs to know the magnitude of the inputs to R&D (personnel and expenditures) and their focus in various sectors, industries, scientific fields and other categories of classification in order to be able to monitor and plan this activity. R&D statistics provide one type of indicator of technological change and are therefore important information for governments concerned with economic growth and productivity. Advisors concerned with science policy, industrial policy and even general economic and social policies use them extensively. R&D statistics are now an essential background element for many government programmes and provide an important tool for evaluating them.

The second reason for measuring R&D is an indirect one. Essentially, the conduct of the survey by the ministry responsible for S&T, its delegate or National Statistical Office (NSO) brings government closer to the other actors in the innovation system, specifically the business sector. The third – another indirect benefit – is that the act of measuring R&D may encourage the surveyed organizations to improve their management of R&D. The following section will examine the principles underlying the measurement of R&D.

3. R&D indicators for evidence-based policymaking

The measurement of R&D is documented and preserved in the *Frascati Manual* (FM) that has evolved through six editions since the its initial publication in 1963. Although it was originally written for R&D surveys in OECD Member countries, the involvement of UNESCO and other international organizations has helped it evolve into a standard for R&D surveys worldwide. Along with the guidelines for measuring R&D is the Frascati family of manuals that now spans the measurement of innovation (Oslo Manual), human resources (Canberra Manual), biotechnology and patent statistics.

This section mostly contains a summary of the definitions and conventions presented in the 6th edition of the FM (OECD, 2002). Some paragraphs may have been edited. It must be noted that reading this Guide is not a substitute for consulting the FM directly. Currently, a revision process is under way that will lead to the 7th edition of the FM in 2015 or 2016. Once the revision is completed, this Guide will need to be updated to ensure that it is in line with the new edition of the FM.

The fundamental definition of R&D has evolved since its first formulation, which focused on science and engineering, into the present inclusive definition *(see **Box 1**).*

Box 1. Definition of R&D (OECD, 2002)

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 (FM §63).

The term R&D covers three activities: basic research, applied research and experimental development (FM §64).

Basic research is experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundation of phenomena and observable facts, without any particular application or use in view.

Applied research 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 is systematic work, drawing on existing knowledge gained from research and/or practical experience, which is directed to producing new materials, products or devices, to installing new processes, systems and services, or to improving substantially those already produced or installed.

The basic criterion for distinguishing R&D from related activities is the presence in R&D of an appreciable element of novelty and the resolution of scientific and/or technological uncertainty, i.e. when the solution to a problem is not readily apparent to someone familiar with the basic stock of common knowledge and techniques for the area concerned (FM §84).[1]

[1] The reference (FM §##) denotes the relevant paragraph number in the 6th edition of the *Frascati Manual* (OECD, 2002).

For survey purposes, R&D must be distinguished from a wide range of related activities with a scientific and technological basis. These other activities are very closely linked to R&D both through flows of information and in terms of operations, institutions and personnel. As far as possible, however, they should be excluded when measuring R&D (FM §65).

The boundaries of R&D

Activities to be excluded from R&D fall under four headings: education and training; other related scientific and technological activities; other industrial activities; and administration and other supporting activities (FM §66).

All education and training of personnel in the natural sciences, engineering, medicine, agriculture, the social sciences and the humanities in universities and special institutions of higher and post-secondary education should be excluded. However, research by students at the PhD level carried out at universities should be counted, whenever possible, as a part of R&D (FM §68).

Other related scientific and technological activities should be excluded from R&D except when carried out solely or primarily for the purposes of an R&D project (FM §69).
These activities comprise:

- Scientific and technical information services;
- General purpose data collection;
- Testing and standardisation;
- Feasibility studies;
- Mineral exploration;
- Specialised health care;
- Patent and licence work;
- Policy-related studies;
- Routine software development.

Possibly the greatest source of error in measuring R&D is the difficulty of locating the cut-off point between experimental development and the related activities required to realise an innovation. Errors in this respect are particularly significant (FM §24).

Excluded from R&D as well are other innovation activities (i.e. all scientific, technical, commercial and financial steps, other than R&D) necessary for the implementation of new or improved products or services and the commercial use of new or improved processes. These activities include acquisition of technology (embodied and disembodied); tooling up and industrial engineering; industrial design not elsewhere classified (n.e.c.); other capital acquisition, production start-up; and marketing for new and improved products. Production and related technical activities are excluded as well (FM §79-80).

Administration and other supporting activities have two components:

- Purely R&D-financing activities: the raising, management and distribution of R&D funds to performers by ministries, research agencies, foundations or charities is not R&D.

- Indirect supporting activities. This covers a number of activities that are not themselves R&D but provide support for R&D. By convention, R&D personnel data cover R&D proper but exclude indirect supporting activities, whereas an allowance for these is included under overheads in R&D expenditure of performers. Typical examples are transportation, storage, cleaning, repair, maintenance and security activities. Administration and clerical activities undertaken not exclusively for R&D, such as the activities of central finance and personnel departments, also fall under this heading (FM §81-83).

The issue of traditional knowledge (TK) is addressed in the recently published Annex to the *Frascati Manual*: "Measuring R&D in Developing Countries" (OECD, 2012). It defines TK to be a largely tacit "cumulative body of knowledge, know-how, practices and representations maintained and developed by peoples with extended histories of interaction with the natural environment […] a cultural complex that encompasses language, naming and classification systems, resource use practices, ritual, spirituality and worldview" (ICSU and UNESCO, 2002). The interaction between TK and R&D activities requires careful demarcation for the purposes of measuring R&D in developing countries. As a general rule, where activities associated with TK form part of an R&D project, the effort (financial and in terms of human resources) should be counted as R&D. They should otherwise be excluded. (FM Annex on Developing Countries §23-24). This is seminally important, as the Annex thus strictly follows the scope of its parent manual, conforming with the specification of activities in the FM that are to be counted as contributing to R&D.

Along with the definition of R&D, criteria for the systematic measurement of the inputs to R&D – namely the personnel and expenditures that are involved – also hold importance. The minimum set of attributes of personnel and expenditure that are to be measured are laid out below.

3.1. R&D personnel

R&D personnel data measure the quantum of human resources involved in R&D activities. All persons employed directly in R&D should be counted as well as those providing direct services such as R&D managers, administrators and clerical staff. Persons providing an indirect service, such as canteen and security staff, should be excluded even though their wages and salaries are included as an overhead cost when measuring expenditure (FM §294-295).

R&D personnel are classified under two major categories: occupation and qualification.

Classification by occupation

R&D personnel can be classified under one of the following three types of occupations:

- Researchers
- Technicians and equivalent staff
- Other supporting staff

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 (FM §301). Managers and administrators engaged in the planning and management of the scientific and technical aspects of a researcher's work also fall into this category (FM §303). Postgraduate students at the PhD level engaged in R&D should be considered researchers. They typically hold basic university degrees (ISCED 1997 level 5A)[2] and perform research while working towards a PhD (ISCED 1997 level 6)[3] (FM §305). For international reporting, the R&D activities of Master's students should be excluded from the R&D data. Countries may choose to report separately on enrolment figures for Master's degree students and other relevant information on the extent of their research activities when they deem it appropriate for internal monitoring and policy purposes (OECD, 2012, §17). For instance, this could be the case in countries where PhD degree programmes are still in consolidation and Master's students play an important role in supporting the national research structure. Researchers also encompass post-doctoral fellows.

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 and/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 (FM §306).

Other supporting staff includes skilled and unskilled craftsmen, secretarial and clerical staff participating in R&D projects or directly associated with such projects (FM §309). Included under this heading are all managers and administrators who deal mainly with financial and personnel matters as well as general administration -- insofar as their activities are a direct service to R&D (FM §311).

Out of the three groups of R&D personnel, researchers form the most important group and a minimum set of attributes related to them should be collected.

Classification by level of formal qualification

The International Standard Classification of Education (ISCED) provides the basis for classifying R&D personnel by formal qualification. In the 2002 edition of the FM, the reference is to ISCED 1997 (UNESCO, 2006a). In that edition, the following six classes are recommended for the purposes of R&D statistics and are defined exclusively by level of education – regardless of the field in which personnel are qualified (FM §312):

- Holders of university degrees at the PhD level (ISCED 1997 level 6).
- Holders of basic university degrees below the PhD level (ISCED 1997 level 5A).
- Holders of other tertiary level diplomas (ISCED 1997 level 5B).
- Holders of other post-secondary, non-tertiary diplomas (ISCED 1997 level 4).
- Holders of diplomas of secondary education (ISCED 1997 level 3).
- Other qualifications. This includes all those with secondary diplomas at less than ISCED 1997 level 3 or with incomplete secondary qualifications or education not falling under any of the other four classes (FM §313-318).

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[2] ISCED 2011 level 6 or 7; see the next section for more details on ISCED.
[3] ISCED 2011 level 8.

ISCED has since been revised. The new version was adopted in 2011 (UNESCO-UIS, 2012). Countries are expected to implement the new ISCED starting in 2014. The next edition of the FM – anticipated in 2015 – will reflect the new ISCED in its classification of R&D personnel by qualification. ISCED 2011 consists of the following levels:

- ISCED level 8 – Doctoral or equivalent level.
- ISCED level 7 – Master's or equivalent level.
- ISCED level 6 – Bachelor's or equivalent level.
- ISCED level 5 – Short-cycle tertiary education.
- ISCED level 4 – Post-secondary non-tertiary education.
- ISCED level 3 – Upper secondary education.
- ISCED level 2 – Lower secondary education.
- ISCED level 1 – Primary education.
- ISCED level 0 – Early childhood education.

R&D personnel most commonly have completed a tertiary education degree. Tertiary education builds on secondary education, providing learning activities in specialised fields of education. It aims at learning at a high level of complexity and specialisation. Tertiary education includes what is commonly understood as academic education but also includes advanced vocational or professional education. It comprises ISCED levels 5, 6, 7 and 8 (UNESCO-UIS, 2012). For the purposes of R&D statistics, the UIS recommends to collect data at the following levels. The model questionnaires in Section 6 reflect this recommendation.

- ISCED level 8 – Doctoral or equivalent level. Programmes at ISCED level 8 are designed primarily to lead to an advanced research qualification. Programmes at this ISCED level are devoted to advanced study and original research and are typically offered only by research-oriented tertiary educational institutions such as universities. Doctoral programmes exist in both academic and professional fields (UNESCO-UIS, 2012, §259).

- ISCED level 7 – Master's or equivalent level. Programmes at ISCED level 7 are often designed to provide participants with advanced academic and/or professional knowledge, skills and competencies, leading to a second degree or equivalent qualification. Programmes at this level may have a substantial research component but do not yet lead to the award of a doctoral qualification. Typically, programmes at this level are theoretically-based but may include practical components and are informed by state-of-the-art research and/or best professional practice. They are traditionally offered by universities and other tertiary educational institutions (UNESCO-UIS, 2012, §241).

- ISCED level 6 – Bachelor's or equivalent level. Programmes at ISCED level 6 are often designed to provide participants with intermediate academic and/or professional knowledge, skills and competencies, leading to a first degree or equivalent qualification. Programmes at this level are typically theoretically-based but may include practical components and are informed by state-of-the-art research and/or best professional practice. They are traditionally offered by universities and equivalent tertiary educational institutions (UNESCO-UIS, 2012, § 224). First degree programmes at this level typically have a duration of three to four years of full-time study at the tertiary level (UNESCO-UIS, 2012, §229).

- ISCED level 5 – Short-cycle tertiary education. Programmes at ISCED level 5 are often designed to provide participants with professional knowledge, skills and competencies. Typically, they are practically-based, occupationally-specific and prepare students to enter the labour market. However, these programmes may also provide a pathway to other tertiary education programmes. Academic tertiary education programmes below the level of a Bachelor's programme or equivalent are also classified as ISCED level 5 (UNESCO-UIS, 2012, §207).

- All other qualifications (ISCED levels 0 to 4).

Headcount and full-time equivalence (FTE) data

R&D personnel are measured in terms of headcount (HC) and full-time equivalent (FTE) data. HC data are on the total number of persons who are mainly or partially employed in R&D (FM §326). Headcount data are also the most appropriate measure for collecting additional information about R&D personnel, such as age, gender or national origin (FM §327).

While a data series measuring the number of R&D staff and, notably, researchers (i.e. HC data) has many important uses, it is not a substitute for a series based on the number of FTE staff (FM §327). R&D may be the primary function of some persons (e.g. workers in an R&D laboratory) or it may be a secondary function (e.g. members of a design and testing establishment). It may also be a significant part-time activity (e.g. university teachers or postgraduate students). Counting only persons whose primary function is R&D would result in an underestimate of the effort devoted to R&D while counting everyone who spends some time on R&D would lead to an overestimate. The number of persons engaged in R&D must, therefore, also be expressed in FTEs on R&D activities (FM §332). A data series based on the number of FTE staff is considered to be a true measure of the volume of R&D (FM §331).

Although the FM does not provide a concise definition of FTE, the following approach is given. One FTE may be thought of as one person-year. That means 1 FTE is equal to 1 person working full-time for 1 year or more persons working part-time or for a shorter period corresponding to one person-year. Thus, a person who normally spends 30% of his/her time on R&D and the rest on other activities (e.g. teaching, university administration and student counselling) should be considered as 0.3 FTE. Similarly, if a full-time R&D worker is employed at an R&D unit for only six months, this amounts to an FTE of 0.5 (FM §333).

More details on estimating FTE data can be found in Section 5.3.3 (FM §335-345) and Annex 2 of the FM where time-use surveys and other methods of estimating shares of R&D (R&D coefficients) in total activities are discussed. Some issues of particular concern for developing countries are addressed in Section 4 of the FM *Annex on Measuring R&D in Developing Countries* (OECD, 2012) and Section 4 of *UIS Technical Paper No. 5* (UIS, 2010).

It is recommended that R&D surveys should include all units where at least one FTE is worked in R&D per year. In practice, it may be acceptable to count all persons spending more than 90% of their time on R&D as one FTE and, correspondingly, to exclude all persons spending less than 10% of their time on R&D (OECD, 1994).

The two recommended aggregates for R&D personnel are: the number of personnel employed in R&D measured in HCs, and R&D personnel measured in FTEs performing R&D in the national territory for a given 12-month period. These should be broken down by sector (refer to Section 3.3) and by occupation and/or formal qualification. The other institutional classifications – and sometimes the functional distributions – mentioned under Section 3.4 are applied within this framework (FM §346). In the case of countries with a large foreign presence, data may be disaggregated according to nationality or other demographic variables.

3.2. R&D expenditure

A statistical unit may have expenditures on R&D either within the unit (intramural) or outside it (extramural) (FM §356).

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 (FM §358). Expenditures made outside the statistical unit or sector but in support of intramural R&D (e.g. purchase of supplies for R&D) are included (FM §359).

Extramural expenditures are the sums a unit, organization or sector reports having paid or committed themselves to pay to another unit, organization or sector for the performance of R&D during a specific period. This includes acquisition of R&D performed by other units and grants given to others for performing R&D (FM §408).

R&D expenditure data should be compiled based on performers' reports of intramural expenditures. As supplementary information, the collection of extramural expenditures is desirable (FM §357).

R&D expenditure is broken down into two major accounting categories – namely, current expenditure and capital expenditure. These expenditures are determined for the entity being surveyed, the statistical unit.

Current costs are composed of:

- Labour costs of R&D personnel (annual wages and salaries and all associated costs or fringe benefits). If R&D is not the primary function of certain persons, the R&D coefficients derived from time-use studies or other methods could be used directly at an appropriate level (i.e. individual, institute, department, university, etc.) to estimate the share of R&D in total labour costs (FM Annex 2 §47-50).
- Other current costs, which encompass non-capital purchases of materials, supplies and equipment to support R&D, including water, gas and electricity; books, journals, reference materials, subscriptions to libraries, scientific societies, etc.; materials for laboratories such as chemicals or animals; costs for on-site consultants; administrative and other overhead costs (e.g. office, insurance, post and telecommunications); costs for indirect services (e.g. security, storage, computer services, printing of R&D reports and the use, repair and maintenance of buildings and equipment); and labour costs of non-R&D personnel (FM §360-364).

  The shares of R&D in other current costs (i.e. purchase of items such as documents, minor equipment, etc.) are estimated on the basis of intended use if such items are used for more than R&D activities. If intended use is not feasible as a criterion, the same distribution coefficients as for labour costs may be used (FM Annex 2 §51).

Administrative and other overhead costs may also be prorated if necessary to allow for non-R&D activities within the same statistical unit (FM §364).

Capital expenditures are the annual gross expenditures on fixed assets used in the R&D programmes of statistical units, including land and buildings; instruments and equipment; and computer software. Expenditure should be reported in full for the period in which it took place and should not be registered as an element of depreciation (FM §374).

All depreciation provisions for building, plant and equipment – whether real or imputed – should be excluded from the measurement of intramural R&D expenditures (FM §375). This approach is different from standard accounting procedures that would spread the cost of capital expenditure over a number of years according to the rules applicable in the country or state where the survey is conducted.

This approach is proposed for two reasons:

- If depreciation – an allowance to finance the replacement of existing assets – is included in current costs, the addition of capital expenditures would result in double counting.
- In the government sector, no provision is normally made for the depreciation of fixed assets. Consequently, even within a country, comparisons between sectors cannot be made unless depreciation provisions are excluded. Likewise, aggregates for a national series cannot be compiled unless the sector totals are comparable (FM §375).

Capital expenditures are composed of expenditures on (FM §376-382):

- Land and buildings. This comprises land acquired for R&D (e.g. testing grounds, sites for laboratories and pilot plants) and buildings constructed or purchased, including major improvements, modifications and repairs.
- Instruments and equipment. This covers major instruments and equipment acquired for use in the performance of R&D, including embodied software.
- Computer software. This includes the acquisition of separately identifiable computer software for use in the performance of R&D. In R&D surveys, however, software for own account[4] produced as part of R&D is included in the relevant cost category (i.e. labour costs or other current costs) (FM §383).

When the R&D term of a fixed asset is not known and it will be used for more than one activity and neither the R&D nor any of the non-R&D activities predominates (e.g. computers and associated facilities; laboratories used for R&D, testing, and quality control), the costs should be prorated between R&D and the other activities. This proportion could be based on numbers of R&D personnel using the facility, compared to total personnel or on administrative calculations already made (e.g. the R&D budget may be charged a particular portion of the capital cost or a particular portion of time or floor space may be assigned to R&D) (FM §385).

[4] Own account software is software developed by an entity's own employees for its own use.

The other possibility for estimating investment shares in instruments/equipment and land and buildings that can be attributed to R&D is according to the intended use of the equipment or intended use of the facilities. This may also be based on conventions or on opinion of the institutes (FM Annex 2 §52-54).

Gross domestic expenditure on R&D (GERD) is the recommended aggregate for R&D expenditure. GERD is the total intramural expenditure on R&D performed in the national territory during a given period. It includes R&D performed within a country and funded from abroad but excludes payments for R&D performed abroad. GERD consists of the total of intramural expenditures of the four performing sectors (i.e. higher education, government, business enterprise and not-for-profit). It is often displayed as a matrix of performing and funding sectors. GERD and the GERD matrix form the basis of international comparisons of R&D expenditures. They also provide the accounting system within which the institutional classifications and functional distributions may be applied (see Section 3.4) (FM §423-424).

Gross national expenditure on R&D (GNERD) is another useful aggregate. It comprises total expenditure on R&D financed by a country's institutions during a given period. This aggregate includes R&D performed abroad but financed by national institutions or residents and excludes R&D performed within a country but funded from abroad. GNERD is constructed by adding the domestically-financed intramural expenditures of each performing sector and the R&D performed abroad but financed by domestic funding sectors. It provides some supplementary information on R&D cooperation between different kinds of units (FM §426).

Government budget appropriations or outlays for R&D (GBAORD) is another valuable indicator that measures government support for R&D using data from budgets. This essentially involves identifying all the budget items involving R&D and measuring or estimating their R&D content in terms of funding. These estimates are less accurate than performance-based data but as they are derived from the budget, they can be linked to policy through classification by objectives or goals (FM §476). Since GBAORD data are compiled from the budget and do not require a survey, it is beyond the scope of this Guide and will not be addressed further.

3.3. Sectors of the economy

To facilitate the collection of data, the description of institutional flows of R&D funds and the analysis and interpretation of R&D data, the statistical unit(s) classified should be grouped by sectors of the economy, following as closely as possible the standard classifications of economic activities (FM §156).

R&D statistical units can be grouped into five sectors:

- Business enterprise. This comprises all firms, organizations and institutions whose primary activity is the market production of goods or services (other than higher education) for sale at an economically significant price to the general public as well as the private non-profit (PNP) institutions that serve them. It includes public enterprises (FM §163).

  The statistical unit is further characterised according to its dominant activity using the International Standard Industrial Classification (ISIC) Rev. 3.1 or ISIC Rev. 4.

  Additional sub classification by type of institution may be required (i.e. national, multinational, locus of ownership of public enterprises).

- Government. This includes all departments, offices and other bodies that provide – but normally do not sell – to the community common services other than higher education that cannot otherwise be conveniently and economically provided. These bodies also encompass those that administer the state, economic and social policy of the community as well as non-profit organizations (NPOs) controlled and mainly financed by government but not administered by the higher education sector. This includes department research sections, department-based research institutes (DBRIs), stand alone public research institutes (PRIs) and other bodies that conduct research as public goods. Public enterprises are excluded (FM §184).
- Higher education. This sector includes all universities, colleges of technology and other institutions of post-secondary education whatever their source of finance or legal status; and all research institutes, experimental stations and clinics operating under the direct control of or administered by or associated with higher education institutions (FM §206). Of particular note is that it does not include all research institutes that are under the Ministry of Higher Education or a similar ministry even if the ministry's name implies a connection to higher education. These research institutions would generally fall under the government sector. If any of these research institutions operate under the direct control of or are administered by higher education establishments such as universities, colleges of technology and other institutes of post-secondary education, then they fall under the higher education sector.
- Private non-profit. Non-market, private PNP institutions serving households (i.e. the general public), private individuals or households are included in this sector (FM §194)
- Abroad. This sector encompasses all institutions and individuals located outside the political borders of a country, except vehicles, ships, aircraft and space satellites operated by domestic entities and testing grounds acquired by such entities; all international organizations, except business enterprises, including facilities and operations within the country's borders (FM §229).

Of note, the abroad sector is only required to break down R&D expenditure by source of funds.

3.4. Functional distribution of R&D resources

Where resources permit, R&D resources may also be measured according to its functional distribution *(see FM Chapter 4).* Functional distributions include the type of R&D, fields of science (FoS), socio-economic objectives and activities by product field – for the business sector only.

Type of activity

Type of activity data are broken down by basic research, applied research and experimental development as was discussed in Box 1 at the start of this section.

Field of science

In the distribution by detailed fields of S&T, the R&D itself is examined rather than the main activity of the performing unit (FM §273).

A distribution by FoS is most easily applied in the higher education and PNP sectors. The units surveyed in the government sector may also be able to break down their R&D activities by FoS

but this has rarely been attempted in the business enterprise sector. This classification is therefore recommended for all R&D carried out by units in the higher education, government and PNP sectors (FM §274).

Many countries also seek to determine the distribution of research staff by FoS. As is the case with expenditure by FoS, this distribution usually relies on a reasonable estimate being made as detailed activity records are not usually available except in organizations that apply strict project management to their R&D projects. Such detailed data may be available for large, high-cost projects involving expensive equipment for which time-use records will be kept. The same level of detail may also be found in R&D fields involving high ethical standards of conduct as in the case of human and animal trials.

The main FoS are:

- Natural sciences
- Engineering and technology
- Medical and health sciences
- Agricultural sciences
- Social sciences
- Humanities

The detailed classification at the two-digit level can be found in Section 6.5.

Socio-economic objectives (SEOs)

The distribution by SEOs is a functional analysis of the primary SEOs of intramural R&D as recorded retrospectively by the performer. It is most easily applied in the government and PNP sectors (FM §277) although it is mainly used as the primary classification of GBOARD.

The list of SEOs has been updated since it appeared in the FM and is now listed according to NABS 2007. NABS is a French acronym that stands for “Nomenclature for the Analysis and Comparison of Scientific Programmes and Budgets,” and was developed for EU reporting. The revised list (NABS 2007) is as follows:

1. Exploration and exploitation of the earth
2. Environment
3. Exploration and exploitation of space
4. Transport, telecommunication and other infrastructures
5. Energy
6. Industrial production and technology
7. Health
8. Agriculture
9. Education
10. Culture, recreation, religion and mass media
11. Political and social systems, structures and processes
12. General advancement of knowledge
13. Defence

Product Field

Product field analysis focuses on the actual industrial orientation of the R&D carried out by institutions in the business enterprise sector (FM §258).

To maintain symmetry with the institutional classification for the business enterprise sector, the same distribution list has been adopted (i.e. ISIC Rev 3.1 or ISIC Rev. 4) (FM §261).

Regional distribution

There is often also demand from policymakers for information on R&D by geographic location. This is clearly a completely local decision. Of note though is that the distribution of statistics by regions is compulsory in some countries.[5]

3.5. Main indicators

The main indicators that are to be compiled are listed below.

- GERD (local currency)
- GERD (million current PPP $/million PPP$ - constant prices)
- GERD per capita (current PPP $/PPP$ - constant prices)
- GERD as a percentage of GDP
- Total R&D personnel (HC/FTE)
- Total R&D personnel per million inhabitants/1,000 labour force/1,000 total employment (HC/FTE)
- Total researchers (HC/FTE)
- Total researchers per million inhabitants/1,000 labour force/1,000 total employment (HC/FTE)
- Female researchers as a percentage of total researchers (based on HC)
- Percentage of GERD financed by industry
- Percentage of GERD financed by government
- Percentage of GERD financed by the higher education sector
- Percentage of GERD financed by the PNP sector
- Percentage of GERD financed from abroad
- Percentage of GERD performed by the business sector
- Percentage of GERD performed by the higher education sector
- Percentage of GERD performed by the government sector
- Percentage of GERD performed by the PNP sector
- Business enterprise expenditure on R&D - BERD (local currency)
- BERD (million current PPP $/million PPP$ - constant prices)
- BERD as a percentage of GDP
- Total business enterprise R&D personnel (HC)
- Total business enterprise R&D personnel (FTE)
- Business enterprise researchers (HC/FTE)
- Percentage of BERD financed by industry
- Percentage of BERD financed by government

[5] For example, the EU countries have to deliver regional data to Eurostat based on the Nomenclature of Territorial Units for Statistics (NUTS) classification.

- Percentage of BERD financed by other national sources
- Percentage of BERD financed from abroad
- Percentage of BERD performed in non-manufacturing industry
- Higher education expenditure on R&D - HERD (local currency)
- HERD (million current PPP $/million PPP$ - constant prices)
- HERD as a percentage of GDP
- Higher education total R&D personnel (HC/FTE)
- Higher education researchers (HC/FTE)
- Government intramural expenditure on R&D - GOVERD (local currency)
- GOVERD (million current PPP $/million PPP$ - constant prices)
- GOVERD as a percentage of GDP
- Government total R&D personnel (HC/FTE)
- Government researchers (HC/FTE)

This section has covered the essential intent of an R&D survey. In general, the R&D survey aims to capture the list of main indicators above. Even if this list is reduced down to a bare minimum, the party responsible for the R&D survey faces the complex task of carrying it out. The next section offers survey advice for each of the sectors of performance while Section 5 outlines a project methodology that may assist with this task.

4. Survey procedures by sector

Each country and its innovation system are unique. This renders a one-size-fits-all solution to conducting R&D surveys inoperative. This should be kept in mind when applying the guidance provided in this Paper. The country as a whole along with each sector and its institutions have developed over time, giving rise to different management styles and approaches to mutual interaction. Economists use the term “path dependence” to describe this phenomena. The success of any survey is affected by these underlying institutional cultural factors, which in turn may be strengthened or mitigated by the overarching administrative culture.

The survey team will have to navigate the prevailing norms that govern information exchange, showing an understanding for the way that organizations may guard their information assets.

R&D surveys are inherently labour-intensive. The interaction between a national statistical office or other data collection agency and respondents is essential to learning and building trust.

With this in mind, it might be advisable for the first R&D survey to collect its data by means of interviews rather than relying on other methods *(see Section 5.3 for more details on means of data collection).* This does raise the cost of the survey. Implicit in this approach is that not only is the survey labour intensive but the survey team must comprise self-confident and articulate persons preferably diploma or degree graduates. They must be able to negotiate and interact with the senior staff of the organizations that are targeted by the survey.

A decision must be made as to which sectors are to be covered: public and/or private? For a country carrying out its first R&D survey, it is advisable that both public and private sectors (i.e. business, government, higher education and private non-profit) be covered in order to establish a data baseline. Assuming that all sectors are to be covered, the next decision concerns the survey methods for each sector.

Some industrialised countries do not cover all sectors in the same survey. They may cover government and higher education only every third or fourth year, concentrating instead on the business sector every second year. The opposite is often the case in developing countries where business sector R&D is a small contributor to total R&D expenditure. The reasons for such strategies are often complex and include concerns for respondent fatigue and that mature innovation systems are slow to change so that variations are small from year to year.

Thus, the frequency of the R&D survey and its coverage should account for the situation in the country and its particular needs. Choosing the most relevant approach and parameters (i.e. survey methods, target population, survey respondents, etc.) would depend on each sector, its size and the complexity of the organizations within it that are being assessed. Therefore, it is useful to approach these decisions sector by sector.

4.1. Higher education sector

Unlike department-based research institutes (DBRIs) or public research institutes (PRIs), the primary function of higher education Institutions (HEIs) is teaching, not research, which is the secondary function of most universities. In many developing countries, the HEIs are the main seat of R&D activity so every effort must be made to ensure good coverage of these bodies.

In general, the R&D survey should cover all universities and corresponding institutions, especially those awarding degrees at the doctorate level. Other institutions in the sector known or assumed to perform R&D should also be included (FM §447).

Usually, HEIs are well known and are easily identifiable. Similar to coverage of the government sector, it is customary to conduct a census of these organizations. In the case of large economies where a big number of universities exist, the higher education sector may be surveyed by a purposive survey that deliberately sets out to identify R&D performers and then elicit the required data from them directly. Factors to be considered when selecting the sample in a purposive survey include the following:

- Older universities are usually more likely to be engaged in R&D;
- Universities offering postgraduate degrees might be more engaged in R&D;
- Private universities are often more focused on teaching;
- Known R&D performers could be captured from previous R&D surveys;
- Universities could be receiving government funds to carry out research;
- Number of publications appearing in peer-reviewed journals could yield good candidates for a sample.

The list of HEIs should be readily available at the Ministry of Higher Education or University Grants Commission or a similar institution. In general, the oldest universities are usually the leading research performers. In practice, examining the output of scientific publications on databases such as the Web of Science™ or Scopus™ can indicate areas where research activity is concentrated. Other sources of information mentioned in the government sector would certainly be useful in this process as well, such as registers of university personnel.

An increasing number of countries are developing some form of database to capture the *curriculum vitae* (CV) of researchers – for example, Brazil's well known *Plataforma Lattes* of the CNPq (*Conselho Nacional de Desenvolvimento Científico e Tecnológico)* as well as databases in Mexico and Belgium. Such databases may be used to promote research activity as well as serve as a base for managing information. Researchers are voluntarily responsible for keeping their CVs up-to-date. In practice, failure to maintain a CV could have negative effects, such as compromising a researcher's access to grants. These databases will be useful for identifying research activities in HEIs and relevant actors performing R&D.

Depending on the complexity of HEIs, the questionnaires may be populated at the organization, division/department or faculty level. The final decision on the way that the organization will administer the questionnaires is usually internal to that organization and will often be a matter for discussion with the survey team. The internal organization of universities, such as how independent faculties are from one another, will play a role in this decision.

The universities, polytechnics and even scientific academies in some countries display varying degrees of autonomy. In some countries, their staff are civil servants, meaning that, in principle, a list of employees by each HEI should be available. In other systems, academics are directly employed by the HEI in question and access to staff records may be protected by statute or HEI regulations. If no central registry of HEI staff exists – particularly at universities – the individual HEIs will have to be approached through the office of the Vice Chancellor/President to assist in obtaining the necessary information. In some universities, there are higher level positions specifically in charge of research, such as the Deputy Vice

Chancellor/Pro-Vice-Chancellor for Research, Dean of Research or Head of Research Management. In these instances, it would be more practical and straightforward to approach them directly to obtain the necessary information.

The maturity of the HEIs and their historical relationship with government is also an important factor in determining the willingness of these institutions to participate in the R&D – or any other – survey. Where there has been conflict between state and academia, it may be difficult to obtain the necessary buy-in to conduct a survey.

If there are many HEIs in the country with say a minimum of five known R&D performers, it would be useful to develop the groundwork for completing the questionnaire by inviting the key respondents to a central workshop. Building trust and a sense of shared purpose is essential.

Determining the headcount (HC) of staff that are active researchers and then estimating the time that they spend on their research is essential to obtaining a good estimate of the overall research expenditure. This is not an easy task. Some countries (e.g. the United States and Canada) make use of predetermined full-time equivalent (FTE) factors. In other countries, where the amount of time allocated to research forms part of official employee-HEI contracts, this may be used to estimate the FTE. Where time permits and if there is a willingness to cooperate, academic staff might be persuaded to keep time diaries so that a reasonably accurate estimate might be obtained at the individual level. The issue of accurately capturing HCs and FTEs has plagued survey measurement for a considerable time (see Sirilli, 1998 for example) and boils down to the fact that the survey relies on estimation. For this reason, the tradition of presenting FTE data to two decimal places is questionable. Further guidelines on "Obtaining data on R&D in the higher education sector" can be found in FM Annex 2 where time-use surveys and other methods of estimating shares of R&D (R&D coefficients) in total activities in the higher education sector are discussed.

4.2. Government sector

In general, units to include in the R&D survey of the government sector are all public sector R&D institutions (e.g. public research institutes and department-based research institutes[6]) as well as public organizations that deal with science and technology services (STS) (e.g. statistical, meteorological, geological and other public services, museums, etc.) (FM §443).

In principle, these government institutions are well understood as it is the norm to conduct a census of the organizations that are known or assumed to be performing R&D. Registers/directories of government departments, research institutes and statutory bodies can help identify the possible R&D performers in the government sector. Other sources of information could be academic or professional and stem from learned societies; research associations; lists of STS institutions; registers or databases of scientists and engineers; and databases of scientific publications, patents and other intellectual property documents.

In some domains, an S&T management information system (STMIS) may exist and could provide an overview of the research system and a framework for establishing registers as sample frames for R&D surveys.

[6] How these institutes are established varies from country to country. This could also include R&D sections/units at central or state government level or at the municipality level.

The R&D survey will most likely be conducted by the ministry responsible for S&T or its equivalent or its delegate under the authority of the NSO. Even if the survey is not yet a component of national statistics, it could be speculated that accessing information from peer government departments would be fairly straightforward. Unfortunately, even when officials are willing to collaborate, they may be hindered by the lack of available information in compiled form when completing the questionnaire. This is particularly the case with department-based research institutes (DBRIs) where the staff are employed as civil servants. The entry point for such DBRIs will be the senior civil servant such as the Director-General or Permanent Secretary.

The case of public research institutes (PRIs) is somewhat different especially where these have been established as arm's length statutory bodies. In this case, the Chief Executive Officer or executive responsible for research management would be the entry point.

It is commonplace to find PRIs reporting that all their staff do research and that their FTE is equal to or close to 100%. This is a tricky issue to resolve. Many PRIs are engaged in R&D, STS and consulting activities. The STS activities may or may not be part of R&D projects and consulting activities are quite often done to provide background papers and studies for policymakers, which generally does not constitute R&D. Although activities that are not R&D should be excluded, this may be difficult to apply in practice. PRIs differ in their orientation and institutional cultures so that it would be futile for instance to generalise that say 70% of their professionals are deemed to be researchers. A systematic count will need to be done.

On the other hand, public organizations primarily engaged in STS often undertake some research in connection with this activity. Such research activities should be clearly identified and be systematically captured in the R&D survey.

4.3. Business enterprise sector

In the business enterprise sector, some firms perform R&D on a regular basis while others do so only occasionally. Yet, it is recommended that all enterprises performing R&D, either continuously or occasionally, be included in R&D surveys (FM §435).

When conducting an R&D survey, it is worthwhile to take note of the characteristics or nature of R&D in the business enterprise sector in developing and emerging economies. Although business is the locus of much R&D in most OECD countries, for many developing and emerging economies, business expenditure on R&D (BERD) is often much smaller than R&D expenditure in the government and higher education sectors. The lower emphasis on R&D in the business enterprise sector may reflect organizational issues. Where businesses cater mainly to the local market, continuous R&D may be the exception rather than the norm – with R&D occurring occasionally across many firms (OECD, 2012).

The business sector is central to the goal of innovation but Gault (2011) points out that R&D is a rare event – in Canada, for example, generally only 5% of firms engaged in regular R&D activity. Many firms that innovate do not carry out in-house R&D. This does not mean that no R&D occurs in developing countries or emerging economies but rather that one has to seek it out very carefully.

In developing and emerging economies, many of which have recent histories of colonial rule or foreign occupation, planners, economists and entrepreneurs can be found grappling with the problem of building and encouraging the small domestic businesses. In the field of high and medium-high technology, start-ups and established firms are few in number. Large domestic firms cluster in relatively mature industries such as food processing, building materials and construction, transport, services and telecommunications, which are not generally sites of much R&D.

In addition, those countries that have suddenly become major commodity exporters have done so through the commissioning of multinational corporation (MNC) turnkey projects involving the rapid development of a resource exploiting a mine or plant with the necessary infrastructure to export the raw or partially refined products. In such cases, most required R&D is performed in the well-established laboratories of the MNC and shifting this R&D activity to a developing country or emerging economy rarely happens.

There are of course exceptions to the above as in the cases of China and India, and increasingly that of Brazil. Both China and India have seen the establishment of MNC R&D laboratories that initially sought to capitalise on the availability of highly-skilled but lower cost research personnel. Over time, these laboratories have become integrated into the value chains of both manufacturing and service industries. Even so, it is important to track the resulting R&D with respect to ownership and make the distinction between R&D occurring in foreign versus local firms. Care also needs to be taken to include research centers of MNCs with no local production unit.

How then to detect R&D activity?

In many countries – industrialised and developing – no comprehensive and up-to-date business register is available nor is there a directory of companies that perform R&D. Even when a business register is available, it is important to ascertain that it includes active companies and excludes ghost or shelf companies. Furthermore, business registers tend to be insensitive to volatile sectors such as small-scale enterprises. If a reliable business register is not on hand, a census estimate through a random sample will be impossible. Even so, random sampling may not be the most reliable way of determining R&D – companies that appear to be similar in terms of what they offer to the market may in fact have very different R&D strategies and random sampling may not account for this.

The alternative approach is to carry out a purposive survey that deliberately sets out to identify R&D performers and then elicit the required data from them directly. This entails trying to survey all firms known or supposed to perform R&D.[7]

The business sector may be surveyed by random sample or, preferably, by a purposive survey.

In order to carry out the purposive survey, the business register of firms that perform R&D must be populated as soon as possible. Eliciting and compiling this information is time-consuming and represents an important investment in future surveys.

[7] Some feasible approaches for establishing the survey population of the business enterprise sector are discussed in FM §436-442 (OECD, 2002).

When no prior register of R&D business sector performers exists, one has to carry out what amounts to detective work. This search for information on firms might proceed by interrogating the following sources of information on firm behaviour:

- Chamber of Commerce/Industries, trade associations, professional associations. A good starting point is to seek out the various associations and ask their information officers what they know about R&D activities of firms.
- National stock exchange. Working through the businesses listed on the main stock exchange is a necessary task.
- Company annual reports, trade journals, directories of R&D laboratories. A base list of R&D performing firms can be created by reviewing R&D expenditures that are included in financial reports or regular accounting systems. These sources should also be reviewed for specific information related to R&D activities, particularly the construction of prototypes, establishing pilot plants, etc.
- Registers of publicly funded research grants/contracts for R&D. In more sophisticated environments, the Ministry of Science and Technology or the national research grant maker may have a list of business beneficiaries of research or innovation grants.
- Lists of enterprises claiming tax deductions for R&D. Close cooperation between the survey and government departments responsible for R&D tax incentives, import facilitation, export promotion and price controls may also assist in identifying other R&D performers.
- Lists of enterprises reporting R&D activities in previous R&D surveys, in innovation surveys or other enterprise surveys.
- Registers of approved clinical trials; Registers of approved Government Medical Office (GMO) trials/ethics clearance registers. Other sources of information are clinical trial registers or those regulating experimentation with GMOs.

The business register of R&D firms is populated through desk work, starting with large firms in sub-sectors that usually involve some R&D, such as petrochemicals, chemicals, mining and mineral processing, pharmaceuticals, electrical, electronics and software. Generally speaking, where local manufacture takes place under licence, little or no local R&D is performed. When dealing with several hundred large firms, a first pass might be done to identify and exclude holding companies as well as construction, retail and utilities as sub-sectors likely to perform little or no R&D. For a given sub-sector, the first identification of an R&D performer should generate the question: Who in your sub-sector is also performing R&D and how do we contact them?

Unless published information confirms the existence of R&D, direct interaction is needed with firms to verify the existence of R&D activities. One approach would be to conduct a 2-stage survey to first track down R&D performers using a very simple questionnaire and then targeting those firms reporting R&D activities with a more extensive questionnaire. In general, the entry point for business firms would be through the Chief Executive Officer (CEO) or a divisional head. Approaching the largest firms – both MNC and local – and meeting with the Chief Financial Officer or Chief Technology Officer as available would be informed by industrial structure and the concentration of firms. Interviewing key firms would help one understand their R&D functions and obtain a clear picture of their activity. Missing a large firm while identifying R&D performers might result in significant error.

To avoid the possibility of double counting – in particular to avoid including extramural expenditure while capturing intramural expenditure – it is necessary to understand the structure of companies. This is especially true in the case of holding companies or diversified industrial groups. It is therefore always important to carefully identify the appropriate unit of measure. The enterprise is recommended as the main statistical unit and the enterprise unit as the reporting unit in the business enterprise sector for R&D surveys (FM §170-173 and §435). Ideally, data should be captured for each independent R&D performing entity. One test of independence might be to determine the income tax status of the various companies that make up a diversified holding company. Each subsidiary that is a registered taxpayer would in principle be of interest to the survey.

The conduct of clinical trials presents a range of challenges. It is important to remember that clinical trials in phases 1, 2 and 3 are regarded as R&D activity and that the inputs to this activity should therefore be counted in the R&D survey. In some countries, the flow of funds to such activity can be considerable and may literally crowd out other investment. This is especially so where donor or philanthropic organizations are funding major interventions into infectious or non-communicable diseases. Ways to navigate clinical trial R&D data can be found in Section 5.2 of the Annex to the FM (OECD, 2012).

A sector that is important everywhere but that tends to be neglected in many countries – industrialised and developing – is the service sector. Services are a site of much innovation activity and the sector may account for significant levels of R&D. The average (unweighted) percentage of BERD in the services sector in 2010 for 33 countries that reported these data to the OECD was 36.6% (OECD, 2013).

The growth of mobile telephony semi-monopolies, local banks, insurance and retail chains points to considerable domestic management capability as well as the ability to develop and integrate software solutions. Software engineering may involve the construction of unique algorithms that are part of the intangible value of a firm. The development of this intellectual property leads to commercial benefit and could be defined as R&D if it leads to an advance/an increase in the stock of knowledge in the area of computer software. In many countries, NSOs tend to concentrate the business survey on manufacturing firms so that services are ignored or undercounted. It is therefore strongly suggested that effort be made to engage with the leading banks, insurers, mobile telephony and ICT companies.

Firms active in various aspects of defence (land, sea and air systems) usually conduct R&D but may be reluctant to disclose any information. Some countries simply do not report on defence-related R&D.

4.4. Private non-profit sector

R&D in the PNP sector differs markedly from country to country and presents measurement challenges similar to those found in the business sector, which means that a purposive survey must also suffice. These difficulties not only stem from the task of identifying PNPs that perform countable R&D but is also tied to their juristic status.

The sources for identifying possible survey respondents are mainly the same as for the government sector. Registry information may be less comprehensive and could be completed by information from researchers or research administrations in other sectors (FM §446). The institution that conducts the R&D survey may ask them if they have any information about the PNP institutions known to perform or support R&D. Some sources used in the business

enterprise sector could also be of use (i.e. lists of institutions receiving government grants for R&D; lists of institutions claiming tax deductions for R&D; register of approved clinical trials; agricultural field trials; as well as other sources such as registers of non-governmental organization (NGO), foundations/associations, etc.).

PNPs may be domestically owned or foreign-owned. Their fields of activity are wide, ranging from poverty alleviation, environmental monitoring and protection to health research. They may be channels of considerable funds for in-house as well as contract R&D – to the extent that this may completely dominate other domestic contributions to GERD. This is especially the case in health R&D where there are large inward flows of funds for clinical trials. Such imbalances may also arise in other fields where a research institute headquartered in the United States or European Union has a foreign subsidiary that is incorporated as a PNP.

Foreign-owned PNPs present other issues of conformance for the R&D survey. In some cases, all professional staff are paid in the home country but data resulting from local R&D work may also be processed abroad so that the local operation is essentially one restricted to data gathering. The contribution of such activities to national R&D efforts is questionable. In such cases, the R&D survey should capture best available data on the R&D that the PNP performs and this could be included in the R&D survey report in a separate category accompanied with notes on the meaning of the data.

4.5. Treatment of BERD in Frascati and Oslo surveys

A final point concerns the relationship between dedicated Frascati-type R&D surveys and Oslo-type innovation surveys. By design, Oslo-type surveys are based on a stratified random sample of businesses. The emphasis of the instrument is on firm behaviour that calls for what is often a subjective assessment by the respondents. The targeted respondents of innovation surveys are chief executives. On the other hand, in the case of R&D surveys, the targeted respondents are those responsible for R&D or technology management.

The innovation survey instruments do not include extensive information as to what comprises R&D, relying instead on broad questions. See for example an extract from the Community Innovation Survey 2012 in **Box 2**.

Given the absence of careful guidelines on what counts as R&D and the general weakness of company records of R&D expenditure, the estimate of BERD obtained from Oslo-type innovation surveys is often quite different to that obtained from the R&D surveys. In general, the Oslo estimates are much higher than the Frascati calculated value. There are some countries where the opposite is true. In these cases, the least one can do is to include a note that declares the different values.

In the ideal case, BERD should be estimated from a Frascati-type survey. Where there are resource constraints and an innovation survey is the only source of data for BERD then this will have to suffice. A number of arguments for and against a combined R&D and innovation surveys, and some guidelines for such surveys are discussed in §457-459 of the Oslo Manual (OECD, 2005).

Box 2. Treatment of R&D in the Community Innovation Survey 2012

5.1 During the three years 2010 to 2012, did your enterprise engage in the following innovation activities:

- *In-house R&D*

  Research and development activities undertaken by your enterprise to create new knowledge or to solve scientific or technical problems (include software development in-house that meets this requirement).

  If yes, did your enterprise perform R&D during the three years 2010 to 2012:
  Continuously (your enterprise has permanent R&D staff in-house)
  Occasionally (as needed only)

- *External R&D*

  R&D that your enterprise has contracted out to other enterprises (including other enterprises in your group) or to public or private research organizations.

- *… (other innovation activities)*

5.2 How much did your enterprise spend on each of the following innovation activities in 2012 only? Innovation activities are defined in question 5.1 above. Include current expenditures (including labour costs, contracted-out activities, and other related costs) as well as capital expenditures on buildings and equipment.

- In-house R&D (include current expenditures including labour costs and capital expenditures on buildings and equipment specifically for R&D)
- External R&D
- *… (other innovation activities)*

Source: Eurostat (2012)

5. The R&D survey: Governance, logistics and process

This section offers a project management framework to conduct an R&D survey. Please note that this is only one example of how to conduct an R&D survey – there may be other established procedures followed by National Statistical Offices (NSOs) that could be adopted by a country.

The R&D survey is a project that studies peer institutions of the national innovation system (NIS) or, in other words, that collects the information from the stakeholders of the NIS. It will be conducted over a fixed time period and use various resources. The conduct of the survey will harbour its own learning processes and result in a final product: the R&D survey report. As such, it is advisable to adopt a recognised project management methodology.

> *It is useful to carry out the R&D survey according to an accepted project management methodology.*

A suitable project management methodology is based on the premise that the conduct of the project entails the parallel development of the final product, the people and the organization involved. In its simplest form, the methodology requires the construction of a project milestone plan/framework structured according to several "result paths/project lines," each with its series of project milestones *(see **Figure 1**).*

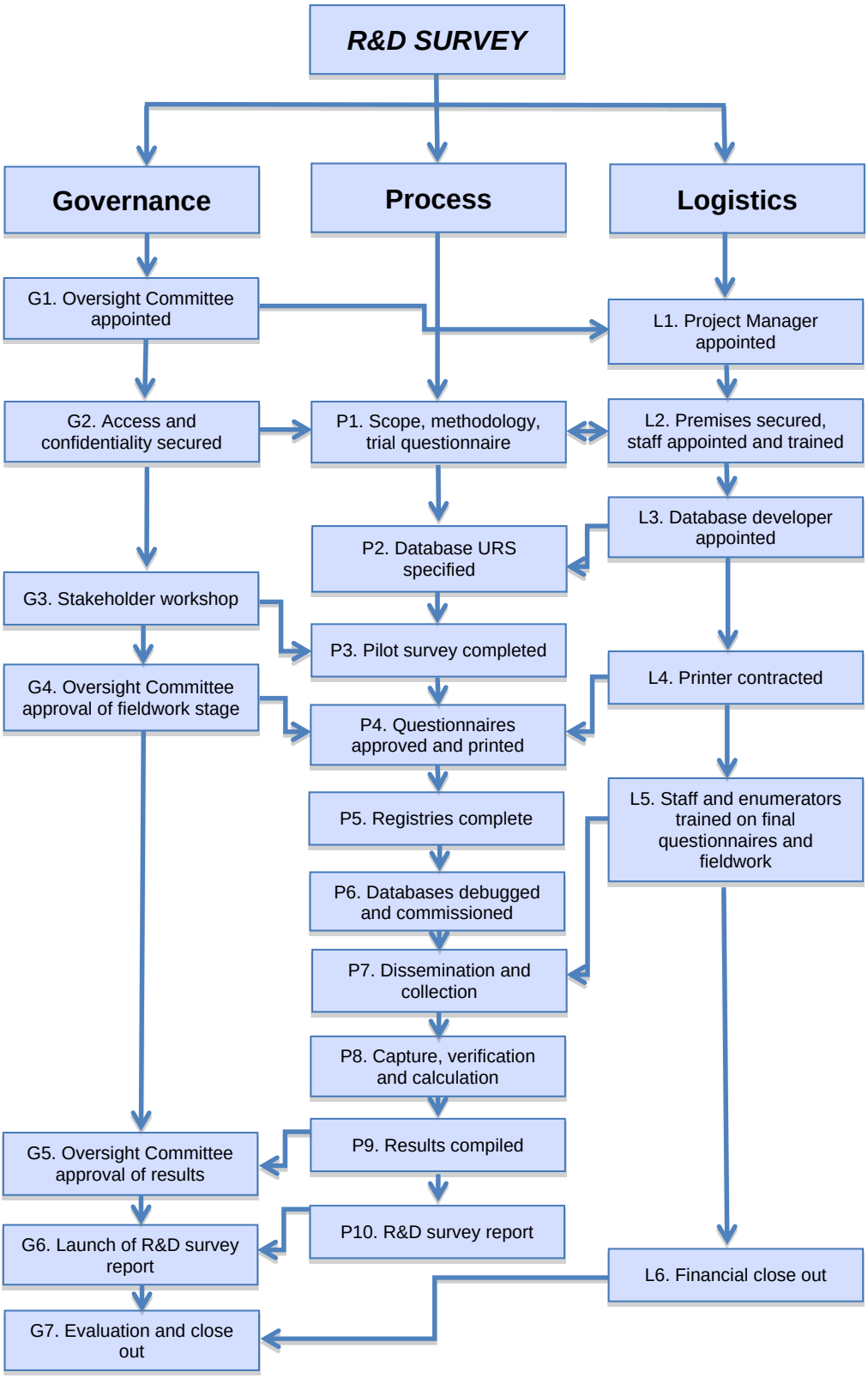
Experience suggests that it is convenient to structure the R&D survey along three result paths – namely, governance, process and logistics:

- Governance addresses oversight, advice and the authority of the survey. It provides the mechanisms for learning and control between the survey, its sponsors and stakeholders.
- Logistics addresses the financial, human and material resources for the survey.
- Process addresses the main work of designing and carrying out the survey to completion.

In the milestone plan presented here, the logistics result path comprises six milestones while the process project line has ten and the governance project line has seven. Although the milestone plan is presented as such in this Guide, the number of milestones and the sequence in each project line could vary. For ease of reference, each milestone is given a unique identifier. Each milestone represents a unique desired goal with a completion date. The milestones are sequential and co-dependent with the milestone plan serving as a work flow template to keep the survey conduct on schedule. The milestone plan may be refined to include target dates if needed.

The initial stages in the preparation of the survey and the determination and allocation of its resources are critical to its success. The parties that have called for the survey should be involved in the early stages of planning when the scope of the survey is laid out and agreed upon. In practice, the project manager and project staff would jointly develop the milestone plan and specify the target dates for each of these. Strategies to deal with the consequences of time delays should be considered. The milestone plan may be shared between survey team members and used as a checking device in regular project meetings as the project rolls out.

Figure 1. R&D survey milestone plan



The frequency of project meetings must be carefully considered. Initially, they might occur daily. During the data collection phase, they might be weekly. As the intensity of work and need for problem solving arises, they might once more become more frequent. Meetings should have a clear purpose and not distract from the need to achieve the necessary milestones. The following sub-sections will address the three result paths that make up the milestone plan: governance, logistics and process.

5.1. Governance

The project is shaped, guided and protected by its system of governance. Approaches to governance vary from country to country so this section will naturally be subject to differing interpretations. Governance includes all the legal aspects of the project, such as contracts with staff and sub-contractors. There are seven milestones suggested for this result path.

G1: Oversight committee appointed

The project calls for the collection of information from the various stakeholders, the actors and organizations that make up the innovation system. Building interest, trust and commitment with survey respondents is essential to gain their cooperation throughout the project life cycle.

> *Identify and recruit a high-profile Project Champion.*

"Information is power" is a widely known truism and regrettably some organizations see the handing over of even low-level information as a danger. Others may see the concentration of information into the R&D survey as unhelpful. For these reasons, strong advocacy to prepare the way for the conduct of the project is called for. This advocacy will be significantly advanced if a high-profile Project Champion can be identified. A Project Champion might be the relevant Minister or another top-level civil servant closely associated with the decision to call for the survey to be performed. It would be desirable if the Project Champion would follow the progress of the survey from inception to final delivery.

The Project Champion should launch the project at a meeting of key stakeholders with media in attendance. It would be desirable that the Project Champion be available to assist as the survey progresses and to help overcome obstacles as the project advances.

The project starts with the appointment of a representative Oversight Committee. This Committee will comprise key local stakeholders to oversee the governance of the project. Ideally, the Project Champion will chair or be a member of this Committee. The project may also benefit from the inputs of a Project Advisory Committee or a similar body to attend to the overall governance principles for such a project and advise on the technical aspects of the survey (i.e. its quality control and the parameters of an evaluation when the results are finalised). The Project Advisory Committee might comprise senior figures drawn from across the innovation system and NSO, and include foreign expertise from practitioners in the field of science, technology and innovation (STI) indicators. Countries may also decide to merge these two committees into one combined Oversight/Advisory Committee.

G2: Access and confidentiality secured

This milestone entails that the necessary access and confidentiality rules for the conduct of the survey be secured. It is closely linked with the design milestone P1 in the process result path.

Among the first governance matters to be addressed is the legal framework within which the project will operate. Any survey of human respondents or organizations carries a particular responsibility concerning its conduct. Authority for the conduct of large-scale surveys is usually vested in the NSO or equivalent body. However, R&D surveys are often conducted by the ministry responsible for S&T (or similar body) or its delegate. It is therefore advisable to work with the NSO to determine the legislation to ensure survey participation by the stakeholders, i.e. regulate the provision of data from the stakeholders and ensure that the standing rules on confidentiality that may apply to the R&D survey are met before taking the R&D survey to the field.

Without a guarantee of confidentiality, respondents may be reluctant to divulge the required information. All members of the project team must therefore be subject to the legislation on data confidentiality and should, if required, sign an Oath of Confidentiality, which should be kept in a secure register. This register should be available for inspection if required.

> *All members of the project should sign an Oath of Confidentiality.*

Despite all precautions, it is an unfortunate reality that even where all the applicable rules are met, some respondents will not submit data for unstated reasons.

G3: Stakeholder workshop

It is advisable to organise stakeholder workshops to ensure that the intended respondents are aware of the importance and intention of the survey, to seek their buy-in and subsequent cooperation. In some countries, it will be possible to bring all the major R&D performers to a single workshop; in others, it may be necessary to convene separate workshops for different sectors. In very large systems, regional workshops may have to be organized.

The following issues could be covered during such a workshop:

- Origins and purpose of R&D surveys and policy relevance.
- What counts as R&D?
- What is measured? R&D personnel and R&D expenditure.
- Headcounts and full-time equivalents.
- Type of R&D and attribution by field of science.
- Unit of measure: individual, group, department, faculty?
- Availability of secondary data sources (funding databases).
- Confidentiality.
- Survey plan.
- Introduction of survey team and their responsibilities.
- Timing of the fieldwork.
- Collaboration, expectation, resources required, etc., from responding institutions.
- Bilateral discussions with participating institutions to discuss tentative time tables and any other issues.
- Draft questionnaire.

G4: Oversight committee approval of fieldwork stage

This Committee meeting is to obtain the necessary authorisation to proceed with the full fieldwork.

At this stage, the design has been tested in the field, any necessary adjustments have been made, the databases are operational, staff is trained and all attention is focused on obtaining quality data.

G5: Oversight committee approval of results

This meeting allows the Committee to review the results of the survey and approve the public launch and dissemination of the results.

G6: Launch of R&D survey results

This event is the official launch of the R&D survey and provides an opportunity for the Project Champion to interact with the major stakeholders.

G7: Evaluation and close out

Close out of the R&D survey project could include an external evaluation if time and resources permit. Close out may also entail the issue of a letter of appreciation to all respondents that will include the final report as well as information concerning data access and future surveys to maintain their trust and buy-in.

5.2. Logistics

The logistics for the project cover everything from the appointment of staff, securing working space and office equipment through to the printing of questionnaires and reports. Logistics forms an essential component of the project – failure to attain the logistics milestones will cause significant delays. Many of the logistics milestones concern aspects of human resources management. It is assumed that the project functions within a larger organization that will provide for the procedural aspects of human resources management.

L1: Project Manager appointed

This initial milestone concerns the identification and appointment of the R&D survey Project Manager. The Project Manager should be someone skilled in managing complex projects and who has a good understanding of the innovation system, its main actors and stakeholders. She/he will lead the execution of the project and will be the head of the team involved in the R&D survey.

L2: Premises secured, staff appointed and trained

Suitable premises with the necessary office equipment, telecoms and broadband are essential. The premises should include a secure area to store hard-copy information.

Consideration may be given to designing the workspace to allow for a call centre style of operations. This implies that some staff (especially those engaged in data collection/processing, etc.) work in cubicles that will isolate their conversations, enabling

telephone interviews, follow-up with respondents, etc. to occur smoothly and without interruption. It will also reduce fatigue and protect confidentiality. At a minimum, hands-free telephone headsets should be available to staff.

This initial milestone also includes the selection, appointment and training of the survey staff. The R&D survey is inherently labour-intensive. Staff who are diploma holders or graduates are essential to the success of the project. The survey team must comprise self-confident and articulate persons able to negotiate and interact with senior staff of the organizations targeted by the survey.

Staff training should occur in tandem with the development and testing of the survey questionnaires. This provides the means to build a shared understanding of the survey rationale and the difficulties likely to be encountered in eliciting quality data from respondents.

L3: Database developer appointed

The survey fieldwork, collection, compilation, analysis and maintenance of the data will benefit from the use of suitable databases. It is therefore advisable to appoint/identify an in-house database developer/manager to design and develop such databases.

While it may be possible to make use of spreadsheet functionality found in typical office suite software, it is desirable to develop customised database tools to support three main requirements:

- A register of possible respondents by sector. This would function as a registry database.
- A survey-tracking tool to manage the fieldwork and track the status of responses.
- A records database that facilitates the storing of data with an analytical interface for data processing.

The records database must be password protected with suitable access rights. This milestone is closely connected to milestone P2 in the process result path.

L4: Printer contracted[8]

The layout and printing of the questionnaire may be carried out in-house using an office photocopier. Nonetheless, resources permitting, the layout design of the approved questionnaires could be done by an external professional layout specialist and then printed by a commercial print shop.

L5: Staff and enumerators trained on final questionnaires and fieldwork

The process of finalising the questionnaires is a matter of development for the project team and involves further training. Depending on the scale of the survey and the requirement to hire additional temporary enumerators, further training will be needed. As in the case of the survey staff, the enumerators should also be graduates. The training will help staff and enumerators

[8] If the survey is deployed through email or web-based correspondence, this step doesn't apply (see P7 for the details on different survey methods).

better understand and explain the technical concepts involved in the R&D survey to non-specialists. Training should also be focused on how to reach and communicate with respondents, how to carry out effective interviews and field work, etc.

L6: Financial close out

As in any project there must be a financial close out. This close out would include any disposal of assets as well as ensuring the safe storage of confidential information.

5.3. Process

The process result path constitutes the main work of the R&D survey from its design through to implementation and project close out.

P1: Scope and methodology; trial questionnaires

This milestone is critical, marking the point when key decisions have been reached, i.e. sectors to be covered, which survey method to use, target population, who is to complete the survey and what substantive data is being sought.

The recommended survey procedures for the various sectors of performance were covered in the previous section.

Questionnaire design

Once the sectors to be surveyed have been chosen, the issue of questionnaire design arises. If financial resources for the project are very constrained, then it makes sense to use one questionnaire for all sectors that incorporates careful instructions to the specific sector respondents as to which parts are to be completed. So, for example, the business sector would ignore items concerning students while other sectors would ignore items to do with “product field.” In practice, however, it is highly advisable to disseminate unique questionnaires for each sector (business enterprise, higher education, government and private non-profit) – even though this may increase cost somewhat.

The survey questionnaire must include a minimum number of basic questions on R&D activity. Owing to the response burden, the questionnaire should be as simple and short as possible, logically structured and provide clear definitions and instructions including explanatory notes and hypothetical examples. Generally, the longer the questionnaire, the lower the unit and item response rates. For smaller units, a simplified survey questionnaire could be used (FM §451, §460-462).

Generic model questionnaires for each sector (higher education, government, business enterprise and private non-profit sectors) are presented in Section 6.

P2: Database URS specified

The appointment of a database developer is discussed under milestone L3 in the logistics result path. There is an intimate connection between the survey questionnaire, the fieldwork, the registry database and the eventual respondent records database that will host and preserve the data going forward.

Careful attention must be given to carry out a user requirement specification (URS) before the construction of the databases begins. An inadequate URS may lead to later frustration when attempts are made to interrogate the databases for information that they are not designed to support.

> *Care in determining the user requirement specification will pay off in the long term.*

A registry database listing all intended respondents is needed. The registry database comprises descriptive information on the respondents – contact information, corporate identity, the person responsible for completing the survey and so on. In the case of a purposive survey, the registry database will expand over time. An added refinement would be for the registry database to serve as a fieldwork management tool that allows the survey fieldworkers to track the status of individual respondents and progress in the return of the questionnaire.

The URS for the records database should be developed in collaboration with the intended users of the data. Its structure should be such that the standard set of indicators may be readily compiled. In addition, a user definable query structure is desirable and costs allowing, this feature should be provided.

As mentioned before, the database cannot provide answers to queries that it is not structured to address. Naturally, all possible future queries cannot be foreseen. Often it is a simple query (e.g. what is the number of female researchers performing research on infectious diseases?) that policymakers will expect the database to answer. Without the properly disaggregated data and suitable links between data fields such queries cannot be addressed. Further, a records database should be structured in a way that facilitates the capture of metadata related to the data gathered.

P3: Pilot survey completed

If resources and time allow, best practice suggests that a pilot of the questionnaire be carried out to verify the validity of the questionnaire items. This pilot may be highly restricted in coverage – a single faculty in the largest university, three to five large firms, a division of a public research organization. The aim of the pilot survey is to determine clarity and eliminate confusion rather than test statistical reliability. The pilot questionnaire may also include a section to capture specific comments from respondents regarding difficulties encountered in completing the questionnaire, i.e. any remarks on the presentation of the questions, etc.

P4: Questionnaires approved and printed

Based on the feedback received for the pilot survey, changes required to the questionnaires should be discussed fully in project meetings. The final questionnaires should be approved by the Project Committee and the order to print should be given.

P5: Registries complete

A decision must be made to declare the registries “closed” for the addition of new records. This does not preclude correcting for errors or adding additional information for particular records.

P6: Databases debugged and commissioned

The changes to the questionnaires introduced through the pilot survey may lead to some changes in the records database. Once the database developer has made these changes, the databases must be tested and declared fit for purpose. The survey may then proceed to the field for dissemination and collection.

P7: Dissemination and collection

This milestone accounts for the main work of the survey (data collection and field work), for which the FM (OECD, 2002), Annex (OECD, 2012) and the *UIS Technical Paper No. 5* (UIS, 2010) provide guidance. Attainment of this milestone signals the completion of the fieldwork.

Who will complete the survey questionnaire?

Ideally, the questionnaire should be completed by a knowledgeable insider whose organization is active in R&D, who knows where to find the necessary data and who is authorised to disclose the aggregated data. This person could be either from the R&D unit/division or accounting/personnel unit/division of the organization. Each has advantages as well as disadvantages (FM §452).

In the case of firms, this person might be the CEO or a technology/production manager or person occupying a similar position. It is rare for staff in human resources or finance to have such knowledge and information. The FM does not count market research as R&D and in many cases the market research division is unlikely to be of much assistance in determining the size and scope of company R&D.

In public research institutes (PRIs) or universities, the collaboration of the head of research or research manager(s) should be sought. She/he may have to liaise with the accounting/personnel unit to compile data. In universities, this person could be the Dean of Research if not Dean of Faculty(ies) or Head of Department(s) working with assistance from the accounting/personnel department.

If time and resources permit, focal points for the completion of the questionnaire should be identified and assigned at least for the PRIs and universities through prior communication with the respective institutions.

Contact with organizations

The project would benefit from having a simple publicity pack available for distribution as the ground is prepared for the survey fieldwork.

In a survey, such as the R&D survey that involves considerable direct interaction between staff in the field and respondents, the golden rule that you can only make a first impression once definitely applies. This is why staff who perform fieldwork should undergo careful training before their first contact with respondents. The Project Manager will want to ensure that every potential respondent is brought into the survey and that none are alienated by unfortunate interactions with novice field staff. Staff who perform fieldwork should be chosen based on their ability to interact with the public and deal with impatient senior managers.

Once the possible respondent has been identified and their contact details captured, an official letter of request should be sent to the organization. For the first R&D survey, it might be advisable to collect data by means of interviews rather than relying on other methods, such as telephonic, email or postal contact. The easiest path is the telephonic interview, which may then be followed up with an on-site interview. This may raise the cost of the survey but will improve the likelihood of its success.

The telephonic interaction must be handled with care and tact. Thus, this first contact with the intended respondent must be planned out. Conducting telephone calls and interviews is a key element of staff training. Where telephonic interviews are conducted, it is advisable to develop a written script to guide the field staff and help capture the desired responses. The actual script that may be followed is beyond the scope of this Guide but a basic script for an enumerator interviewing an R&D manager could play out as follows:

Salutation …….

Thank you for your time. We are trying to estimate the amount of R&D activity in your organization.

Does your firm carry out R&D?

Could you give me some idea of what R&D you are working on?

I see….. and this work is done in-house?

How many staff are involved in this work? Professionals, technicians?

Full time/part time?

How much do you think this costs at present?

Excellent. We would like you to complete a survey questionnaire ….

Common elements that have proven useful in some countries include a clear statement of authority and purpose as well as a statement concerning confidentiality of information.

If the data are collected through on-site interviews, the enumerator should be able to provide all the explanations requested, such as the purpose of the survey, its scope and the meaning of any particular question, etc. The enumerator may fill in the questionnaire her/himself on the basis of the oral responses and, where appropriate, should also make use of any additional documents provided (UNESCO, 1984b).

In order to save time and reduce cost, the survey questionnaires may be dispatched a few weeks before the field operations start. During the interview, the enumerator could have the following tasks: collecting the questionnaires that are fully completed, providing explanations requested by the respondent, and filling in the questionnaire based on existing documents and appropriate supporting oral responses (UNESCO, 1984b).

If the interviews are not possible, other survey methods, such as through correspondence (e.g. e-mail, postal survey or combination of these methods, etc.) could be considered. In such instances, the questionnaire should be dispatched well in advance so that the respondents have sufficient time to prepare the responses needed. A special receipt form may be attached to the questionnaire so that the respondents can confirm its receipt. In normal circumstances, a two- or three-month term would be adequate for a respondent to fill in the questionnaire. Approximately one month before the deadline determined for this purpose, a reminder may be sent to all responding organizations to ensure that the replies are collected in a timely manner.

Necessary arrangements should be made for respondents to receive advice and explanations concerning the filling in of the questionnaire (UNESCO, 1984b).

Countries with advance internet access could use a web-based survey as another option to conduct the survey. However, as indicated before, for initial survey cycles, other approaches would be more suitable. When the R&D survey becomes mature and established, countries should consider shifting to a web-based approach.

Tracking incidents

In the data collection stage, one important aspect is tracking incidents. All interactions between the survey and respondents must be logged for future audit/reference.

Although hardcopy questionnaires might be thought to belong to the pre-information and communication technologies age, they have considerable value if the questionnaire is designed so that every incident is logged. This audit trail allows for error detection and correction. Although this functionality can be built into an electronic database, this will be costly and may also introduce considerable delays to the survey fieldwork getting under way.

An additional benefit of incident logging is that it simplifies the hand over of work from one field staff to another. Field staff may come and go but the survey must continue as smoothly as possible. The better the documentation associated with a respondent, the less likely it is that the close out with be disrupted and data quality affected.

Every conversation with a respondent should be logged and include the name of the survey staff person; the party and organization contacted; date and time of call; and brief reason for the call (i.e. reminder, checking data etc.).

Similarly, it is important to log the date of dispatch of a questionnaire, its receipt by the respondent, follow-up steps, and so on. Each questionnaire should be assigned to an individual member of the survey team. The questionnaire will include space for recording such events, including final checking and sign-off by a second member of the survey.

It is equally important to log/keep documentation on specific guidance given to respondents, such as how difficult borderline cases were solved. This would help build on experience and improve guidance for future surveys.

The questionnaires are a shared resource between the survey and respondents. Respondents have the right to receive a copy of their final completed questionnaire.

Key issues that are likely to be confronted in the work include but are not limited to the following.

What is in-house R&D?

The definition of R&D is given in Section 3 and is also included in the model questionnaires.

University research managers should in principle have no difficulty deciding whether or not staff are conducting R&D. They will have knowledge of the existence of research grant flows and the institutional outputs that result from R&D in the form of PhD graduates, scientific reports and articles, books and other forms of scholarship.

PRIs carry that title because they do R&D so, in principle, evidence of R&D should be evident in reports, artefacts, scientific publications and other forms of intellectual property. Care must be taken to distinguish R&D from science and technology services (STS).

Companies, enterprises or firms may or may not do R&D. The survey enumerator should liaise with the respondent to determine the broad field of R&D activity.

Headcount of R&D staff and calculation of FTE

The survey methodology rests on a bottom-up calculation of the R&D expenditure according to the sum: R&D expenditure = labour cost + other current expenditure + capital expenditure. To estimate the labour cost, the R&D staff headcount (HC) and their associated full-time equivalent (FTE) applied to R&D will need to be determined. To estimate the labour cost, the FTE for researchers, technicians and other staff will need to be determined. Other than detecting the presence of R&D, this is perhaps the most difficult aspect of the R&D survey. The model questionnaires provide guidance to the respondents on how to calculate FTE.

Sources of funds for R&D

The total R&D expenditure should match the sources of funds. These sources vary somewhat across the four major sectors of the survey.

The most difficult estimation is that of higher education “own funds”. For historic reasons, this information may not be readily available in certain countries so estimates may have to be obtained from published annual reports. Higher education rarely obtains funds from other domestic higher education sources.

R&D expenditure by field of science and socio-economic objective

It is the norm to classify R&D according to the respective five-digit field of science (FoS) as well as socio-economic objective (SEO) with associated percentage expenditures. Considerable judgement is expected of respondents when providing this information.

The data collection milestone can be considered attained once the questionnaires are completed and signed off by respondents.

P8: Capture, verification and calculation

Once the questionnaires are completed and signed off by respondents, the data must be verified and cleaned. Once all discrepancies are resolved, the fieldwork staff will need to sign off on the final questionnaire and the data captured will be entered into the records database. Ideally, the questionnaire would also be verified by an independent fieldwork staff member.

At this stage, the primary data collection is over and the questionnaire may be verified for accuracy and completeness. All calculations and totals must be verified. Respondents should be consulted in the clarification of all discrepancies.

The following consistency checks are advised:

- FTE count must be smaller than the HC.
- R&D expenditure should be less than or equal to organization total revenue, especially in the public sector.
- Check previous survey returns, where these exist.
- The wages/FTE relation should be in line with the overall wage level.

If items are incomplete or missing, a decision must be made as to how to proceed. In extreme cases, responses from a particular respondent would be excluded in its entirety.

Broadly speaking, there are three ways to deal with vacant data fields.[9]

- The first is to find an alternative public source that might yield that data. For example, locating a company's annual report may yield the relevant item. Whatever the outcome of that search, this should be logged as an incident.
- A second approach would be to check the historic data for the entity from a previous survey.
- The third would be to use imputation techniques. In its simplest form, imputation involves the identification of firms that are as similar as possible to the one for which data is unavailable and to use their characteristics as a means of estimation. So, if four similar firms show R&D expenditure/sales at 1%, then it is reasonable to impute that ratio as applicable to the firm for which the R&D data are missing. The fact that data have been imputed must be logged in the questionnaire. Imputation assumes that non-responding entities had the same characteristics as responding entities. However, one reason why institutions might not respond at all is because they do not carry out R&D and therefore assume that it is not important or relevant for them to complete a questionnaire and send it back. In order to analyse this, it is necessary to do a non-response analysis. This entails contacting a fair number of non-respondents and asking them the reasons for not responding and whether they are carrying out any R&D at all.

When combined across the survey, the various incidents for each respondent contribute to the metadata – the information underlying the data that is needed to interpret the full meaning of the survey. All metadata need to be recorded and stored and a metadata report should be produced.

Once all questionnaires are finalised and signed off and the data has been captured to a suitable database, all questionnaires should be lodged in a secure storage area.

[9] A few feasible estimation procedures are discussed in the FM (§463-472).

P9: Results compiled

After the data collection is closed, the process of compilation may begin. The objective here is to compile the standard set of indicators needed for reporting purposes and to assemble a high-level overview of the R&D survey.

When compiling totals for the universe of R&D performers using the survey results, there are two things to remember. Firstly, the public sector (government and higher education) is covered as a census so that the results for GOVERD and HERD are not population estimates. Secondly, if the business sector is surveyed purposively, this does not, strictly speaking, constitute a sample, making scaling up to a population estimate inappropriate. The goal of the purposive survey is to identify as many R&D performers as possible and it is important to remember that this will be achieved to an unknown degree of completeness.

The most common types of indicators are the following. The sentinel indicator is GERD as a percentage of GDP. Perhaps the second most widely used indicator is the relative share of GERD across BERD, HERD and GOVERD. The third indicator in common usage is the total researcher FTE in relation to the population or total employed workforce. For a media launch of the survey, this information will suffice together with other macro indicators, such as statistics on the distribution of R&D staff by gender, sector of employment, level of qualification, regional distribution and nationality as well as distribution of R&D expenditure by main FoS (for R&D staff as well), source of finances, type of cost and type of activity.

P10: R&D survey report

It is important to communicate these results back to the participants at the earliest opportunity, thereby maintaining their trust and buy-in. The Project Champion should be closely involved in the public launch of the high-level overview of the R&D survey. A more detailed report would follow at a later stage.

A final report on the survey may be produced after a summative evaluation has been received, which could provide a much richer account of the conduct of the survey as well as more detailed data tables.

One might expect this report to be hosted on the website of the institution that conducts the survey and the NSO website (if not the same), and for hard copies to be available for distribution to respondents along with a letter of appreciation for their contribution. At this stage, the R&D survey has been completed.

6. Model questionnaires

This section provides model questionnaires for the four sectors of performance: higher education, government, business enterprise and private non-profit (PNP). These questionnaires are generic and need to be adapted to fit specific national circumstances. For example, the international standard classifications are used here but countries should use their own national classification to collect data and then later map the collected data to the international classification when reporting to international organizations.

The model questionnaires are available as Word documents on the UIS website, at the following address: http://www.uis.unesco.org/ScienceTechnology/Pages/research-and-development-statistics.aspx. This allows countries to download the version that they want to adapt to their own circumstances.

Information collected using these model questionnaires or modified versions thereof will allow a country to respond to the UIS Questionnaire on Research and Experimental Development (R&D) Statistics.[10] In addition to the standard survey, the modified version includes more details requested for some tables and a number of questions added that are not requested in the UIS questionnaire but that could be of interest to national policymakers. These questions are marked as optional. Examples include a question on the age breakdown of researchers, the field of science (FoS) classification at the two-digit level (i.e. typically, the UIS only collects this information at the one-digit level) and a question on extramural R&D.

The main concepts and definitions have been included in the questionnaires. This is particularly helpful when the questionnaires are sent to respondents without the intervention of trained interviewers.

6.1. Higher education sector

The model questionnaire for the higher education sector starts after this introduction. A Word version of this questionnaire can be downloaded from the UIS website at this address: http://www.uis.unesco.org/ScienceTechnology/Pages/research-and-development-statistics.aspx

Countries that adopt this questionnaire will need to adapt it to fit their national needs and circumstances. The following adaptations might be required:

- The front page will need to be completely redone by the data collection agency.
- Countries may change the financial year to calendar year or any reference period of one year.
- If the status of the responding unit is unknown to the data collection agency, a question could be included after Question 2 on the type of the responding unit and its level of independence.

[10] Available at http://www.uis.unesco.org/UISQuestionnaires/Pages/ScienceTechnology.aspx

- In Part 2 on R&D personnel, the respondent is requested to report the average number of persons engaged in R&D during the reference year. This can be adapted to any other approach. However, it is recommended that the approach adopted for measuring headcount (HC) data for R&D personnel be similar to that used for collecting other statistical HC series (employment, education) to which the R&D series are likely to be compared (FM §329).
- The FM excludes research undertaken by Master's students. In countries where Master's students do perform R&D, a question could be added to capture this information separately.
- In Questions 4.1 and 5.1, countries may want to replace the levels of qualification, which are based on the 2011 version of ISCED, with the levels applicable to their country.
- Sources of funds in Question 7 can be adapted to suit local conditions.

The cells in grey correspond to data that are either a summation or reported earlier in the questionnaire and should not be completed by the respondent. If the questionnaire is converted to a web-based questionnaire or Excel questionnaire, these cells should be calculated or carried over automatically.

Some questions are not needed to provide data to the UIS but are of interest nevertheless and can be included if so desired by the policymakers. The following questions are implicated:

- Question 4.3 on the age of R&D personnel.
- Question 9 on detailed fields of science (FoS). For this question, the respondent is required to look up the detailed FoS codes for all academic disciplines and areas of study practised in his/her department in Appendix A of the questionnaire and copy this code in Question 9 together with the corresponding percentage. Appendix A should be included in the questionnaire. Since it applies to the model questionnaires for all sectors of performance, it is only included once in this Guide in Section 6.5.
- Question 10 on socio-economic objectives (SEO). For this question, the respondent is required to look up the code for all objectives applicable to his/her department in Appendix B of the questionnaire and copy this code in Question 10 together with the corresponding percentage. Appendix B should be included in the questionnaire. Since it applies to the model questionnaires for all sectors of performance, it is only included once in this Guide in Section 6.5.
- Question 11 on a regional breakdown of R&D expenditure.
- Questions 12 and 13 on extramural R&D.

STRICTLY CONFIDENTIAL

<LOGO OF INSTITUTION>

NATIONAL SURVEY OF RESEARCH AND EXPERIMENTAL DEVELOPMENT (R&D) INPUTS	
HIGHER EDUCATION FINANCIAL YEAR: …….. (YYYY/YYYY)	
Organization	**Please modify address label (only if there is one)**

AUTHORITY
(NAME OF THE CENTRE/AGENCY/DIRECTORATE) is mandated to conduct a Survey of Inputs into research and experimental development (R&D) for the ……. (Ministry).

All data gathered for this survey are confidential. Only the survey team sees individual organization data. Raw data gathered for this survey is confidential except when an organization gives written permission for its data to be disclosed to other parties.

PURPOSE AND SCOPE OF SURVEY
The R&D survey collects data on the inputs into R&D activities performed IN-HOUSE by all organizations (including higher education, government, business enterprise and not-for profit). The data are used for planning and monitoring purposes and for measuring international competitiveness.

This survey covers the Financial Year: DD/MM/YYY to DD/MM/YYYY (or your nearest complete financial or academic year).

DUE DATE
Kindly complete and return this questionnaire by ..... to: R&D Survey, [full address]

ASSISTANCE
To assist you with queries kindly contact one of the survey managers:

Name	Contact number	Email

PERSON COMPLETING THE QUESTIONNAIRE

Organization		**Tel**	( )
Name (with title)		**Fax**	( )
Designation		**Cell**	( )
Date		**Email**	
Signature		**Website**	

THE FOLLOWING DEFINITIONS ARE IMPORTANT IN THE COMPLETION OF THIS QUESTIONNAIRE:

Definition of R&D:
This survey follows the *Frascati Manual* guidelines for conducting surveys on the inputs to R&D (OECD, 2002).
It defines research and experimental development (R&D) as:

- **Research** is creative work and original investigation undertaken on a systematic basis to gain new knowledge, including knowledge of humanity, culture and society.
- **Experimental development** is the application of research findings or their scientific knowledge for the creation of new or significantly improved products, applications or processes.

The basic criterion for distinguishing R&D from related activities is the presence in R&D of an appreciable element of novelty and the resolution of scientific and/or technological uncertainty, i.e. when the solution to a problem is not readily apparent to someone familiar with the basic stock of commonly used knowledge and techniques in the area concerned.

Scope of survey:

- The survey requests data on **R&D performed IN-HOUSE by your organization** in the national territory.
- Part five includes some questions on "extramural R&D".

R&D in higher education institutions:
Any activity classified as R&D is characterised by originality; it should have investigation as a primary objective and should have the potential to produce results that are sufficiently general for humanity's stock of knowledge (theoretical and/or practical) to be recognisably increased.

R&D includes – but is not limited to:
Activities of personnel who are obviously engaged in R&D.
In addition, research activity includes:

- The provision of professional, technical, administrative or clerical support and/or assistance to personnel directly engaged in R&D.
- The management of personnel who are either directly engaged in R&D or are providing professional, technical or clerical support or assistance to those R&D activities of students undertaking postgraduate research courses.
- Software development where the aim of the project is the systematic resolution of a scientific uncertainty.
- Research work in the natural sciences, engineering, medical sciences, agricultural sciences, social sciences and the humanities.
- R&D carried out as a participant in any unincorporated joint venture.

R&D excludes:
The following specific activities are excluded except where they are used primarily for the support of or as part of R&D activities performed in this reporting unit:

- Preparation for teaching.
- Academic development activities.
- Scientific and technical information services.
- Engineering and technical services.
- General purpose or routine data collection.
- Standardisation and routine testing.
- Feasibility studies (except into R&D projects).
- Specialised routine medical care, for example routine pathology services.
- The commercial, legal and administrative aspects of patenting, copyrighting or licensing activities.
- Routine computer programming, systems work or software maintenance where there are no technological uncertainties to be resolved.

The classification of borderline institutions:
Research institutes (such as specialised health care clinics or "attached" research institutions) that are not directly concerned with third-level teaching but host activities, R&D or otherwise, that are all the same closely associated with the higher education sector should be carefully considered:

- Entities initiated by a higher education institution (HEI) but subsequently became a not-for-profit or business entity should be classified as such and surveyed by not-for profit or business sectors even if there are close links with an HEI.
- Staff and R&D expenditure should be reported where it was incurred.
- Staff members on the payroll of the HEI (e.g. department heads) should be reported by the HEI concerned.
- Staff that appears on the payroll of the "borderline" institution should be reported by the institution concerned and not the HEI.
- The same applies to equipment and running costs.
- It would be appreciated if we were informed of all such institutions to ensure that they are surveyed by the appropriate sectors and to minimise double counting.

Government/academic hospitals:
Higher education institutions (HEIs) are requested to report on all academic and technical staff performing R&D with joint appointments between government/academic hospitals and the HEI. This includes headcount, FTEs, labour costs, equipment and running costs.

It is understood that some of these costs may not be reflected in the HEI's Management Information System data or financial statements but we request that a best estimate be included where necessary.

PART 1: GENERAL INFORMATION

1. Name of higher education institution	

2. Name of reporting unit (e.g. faculty)	

3. Did the reporting unit perform any <u>IN-HOUSE R&D</u> during the fiscal year?

Yes ☐ **Continue with Question 4.**

No ☐ **Proceed to Part 5 if you paid for R&D to other parties (optional).**

☐ **If the organization/unit does *not* do any In-House and/or any extramural R&D, tick this box and return the questionnaire as a NIL response.**

PART 2: IN-HOUSE R&D PERSONNEL

R&D PERSONNEL

- **Report against the categories listed below for all personnel employed directly in R&D or providing direct R&D services/support for at least 5% of their time. Do not count any staff NOT supporting research.**
- **Please report the average number of persons engaged in R&D during the reference year.**
- **Please include permanent, temporary, full-time, part-time and contract staff.**

1. Researchers

INCLUDE:

- Academic staff engaged in the conception or creation of new knowledge, products, processes, methods and systems and also in the direct management of the projects concerned.
- Managers and administrators engaged in the planning and management of the scientific and technical aspects of a researcher's work. Their rank is usually equal or superior to that of persons directly employed as researchers and they are often former or part-time researchers.
- Academic staff involved in research and also studying towards a Master's or Doctoral degree should be included as research staff (not students).
- All post-doctoral fellows in whichever capacity they are appointed by the institution.
- Doctoral students working on R&D.

EXCLUDE:

- Managers and directors concerned primarily with budgets and human resources rather than project management or content (include in "other personnel directly supporting R&D").
- Master's students.

2. Technicians

INCLUDE:

- Persons performing technical tasks in support of R&D, normally under the direction & supervision of a researcher.

3. Other personnel directly supporting R&D

INCLUDE:

3.1 Executive and managerial level

- Executives and directors concerned primarily with budgets and human resources in support of research rather than project management.

3.2 Administrative and support staff

- Skilled and unskilled craft workers directly supporting research.
- Secretarial, administrative and clerical personnel supporting/working on or directly associated with R&D activity.

EXCLUDE:

- Persons providing indirect services, such as security and maintenance personnel, staff of central libraries, IT departments or head offices, should be excluded here but the relevant proportion of their labour costs should be included under "other current costs" in Question 6B.

4. HEADCOUNT OF R&D PERSONNEL

CALCULATING HEADCOUNT (HC) DATA
HC data cover the total number of persons who are mainly or partially employed in R&D. This includes staff employed both full-time and part-time on R&D activities.

4.1 Headcount of all R&D personnel according to three categories and highest qualification

(1) RESEARCHERS

Highest qualification	**M**	**F**	**TOTAL**
Doctoral or equivalent level (**ISCED level 8**)			
Master's or equivalent level (**ISCED level 7**)			
Bachelor's or equivalent level (**ISCED level 6**)			
Short-cycle tertiary education (**ISCED level 5**)			
All other qualifications, including post-secondary non-tertiary programmes **(ISCED 4)** and upper secondary programmes **(ISCED 3)**			
TOTAL RESEARCHERS (1)			

Carry subtotals over to Q 5

(2) TECHNICIANS

Highest qualification	**M**	**F**	**TOTAL**
Doctoral or equivalent level (**ISCED level 8**)			
Master's or equivalent level (**ISCED level 7**)			
Bachelor's or equivalent level (**ISCED level 6**)			
Short-cycle tertiary education (**ISCED level 5**)			
All other qualifications, including post-secondary non-tertiary programmes **(ISCED 4)** and upper secondary programmes **(ISCED 3)**			
TOTAL TECHNICIANS (2)			

Carry subtotals over to Q 5

(3) OTHER SUPPORT STAFF

Highest qualification	**M**	**F**	**TOTAL**
Doctoral or equivalent level (**ISCED level 8**)			
Master's or equivalent level (**ISCED level 7**)			
Bachelor's or equivalent level (**ISCED level 6**)			
Short-cycle tertiary education (**ISCED level 5**)			
All other qualifications, including post-secondary non-tertiary programmes **(ISCED 4)** and upper secondary programmes **(ISCED 3)**			
TOTAL OTHER SUPPORT STAFF (3)			

Carry subtotals over to Q 5

	M	**F**	**TOTAL**
TOTAL R&D PERSONNEL (1+2+3)			

4.2 Headcount of all R&D personnel according to three categories and fields of science

(1) RESEARCHERS

Field of science	**M**	**F**	**TOTAL**
Natural sciences			
Engineering and technology			
Medical and health sciences			
Agricultural sciences			
Social sciences			
Humanities			
Not specified elsewhere			
TOTAL RESEARCHERS (same as 4.1)			

(2) TECHNICIANS

Field of science	**M**	**F**	**TOTAL**
Natural sciences			
Engineering and technology			
Medical and health sciences			
Agricultural sciences			
Social sciences			
Humanities			
Not specified elsewhere			
TOTAL TECHNICIANS (same as 4.1)			

(3) OTHER SUPPORT STAFF

Field of science	**M**	**F**	**TOTAL**
Natural sciences			
Engineering and technology			
Medical and health sciences			
Agricultural sciences			
Social sciences			
Humanities			
Not specified elsewhere			
TOTAL OTHER SUPPORT STAFF (same as 4.1)			

4.3 Headcount of all R&D personnel according to three categories and age (optional)

(1) RESEARCHERS

Age	**M**	**F**	**TOTAL**
Under 25 years			
25-34 years			
35-44 years			
45-54 years			
55-64 years			
65 years and more			
Unknown			
TOTAL RESEARCHERS (same as 4.1)			

(2) TECHNICIANS

Age	**M**	**F**	**TOTAL**
Under 25 years			
25-34 years			
35-44 years			
45-54 years			
55-64 years			
65 years and more			
Unknown			
TOTAL TECHNICIANS (same as 4.1)			

(3) OTHER SUPPORT STAFF

Age	**M**	**F**	**TOTAL**
Under 25 years			
25-34 years			
35-44 years			
45-54 years			
55-64 years			
65 years and more			
Unknown			
TOTAL OTHER SUPPORT STAFF (same as 4.1)			

5. RESEARCH FULL-TIME EQUIVALENTS (FTEs) AND COST TO HIGHER EDUCATION INSTITUTIONS

Provide an estimate of <u>person-years of effort on R&D (or Full-time equivalents)</u>, according to the categories below.

Using the male and female headcounts of all R&D personnel reported for in Question 4, provide the research full-time equivalents (time devoted to R&D). Then, calculate the total labour costs of R&D using the average annual full cost-to-company for full-time staff (including annual wages, salaries and all associated costs or fringe benefits, such as bonus payments, contributions to pension and medical aid funds, payroll tax, unemployment insurance fund and all other statutory payments) per category below.

CALCULATING FULL-TIME EQUIVALENT (FTE) PERSONS

FTE data measure the volume of human resources in R&D. One FTE may be thought of as one person-year. That is 1 FTE is equal to 1 person working full-time on R&D for a period of 1 year or more persons working part-time or for a shorter period corresponding to one person-year.

For the purpose of this survey, an employee can work a maximum of 1 FTE in a year.

The following is a theoretical approach to calculating FTE:

FTE: (Dedication to the employment: Full-time/Part-time) x (Portion of the year active on R&D) x (Time or portion spent on R&D)

See the following examples:

- A full-time employee spending 100% of time on R&D during a year: (1 x 1 x 1) = 1 FTE
- A full-time employee spending 30% of time on R&D during a year: (1 x 1 x 0.3) = 0.3 FTE
- A full-time R&D worker who is spending 100% of time on R&D and is employed at an R&D institution for only six months: (1 x 0.5 x 1) = 0.5 FTE
- A full-time employee spending 40% of time on R&D during half of the year (person is only active for 6 months per year): (1 x 0.5 x 0.4) = 0.2 FTE
- A part-time employee (working 40% of a full time year) engaged only in R&D (spending 100% of time on R&D) during a year: (0.4 x 1 x 1) = 0.4 FTE
- A part-time employee (working 40% of a full-time year) spending 60% of time on R&D during half of the year (person is only active for 6 months per year): (0.4 x 0.5 x 0.6) = 0.12 FTE
- 20 full-time employees spending 40% of time on R&D during a year: 20 x (1 x 1 x 0.4) = 8 FTE

NOTE: please calculate FTEs for all R&D personnel.

5.1 FTE by personnel category

Personnel category	Headcounts (From Q 4.1)			Full-time equivalent (FTE)		
	M	F	Tot	M	F	Tot

(1) RESEARCHERS

Doctoral or equivalent level (**ISCED level 8**)						
Master's or equivalent level (**ISCED level 7**)						
Bachelor's or equivalent level (**ISCED level 6**)						
Short-cycle tertiary education (**ISCED level 5**)						
All other qualifications, including post-secondary non-tertiary programmes **(ISCED 4)** and upper secondary programmes **(ISCED 3)**						
TOTAL RESEARCHERS (1)						

(2) TECHNICIANS

Doctoral or equivalent level (**ISCED level 8**)						
Master's or equivalent level (**ISCED level 7**)						
Bachelor's or equivalent level (**ISCED level 6**)						
Short-cycle tertiary education (**ISCED level 5**)						
All other qualifications, including post-secondary non-tertiary programmes **(ISCED 4)** and upper secondary programmes **(ISCED 3)**						
TOTAL TECHNICIANS (2)						

(3) OTHER SUPPORT STAFF

Doctoral or equivalent level (**ISCED level 8**)						
Master's or equivalent level (**ISCED level 7**)						
Bachelor's or equivalent level (**ISCED level 6**)						
Short-cycle tertiary education (**ISCED level 5**)						
All other qualifications, including post-secondary non-tertiary programmes **(ISCED 4)** and upper secondary programmes **(ISCED 3)**						
TOTAL OTHER SUPPORT STAFF (3)						

Personnel category	Headcounts (from Q 4.1)			Full-time equivalent (FTE)		
	M	F	Tot	M	F	Tot
TOTAL R&D PERSONNEL (1+2+3)						

5.2 FTE by field of science

Field of science	Headcounts (from Q 4.2)			Full-time equivalent (FTE)		
	M	F	Tot	M	F	Tot
(1) RESEARCHERS						
Natural sciences						
Engineering and technology						
Medical and health sciences						
Agricultural sciences						
Social sciences						
Humanities						
Not specified elsewhere						
TOTAL RESEARCHERS (same as 5.1)						
(2) TECHNICIANS						
Natural sciences						
Engineering and technology						
Medical and health sciences						
Agricultural sciences						
Social sciences						
Humanities						
Not specified elsewhere						
TOTAL TECHNICIANS (same as 5.1)						
(3) OTHER SUPPORT STAFF						
Natural sciences						
Engineering and technology						
Medical and health sciences						
Agricultural sciences						
Social sciences						
Humanities						
Not specified elsewhere						
TOTAL OTHER SUPPORT STAFF (same as 5.1)						

5.3 FTE by personnel category and labour cost

Personnel categories	Full Time Equivalent (FTE) (From Q 5.1) (A)	Average annual labour cost per person Local Currency '000 (Excl. VAT[11]) (B)	Calculated labour cost of R&D Local Curr. '000 (Excl. VAT) (A x B)
Total researchers (1)			
Total technicians (2)			
Total other support staff (3)			
TOTAL LABOUR COST (1+2+3)			

Carry subtotal over to Q 6A

[11] VAT = Value-added tax.

PART 3: IN-HOUSE R&D EXPENDITURE

THE DEFINITION AND CALCULATION OF IN-HOUSE R&D EXPENDITURE

OTHER CURRENT EXPENDITURE

Including – but not limited to:

- Direct project costs, project consumables and running costs linked to research, such as materials, fuels and other inputs, including telephone and printing.
- Subsistence and travel expenses.
- Repair and maintenance expenses.
- Payments to outside organizations for use of specialised testing facilities, analytical work, engineering or other specialised services in support of R&D projects carried out by this reporting unit.
- Commission/consultant expenses for research projects carried out by this reporting unit.
- The relevant % of indirect and institutional costs and utility costs, such as rent, space charge, leasing and hiring expenses, furniture, water, electricity and any other overhead costs.
- The relevant % of labour costs of persons providing indirect services such as the head office, human resources, finances, security and maintenance personnel as well as staff of central libraries and IT departments.

Excluding:

- Contract R&D expenses where the research project is carried out elsewhere by others on behalf of this reporting unit.
- Payments for purchases of technical know-how (goodwill).
- Licence fees.
- Depreciation provisions.

- Where current expenses such as direct project costs and consumables are used solely for R&D, allocate the full cost of the items.
- If these current expenses are used for more than one activity, include only an estimate of the portion used for R&D.
- Only where such an estimate of the portion used for R&D is not available, such as indirect and utility costs and labour costs of staff providing indirect services, it is advised that respondents apply the percentage time that researchers in the reporting unit spent on R&D to the total of these current expenditures.
- So if a faculty's income and expenditure statement shows that the current expenditure for indirect and utility costs and labour costs of staff providing indirect services for the year was say USD 1,700,000 and that researchers on average spent 22% of their time to R&D, then this component of R&D current expenditure may be estimated as 0.22 x USD 1,700,000 = USD 374,000.

CAPITAL EXPENDITURE

The full cost of capital expenses must be reported in the year of purchase (do not depreciate).

Including – but not limited to:

- Expenditure on fixed assets used in the R&D projects of this reporting unit.
- Acquisition of software, including license fees, expected to be used for more than one year.
- Purchase of databases expected to be used for more than one year.
- Major repairs, improvements and modifications on land and buildings.

Excluding:

- Other repairs and maintenance expenses.
- Depreciation provisions.
- Proceeds from the sale of R&D assets.

- Where a capital item is used solely for R&D, allocate the full cost of the item.
- If the capital item is used for more than one activity, include only an estimate of the portion used for R&D. For example, a new piece of equipment that will be used for R&D (included), testing (excluded) and quality control (excluded). For instance, if the intended use of this new equipment for R&D purposes is 40% of the total usage (i.e. the other 60% for other activities), only 40% of the total equipment cost should be considered as relevant R&D expenditure.
- Only where such an estimate of the portion used for R&D is not available, apply the percentage time that researchers in the reporting unit spent on R&D to the cost of the item.

6. IN-HOUSE R&D EXPENDITURE

Compile expenditure on IN-HOUSE R&D during the fiscal year …<YYYY>... Include expenditure funded from all sources: internal and external (contracts and grants) and undertaken by the reporting unit on its own behalf or for other parties.

PLEASE NOTE: Extramural R&D should be reported under Part 5.

Purchase of equipment can in theory be classified as either capital or current expenditure. A distinction can therefore be made between "major" and "minor" equipment (to be included in "capital" and "current" expenditures respectively) by establishing some kind of monetary limitation. Please provide us with this limitation as used by your institution.	
Local currency:	

LABOUR COSTS OF R&D

		Local currency '000 excluding VAT
Total cost of R&D personnel (carried over from Question 5.3)	**A**	

OTHER CURRENT EXPENDITURE ON R&D
(See the definition of current expenditure and how to calculate current expenditure devoted to R&D on the previous page)

		Local currency '000 excluding VAT
Other current expenditure	**B**	

CAPITAL EXPENDITURE ON R&D
(See the definition of capital expenditure and how to calculate capital expenditure on R&D on the previous page)

		Local currency '000 excluding VAT
Vehicles, plant, machinery and equipment	**C**	
Land, buildings and other structures	**D**	
Software	**E**	

		Local currency '000 excluding VAT
TOTAL R&D EXPENDITURE (A + B + C + D + E)	**F**	

Carry total R&D expenditure (F) over to Question 7

7. SOURCES OF FUNDS FOR IN-HOUSE R&D

Provide a breakdown of the total R&D expenditure according to the sources of funds listed below (NOTE: Only the proportion of the money actually SPENT is required, not the total income per source)

To adapt to national context

OWN AND EXTERNAL SOURCES SPENT ON R&D		Local currency '000 excluding VAT
University's own sources*		
Direct grants from national, federal state, provincial and local government		
Government research institutes		
Agency funding		
Domestic business including industry funds		
Other NATIONAL sources		
• Other higher education institutions		
• Not-for-profit organizations		
• Donations and bequests from individuals		
Foreign sources		
SUBTOTAL OWN AND EXTERNAL SOURCES	**G**	

* University's own sources include income from endowments, shareholdings, property, student fees and subscriptions to journals.

THE CALCULATION OF GENERAL UNIVERSITY FUNDS

To calculate general university funds please subtract the subtotal of all own and external sources listed above (G) from the total in-house R&D expenditure reported in Question 8 (F). The result can be considered general university funds, which is the R&D part of the government block grant to universities.

To adapt to national context

Total R&D EXPENDITURE (carried over from Q 6)	**F**	
SUB TOTAL (EXTERNAL SOURCES) (carried over from Q 7G above)	**G**	
GENERAL UNIVERSITY FUNDS	**F - G**	

PART 4: CATEGORIES OF IN-HOUSE R&D EXPENDITURE

8. IN-HOUSE R&D EXPENDITURE BY TYPE OF R&D

Specify the percentage of: a) IN-HOUSE TOTAL R&D expenditure (both current costs and capital expenditure) by type of R&D, and (optional) b) total IN-HOUSE R&D CURRENT expenditure (labour costs and other current cost) by type of R&D.

		Column b optional
Basic research		
• Work undertaken primarily to acquire new knowledge of the underlying foundations of phenomena and observable facts without a specific application in view • Analyses of properties, structures and relationships with a view to formulating and testing hypotheses, theories or laws. • The results of basic research are usually published in peer-reviewed scientific journals.	a). Based on **total intramural expenditure** (Percentage)	b). Based on **only current expenditure** (Percentage)
Applied research		
• Original investigation to acquire new knowledge with a specific application in view. • Activities that determine the possible uses for the findings of basic research. • The results of applied research are intended primarily to be valid for a single or limited number of products, operations, methods or systems. • Applied research develops ideas into operational form. • Information or knowledge derived from applied research may be published in peer-reviewed journals or subjected to other forms of intellectual property protection.	a). Based on **total intramural expenditure** (Percentage)	b). Based on **only current expenditure** (Percentage)
Experimental development		
• Systematic work using existing knowledge for creating new or improved materials, products, processes or services, or improving substantially those already produced or installed.	a). Based on **total intramural expenditure** (Percentage)	b). Based on **only current expenditure** (Percentage)
TOTAL	**1 0 0**	**1 0 0**

9. DETAILED FIELDS OF SCIENCE (FOS) (OPTIONAL)

Classify R&D according to two-digit field of science (FoS) with associated percentage expenditure (see Appendix A)

- The FoS codes are based on recognised academic disciplines and emerging areas of study.

FoS codes			Percentage	
FoS				
FoS				
FoS				
FoS				
FoS				
FoS				

FoS codes			Percentage	
FoS				
FoS				
FoS				
FoS				
FoS				
FoS				
	Total		1 0	0

10. SOCIO-ECONOMIC OBJECTIVES (SEO) (OPTIONAL)

Classify R&D according to socio-economic objective (SEO) with associated percentage expenditure (see Appendix B)

- The SEO classification provides an indication of the main beneficiary of your R&D activities.

SEO codes			Percentage	
SEO				
SEO				
SEO				
SEO				
SEO				
SEO				

SEO codes			Percentage	
SEO				
SEO				
SEO				
SEO				
SEO				
SEO				
	Total		1 0	0

11. FEDERAL STATE OR PROVINCIAL EXPENDITURE ON R&D (OPTIONAL)

Please indicate the geographic location (by federal state or province) where the department/unit carried out R&D activities and the percentage of the total R&D expenditure.

Distribution of R&D expenditure by federal state or province (create more rows if needed)
Please specify where R&D is actually performed, rather than where it is managed/financed from.

Name	
Name	
Name	
Name	
Name	

Name	
Name	
Name	
Name	
Total	**100%**

PART 5: EXTRAMURAL R&D (OPTIONAL)

Extramural R&D refers to:

- Extramural expenditures are the sums a reporting unit paid or committed to pay to another organization for the performance of R&D during a specific period.
- This includes acquisition of R&D performed by and/or grants given to other organizations for performing R&D (FM § 408).

	Approximate value local currency '000 (excl. VAT)
12. State details of extramural R&D paid **locally**	
13. State details of extramural R&D paid **abroad**	

THANK YOU FOR YOUR TIME AND EFFORT

6.2. Government sector

The model questionnaire for the government sector starts after this introduction. A Word version of this questionnaire can be downloaded from the UIS website at this address: http://www.uis.unesco.org/ScienceTechnology/Pages/research-and-development-statistics.aspx.

Countries that adopt this questionnaire will need to adapt it to fit their national needs and circumstances. The following adaptations might be needed:

- The front page will need to be completely redone by the data collection agency.
- Countries may change the financial year to calendar year or any reference period of one year.
- In Part 2, on R&D personnel, the respondent is requested to report the average number of persons engaged in R&D during the reference year. This can be adapted to any other approach. However, it is recommended that the approach adopted for measuring HC data for R&D personnel be similar to that used for collecting other statistical HC series (employment, education) to which the R&D series are likely to be compared (FM §329).
- In Questions 5.1 and 6.1, countries may want to replace the levels of qualification, which are based on the 2011 version of ISCED, with the levels applicable to their country.
- Sources of funds in Question 8 can be adapted to suit local conditions.

The cells in grey correspond to data that are either a summation or reported earlier in the questionnaire and should not be completed by the respondent. If the questionnaire is converted to a web-based questionnaire or Excel questionnaire, these cells should be calculated or carried over automatically.

Some questions are not needed to provide data to the UIS but are of interest nevertheless and can be included if so desired by the policymakers. The following questions are implicated:

- Question 5.3 on the age of R&D personnel.
- Question 10 on detailed FoS. For this question, the respondent is required to look up the detailed FoS codes for all academic disciplines and areas of study practised in his/her organisation in Appendix A of the questionnaire and copy this code in Question 10 together with the corresponding percentage. Appendix A should be included in the questionnaire. Since it applies to the model questionnaires for all sectors of performance, it is only included once in this Guide in Section 6.5.
- Question 11 on SEO. For this question, the respondent is required to look up the code for all objectives applicable to his/her organisation in Appendix B of the questionnaire and copy this code in Question 11 together with the corresponding percentage. Appendix B should be included in the questionnaire. Since it applies to the model questionnaires for all sectors of performance, it is only included once in this Guide in Section 6.5.
- Question 12 on a regional breakdown of R&D expenditure.
- Questions 13 and 14 on extramural R&D.

STRICTLY CONFIDENTIAL

<LOGO OF INSTITUTION>

NATIONAL SURVEY OF RESEARCH AND EXPERIMENTAL DEVELOPMENT (R&D) INPUTS	
GOVERNMENT SECTOR: PUBLIC RESEARCH INSTITUTES, OTHER GOVERNMENT DEPARTMENTS/UNITS ENGAGED IN R&D AND GOVERNMENT S&T SERVICE INSTITUTIONS FINANCIAL YEAR: …….. (YYYY/YYYY)	
Organization	**Please modify address label (only if there is one)**

AUTHORITY
(NAME OF THE CENTRE/AGENCY/DIRECTORATE) is mandated to conduct a Survey of Inputs into research and experimental development (R&D) for the …… (Ministry).

All data gathered for this survey are confidential. Only the survey team sees individual organization data. Raw data gathered for this survey is confidential except when an organization gives written permission for its data to be disclosed to other parties.

PURPOSE AND SCOPE OF SURVEY
The R&D survey collects data on the inputs into R&D activities performed IN-HOUSE by all organizations (including higher education, government, business and not-for profit). The data are used for planning and monitoring purposes and for measuring international competitiveness.

This survey covers the Financial Year: DD/MM/YYY to DD/MM/YYYY (or your nearest complete financial year).

DUE DATE
Kindly complete and return this questionnaire by ..... to: R&D Survey, [full address]

ASSISTANCE
To assist you with queries kindly contact one of the survey managers:

Name	Contact Number	Email

PERSON COMPLETING THE QUESTIONNAIRE:

Organization	
Name (with title)	
Designation	
Date	
Signature	

Tel	( )
Fax	( )
Cell	( )
Email	
Website	

THE FOLLOWING DEFINITIONS ARE IMPORTANT IN THE COMPLETION OF THE SURVEY QUESTIONNAIRE:

Definition of R&D:
This survey follows the *Frascati Manual* guidelines for conducting surveys on the inputs to R&D (OECD, 2002).
It defines research and experimental development (R&D) as:

- **Research** is creative work and original investigation undertaken on a systematic basis to gain new knowledge, including knowledge of humanity, culture and society.
- **Experimental development** is the application of research findings or their scientific knowledge for the creation of new or significantly improved products, applications or processes.

The basic criterion for distinguishing R&D from related activities is the presence in R&D of an appreciable element of novelty and the resolution of scientific and/or technological uncertainty, i.e. when the solution to a problem is not readily apparent to someone familiar with the basic stock of commonly used knowledge and techniques in the area concerned.

Scope of survey:

- The survey requests data on **R&D performed IN-HOUSE by your organization** on the national territory.
- Part five includes some questions on "extramural R&D."

R&D in government research Institutions:
Any activity classified as R&D is characterised by originality; it should have investigation as a primary objective and should have the potential to produce results that are sufficiently general for humanity's stock of knowledge (theoretical and/or practical) to be recognisably increased.

R&D includes – but is not limited to:
Activities of personnel who are obviously engaged in R&D.
In addition, research activity includes:

- The provision of professional, technical, administrative or clerical support and/or assistance to personnel directly engaged in R&D.
- The management of personnel who are either directly engaged in R&D or are providing professional, technical or clerical support or assistance to those R&D activities of students undertaking postgraduate research courses.
- Software development where the aim of the project is the systematic resolution of a scientific uncertainty.
- Research work in the natural sciences, engineering, medical sciences, agricultural sciences, social sciences and the humanities.
- R&D carried out as a participant in any unincorporated joint venture.
- R&D projects performed on contract for other legal entities, such as businesses.
- "Feedback R&D" directed at solving problems occurring beyond the original R&D phase – for example, technical problems arising during initial production runs.

R&D excludes:
The following specific activities are excluded, except where they are used primarily for the support of or as part of R&D activities performed in this reporting unit:

- Preparation for teaching.
- Academic development activities.
- Scientific and technical information services.
- Engineering and technical services.
- General purpose or routine data collection.
- Standardisation and routine testing.
- Feasibility studies (except into R&D projects).
- Specialised routine medical care, for example routine pathology services.
- The commercial, legal and administrative aspects of patenting, copyrighting or licensing activities.
- Routine computer programming, systems work or software maintenance where there are no technological uncertainties to be resolved.

Examples:

- Investigating electrical conduction in crystals is basic research; application of crystallography to the properties of alloys is applied research.
- New chip designs involve development.
- Investigating the limiting factors in chip element placement lies at the border between basic and applied research, and increasingly involves nanotechnology.
- Much service R&D involves software development where the completion of the project is dependent on a scientific or technological advance and the aim of the project is the systematic resolution of a scientific or technological uncertainty.

Borderline cases:

- Institutions (public research institutions and other government departments engaged in R&D) whose principal activity is R&D often have secondary, non-R&D activities (e.g. scientific and technical information, testing, quality control, analysis, background papers and studies for policymakers). Insofar as a secondary activity is undertaken primarily in the interests of R&D, it should be included in R&D activities; if the secondary activity is designed essentially to meet needs other than R&D, it should be excluded.
- S&T service institutions whose main purpose is an R&D-related scientific service/activity often undertake some research in connection with this activity. Such research should be isolated and included when measuring R&D.

PART 1: GENERAL INFORMATION

1. Parent organization/Department	
2. Name of reporting organization/unit	
3. Total number of all employees	

4. Did the reporting unit perform any <u>IN-HOUSE R&D</u> during the financial year?

Yes ☐ **Continue with Question 5.**

No ☐ **Proceed to Part 5 if you paid for R&D to other parties (optional).**

☐ **If the organization/unit does *not* do any In-House and/or any extramural R&D, tick this box and return the questionnaire as a NIL response.**

PART 2: IN-HOUSE R&D PERSONNEL

R&D PERSONNEL

- **Report against the categories listed below for all personnel employed directly in R&D or providing direct R&D services/support for at least 5% of their time. Do not count any staff NOT supporting research.**
- **Please report the average number of persons engaged in R&D during the reference year.**
- **Please include permanent, temporary, full-time, part-time and contract staff.**

Researchers

- Researchers are professionals engaged in the conception or creation of new knowledge, products, processes, methods and systems and also in the planning and management of the projects concerned.

- Researchers include managers and administrators engaged in the planning and management of the scientific and technical aspects of a researcher's work. Their rank is usually equal or superior to that of persons directly employed as researchers and they are often former or part-time researchers.

- Excluded are managers and directors concerned primarily with budgets and human resources rather than project management or content (include in "other personnel directly supporting R&D").

Technicians directly supporting R&D

- Persons doing technical tasks in support of R&D, normally under the direction and supervision of a researcher.

Other personnel directly supporting R&D

- Other supporting staff includes skilled and unskilled crafts persons, secretarial and clerical staff participating in R&D projects or directly associated with such projects.

- Included are executives and directors concerned primarily with budgets and human resources in support of research rather than project management.

Note:

- Do not include personnel indirectly supporting R&D. Typical examples are transportation, storage, cleaning, repair, maintenance and security activities as well as administration and clerical activities undertaken not exclusively for R&D, such as the activities of central finance and personnel departments.

- Allowance for these should be made under overheads in R&D expenditure ("other current expenditure" in Question 7B) but such persons should not be included as R&D Personnel.

5. HEADCOUNT OF R&D PERSONNEL

CALCULATING HEADCOUNT (HC) DATA

HC data cover the total number of persons who are mainly or partially employed in R&D. This includes staff employed both full-time and part-time on R&D activities.

5.1 Headcount of all R&D personnel according to three categories and highest qualification

(1) RESEARCHERS

Highest qualification	**M**	**F**	**TOTAL**
Doctoral or equivalent level (**ISCED level 8**)			
Master's or equivalent level (**ISCED level 7**)			
Bachelor's or equivalent level (**ISCED level 6**)			
Short-cycle tertiary education (**ISCED level 5**)			
All other qualifications, including post-secondary non-tertiary programmes **(ISCED 4)** and upper secondary programmes **(ISCED 3)**			
TOTAL RESEARCHERS (1)			

Carry subtotals over to Q 6

(2) TECHNICIANS

Highest qualification	**M**	**F**	**TOTAL**
Doctoral or equivalent level (**ISCED level 8**)			
Master's or equivalent level (**ISCED level 7**)			
Bachelor's or equivalent level (**ISCED level 6**)			
Short-cycle tertiary education (**ISCED level 5**)			
All other qualifications, including post-secondary non-tertiary programmes **(ISCED 4)** and upper secondary programmes **(ISCED 3)**			
TOTAL TECHNICIANS (2)			

Carry subtotals over to Q 6

(3) OTHER SUPPORT STAFF

Highest qualification	**M**	**F**	**TOTAL**
Doctoral or equivalent level (**ISCED level 8**)			
Master's or equivalent level (**ISCED level 7**)			
Bachelor's or equivalent level (**ISCED level 6**)			
Short-cycle tertiary education (**ISCED level 5**)			
All other qualifications, including post-secondary non-tertiary programmes **(ISCED 4)** and upper secondary programmes **(ISCED 3)**			
TOTAL OTHER SUPPORT STAFF (3)			

Carry subtotals over to Q 6

	M	**F**	**TOTAL**
TOTAL R&D PERSONNEL (1+2+3)			

5.2 Headcount of all R&D personnel according to three categories and fields of science

(1) RESEARCHERS

Field of science	**M**	**F**	**TOTAL**
Natural sciences			
Engineering and technology			
Medical and health sciences			
Agricultural sciences			
Social sciences			
Humanities			
Not specified elsewhere			
TOTAL RESEARCHERS (same as 5.1)			

(2) TECHNICIANS

Field of Science	**M**	**F**	**TOTAL**
Natural sciences			
Engineering and technology			
Medical and health sciences			
Agricultural sciences			
Social sciences			
Humanities			
Not specified elsewhere			
TOTAL TECHNICIANS (same as 5.1)			

(3) OTHER SUPPORT STAFF

Field of Science	**M**	**F**	**TOTAL**
Natural sciences			
Engineering and technology			
Medical and health sciences			
Agricultural sciences			
Social sciences			
Humanities			
Not specified elsewhere			
TOTAL OTHER SUPPORT STAFF (same as 5.1)			

5.3 Headcount of all R&D personnel according to three categories and age (optional)

(1) RESEARCHERS

Age	**M**	**F**	**TOTAL**
Under 25 years			
25-34 years			
35-44 years			
45-54 years			
55-64 years			
65 years and more			
Unknown			
TOTAL RESEARCHERS (same as 5.1)			

(2) TECHNICIANS

Age	**M**	**F**	**TOTAL**
Under 25 years			
25-34 years			
35-44 years			
45-54 years			
55-64 years			
65 years and more			
Unknown			
TOTAL TECHNICIANS (same as 5.1)			

(3) OTHER SUPPORT STAFF

Age	**M**	**F**	**TOTAL**
Under 25 years			
25-34 years			
35-44 years			
45-54 years			
55-64 years			
65 years and more			
Unknown			
TOTAL OTHER SUPPORT STAFF (same as 5.1)			

6. RESEARCH FULL-TIME EQUIVALENTS (FTEs) AND COST TO GOVERNMENT INSTITUTIONS

Provide an estimate of <u>person-years of effort on R&D (or full-time equivalents)</u>, according to the categories below.

Using the male and female headcounts of all R&D personnel reported for in Question 4, provide the research full-time equivalents (time devoted to R&D). Then, calculate the total labour costs of R&D using the average annual full cost-to-institution for full-time staff (including annual wages and salaries and all associated costs or fringe benefits, such as bonus payments, contributions to pension and medical aid funds, payroll tax, unemployment insurance fund and all other statutory payments) per category below.

CALCULATING FULL-TIME EQUIVALENT (FTE) PERSONS

FTE data measure the volume of human resources in R&D. One FTE may be thought of as one person-year. That is 1 FTE is equal to 1 person working full-time on R&D for a period of 1 year or more persons working part-time or for a shorter period corresponding to one person-year.

For the purpose of this survey, an employee can work a maximum of 1 FTE in a year.

The following is a theoretical approach to calculating FTE:

FTE: (Dedication to the employment: Full-time/Part-time) x (Portion of the year active on R&D) x (Time or portion spent on R&D)

See the following examples:

- A full-time employee spending 100% of time on R&D during a year: (1 x 1 x 1) = 1 FTE
- A full-time employee spending 30% of time on R&D during a year: (1 x 1 x 0.3) = 0.3 FTE
- A full-time R&D worker who is spending 100% of time on R&D and is employed at an R&D institution for only six months: (1 x 0.5 x 1) = 0.5 FTE
- A full-time employee spending 40% of time on R&D during half of the year (person is only active for 6 months per year): (1 x 0.5 x 0.4) = 0.2 FTE
- A part-time employee (working 40% of a full-time year) engaged only in R&D (spending 100% of time on R&D) during a year: (0.4 x 1 x 1) = 0.4 FTE
- A part-time employee (working 40% of a full time year) spending 60% of time on R&D during half of the year (person is only active for 6 months per year): (0.4 x 0.5 x 0.6) = 0.12 FTE
- 20 full-time employees spending 40% of time on R&D during a year: 20 x (1 x 1 x 0.4) = 8 FTE

NOTE: Please calculate FTEs for all R&D personnel.

6.1 FTE by personnel category

Personnel category	Headcounts (From Q 5.1)			Full-time equivalent (FTE)		
	M	F	Tot	M	F	Tot

(1) RESEARCHERS

Doctoral or equivalent level (**ISCED level 8**)						
Master's or equivalent level (**ISCED level 7**)						
Bachelor's or equivalent level (**ISCED level 6**)						
Short-cycle tertiary education (**ISCED level 5**)						
All other qualifications, including post-secondary non-tertiary programmes **(ISCED 4)** and upper secondary programmes **(ISCED 3)**						
TOTAL RESEARCHERS (1)						

(2) TECHNICIANS

Doctoral or equivalent level (**ISCED level 8**)						
Master's or equivalent level (**ISCED level 7**)						
Bachelor's or equivalent level (**ISCED level 6**)						
Short-cycle tertiary education (**ISCED level 5**)						
All other qualifications, including post-secondary non-tertiary programmes **(ISCED 4)** and upper secondary programmes **(ISCED 3)**						
TOTAL TECHNICIANS (2)						

(3) OTHER SUPPORT STAFF

Doctoral or equivalent level (**ISCED level 8**)						
Master's or equivalent level (**ISCED level 7**)						
Bachelor's or equivalent level (**ISCED level 6**)						
Short-cycle tertiary education (**ISCED level 5**)						
All other qualifications, including post-secondary non-tertiary programmes **(ISCED 4)** and upper secondary programmes **(ISCED 3)**						
TOTAL OTHER SUPPORT STAFF (3)						

Personnel category	Headcounts (From Q 5.1)			Full-time equivalent (FTE)		
	M	F	Tot	M	F	Tot
TOTAL R&D PERSONNEL (1+2+3)						

6.2 FTE by field of science

Field of science	Headcounts (From Q 5.2)			Full-time equivalent (FTE)		
	M	F	Tot	M	F	Tot
(1) RESEARCHERS						
Natural sciences						
Engineering and technology						
Medical and health sciences						
Agricultural sciences						
Social sciences						
Humanities						
Not specified elsewhere						
TOTAL RESEARCHERS (same as 6.1)						
(2) TECHNICIANS						
Natural sciences						
Engineering and technology						
Medical and health sciences						
Agricultural sciences						
Social sciences						
Humanities						
Not specified elsewhere						
TOTAL TECHNICIANS (same as 6.1)						
(3) OTHER SUPPORT STAFF						
Natural sciences						
Engineering and technology						
Medical and health sciences						
Agricultural sciences						
Social sciences						
Humanities						
Not specified elsewhere						
TOTAL OTHER SUPPORT STAFF (same as 6.1)						

6.3 FTE by personnel category and labour cost

Personnel categories	Full Time Equivalent (FTE) (From Q 6.1) (A)	Average annual labour cost per person Local Currency '000 (Excl. VAT[12]) (B)	Calculated labour cost of R&D Local Curr. '000 (Excl. VAT) (A x B)
Total researchers (1)			
Total technicians (2)			
Total other support staff (3)			
TOTAL LABOUR COST (1+2+3)			

Carry subtotal over to Q 7A

[12] VAT = Value-added tax

PART 3: IN-HOUSE R&D EXPENDITURE

THE DEFINITION AND CALCULATION OF IN-HOUSE R&D EXPENDITURE

OTHER CURRENT EXPENDITURE

Including – but not limited to:

- Direct project costs, project consumables and running costs linked to research, such as materials, fuels and other inputs, including telephone and printing.
- Subsistence and travel expenses.
- Repair and maintenance expenses.
- Payments to outside organizations for use of specialised testing facilities, analytical work, engineering or other specialised services in support of R&D projects carried out by this reporting unit.
- Commission/consultant expenses for research projects carried out by this reporting unit.
- The relevant % of indirect and institutional costs and utility costs such as rent, space charge, leasing and hiring expenses, furniture, water, electricity and any other overhead costs.
- The relevant % of labour costs of persons providing indirect services such as the head office, human resources, finances, security and maintenance personnel as well as staff of central libraries and IT departments.

Excluding:

- Contract R&D expenses where the research project is carried out elsewhere by others on behalf of this reporting unit.
- Payments for purchases of technical know-how (goodwill).
- Licence fees.
- Depreciation provisions.

- Where current expenses such as direct project costs and consumables are used solely for R&D, allocate the full cost of the items.
- If these current expenses are used for more than one activity, include only an estimate of the portion used for R&D.
- Only where such an estimate of the portion used for R&D is not available, such as indirect and utility costs and labour costs of staff providing indirect services, it is advised that respondents apply the percentage time that researchers in the reporting unit spent on R&D to the total of these current expenditures.
- So, if the income and expenditure statement shows that the current expenditure for indirect and utility costs and labour costs of staff providing indirect services for the year was say USD 1,700,000 and that researchers on average spent 80% of their time on R&D, then this component of R&D current expenditure may be estimated as 0.8 x USD 1,700,000 = USD 1,360,000.

CAPITAL EXPENDITURE

The full cost of capital expenses must be reported in the year of purchase (do not depreciate).

Including – but not limited to:

- Expenditure on fixed assets used in the R&D projects of this reporting unit.
- Acquisition of software, including license fees, expected to be used for more than one year.
- Purchase of databases expected to be used for more than one year.
- Major repairs, improvements and modifications on land and buildings.
- Where a capital item is used solely for R&D, allocate the full cost of the item.

Excluding:

- Other repairs and maintenance expenses.
- Depreciation provisions.
- Proceeds from the sale of R&D assets.

- If the capital item is used for more than one activity, include only an estimate of the portion used for R&D. For example, a new piece of equipment that will be used for R&D (included), testing (excluded) and quality control (excluded). For instance, if the intended use of this new equipment for R&D purposes is 40% of the total usage (i.e. the other 60% for other activities), only 40% of the total equipment cost should be considered as relevant R&D expenditure.
- Only where such an estimate of the portion used for R&D is not available, apply the percentage time that researchers in the reporting unit spent on R&D to the cost of the item.

7. IN-HOUSE R&D EXPENDITURE

Compile expenditure on IN-HOUSE R&D during the fiscal year …<YYYY>... Include expenditure funded from all sources: internal and external (contracts and grants) and undertaken by the reporting unit on its own behalf or for other parties.
PLEASE NOTE*:* Extramural R&D should be reported under Part 5.

Purchase of equipment can in theory be classified as either capital or current expenditure. A distinction can therefore be made between "major" and "minor" equipment (to be included in "capital" and "current" expenditures, respectively) by establishing some kind of monetary limitation. Please provide us with this limitation as used by your institution.	
Local currency:	

LABOUR COSTS OF R&D

		Local currency '000 excluding VAT
Total cost of R&D personnel (carried over from Question 6.3)	**A**	

OTHER CURRENT EXPENDITURE ON R&D
(See the definition of current expenditure and how to calculate current expenditure devoted to R&D on the previous page)

		Local currency '000 excluding VAT
Other current expenditure	**B**	

CAPITAL EXPENDITURE ON R&D
(See the definition of capital expenditure and how to calculate capital expenditure on R&D on the previous page)

		Local currency '000 excluding VAT
Vehicles, plant, machinery and equipment	**C**	
Land, buildings and other structures	**D**	
Software	**E**	

		Local currency '000 excluding VAT
TOTAL R&D EXPENDITURE (A + B + C + D + E)	**F**	

Carry total R&D expenditure (F) over to Question 8

8. SOURCES OF FUNDS FOR IN-HOUSE R&D

Provide a breakdown of the total R&D expenditure according to the sources of funds listed below (NOTE: Only the proportion of the money actually SPENT is required not the total income per source)

To adapt to national context

Organization	Local currency '000 excluding VAT
Own funds	

Other government (includes departments/ministries and grant-making institutes)

Grants, especially general purpose, including studentships	
Contracts to perform directed R&D	

Local businesses

Contracts to perform R&D	

Other national sources

Not-for-profit organizations (including foundations)	
Individual donations	
Higher education	

Foreign sources

Foreign funds	

	Local currency '000 excluding VAT
TOTAL R&D EXPENDITURE (to equal Question 7F)	

PART 4: CATEGORIES OF IN-HOUSE R&D EXPENDITURE

9. IN-HOUSE R&D EXPENDITURE BY TYPE OF R&D

Specify the percentage of: a) IN-HOUSE TOTAL R&D expenditure (both current costs and capital expenditure) by type of R&D and (optional) b) total IN-HOUSE R&D CURRENT expenditure (labour costs and other current cost) by type of R&D.

		Column b optional
Basic research		
• Work undertaken primarily to acquire new knowledge of the underlying foundations of phenomena and observable facts without a specific application in view • Analyses of properties, structures and relationships with a view to formulating and testing hypotheses, theories or laws. • The results of basic research usually published in peer-reviewed scientific journals.	a). Based on **total Intramural expenditure** (Percentage)	b). Based on **only current expenditure** (Percentage)
Applied research		
• Original investigation to acquire new knowledge with a specific application in view. • Activities that determine the possible uses for the findings of basic research. • The results of applied research are intended primarily to be valid for a single or limited number of products, operations, methods or systems. • Applied research develops ideas into operational form. • Information or knowledge derived from applied research may be published in peer-reviewed journals or subjected to other forms of intellectual property protection.	a). Based on **total Intramural expenditure** (Percentage)	b). Based on **only current expenditure** (Percentage)
Experimental development		
• Systematic work using existing knowledge for creating new or improved materials, products, processes or services, or improving substantially those already produced or installed.	a). Based on **total Intramural expenditure** (Percentage)	b). Based on **only current expenditure** (Percentage)
TOTAL	**1 0 0**	**1 0 0**

10. DETAILED FIELDS OF SCIENCE (FOS) (OPTIONAL)

Classify R&D according to two-digit field of science (FoS) with associated percentage expenditure (see Appendix A)

- The FoS codes are based on recognised academic disciplines and emerging areas of study.

FoS codes			Percentage	
FoS				
FoS				
FoS				
FoS				
FoS				
FoS				

FoS codes			Percentage	
FoS				
FoS				
FoS				
FoS				
FoS				
FoS				
Total		1	0	0

11. SOCIO-ECONOMIC OBJECTIVES (SEO) (OPTIONAL)

Classify R&D according to socio-economic objective with associated percentage expenditure (see Appendix B)

- The SEO classification provides an indication of the main beneficiary of your R&D activities.

SEO codes			Percentage	
SEO				
SEO				
SEO				
SEO				
SEO				
SEO				

SEO codes			Percentage	
SEO				
SEO				
SEO				
SEO				
SEO				
SEO				
Total		1	0	0

12. FEDERAL STATE OR PROVINCIAL EXPENDITURE ON R&D (OPTIONAL)

Please indicate the geographic location (by federal state or province) where the department/unit carried out R&D activities and the percentage of the total R&D expenditure.

Distribution of R&D expenditure by federal state or province (create more rows if needed)
Please specify where R&D is actually performed rather than where it is managed/financed from.

Name	
Name	
Name	
Name	
Name	

Name	
Name	
Name	
Name	
Total	**100%**

PART 5: EXTRAMURAL R&D (OPTIONAL)

Extramural R&D refers to:

- Extramural expenditures are the sums a reporting unit paid or committed to pay to another organization for the performance of R&D during a specific period.
- This includes acquisition of R&D performed by and/or grants given to other organizations for performing R&D (FM § 408).

	Approximate value local currency ’000 (excl. VAT)
13. State details of extramural R&D paid **locally**	
14. State details of extramural R&D paid **abroad**	

THANK YOU FOR YOUR TIME AND EFFORT

6.3. Business enterprise sector

The model questionnaire for the business enterprise sector starts after this introduction. A Word version of this questionnaire can be downloaded from the UIS website at this address: http://www.uis.unesco.org/ScienceTechnology/Pages/research-and-development-statistics.aspx.

Countries that adopt this questionnaire will need to adapt it to fit their national needs and circumstances. The following adaptations might be needed:

- The front page will need to be completely redone by the data collection agency.
- Countries may change the financial year to calendar year or any reference period of one year.
- In Part 2 on R&D personnel, the respondent is requested to report the average number of persons engaged in R&D during the reference year. This can be adapted to any other approach. However, it is recommended that the approach adopted for measuring HC data for R&D personnel be similar to that used for collecting other statistical HC series (employment, education) to which the R&D series are likely to be compared (FM §329).
- In Questions 9.1 and 10.1, countries may want to replace the levels of qualification, which are based on the 2011 version of ISCED, with the levels applicable to their country.
- Sources of funds in Question 12 can be adapted to suit local conditions.
- In Question 20 on the details of extramural R&D, the threshold needs to be adapted to national needs.

Questions 2b and 14 request identification of International Standard Industrial Classification (ISIC) codes. The full list of ISIC codes is included in Annex C, which should be included in this questionnaire. In this Guide, it is included in Section 6.5. Two versions are included: ISIC Rev. 3.1 and ISIC Rev. 4. The data collection agency should select the most appropriate for the country or replace it with a national classification.

The cells in grey correspond to data that are either a summation or reported earlier in the questionnaire and should not be completed by the respondent. If the questionnaire is converted to a web-based questionnaire or Excel questionnaire, these cells should be calculated or carried over automatically.

Some questions are not needed to provide data to the UIS but are of interest nevertheless and can be included if so desired by the policymakers. The following questions are implicated:

- Question 9.3 on the age of R&D personnel.
- Question 15 on detailed FoS. For this question, the respondent is required to look up the detailed FoS codes for all academic disciplines and areas of study practised in his/her organization in Appendix A of the questionnaire and copy this code in Question 15 together with the corresponding percentage. Appendix A should be included in the questionnaire. Since it applies to the model questionnaires for all sectors of performance, it is only included once in this Guide in Section 6.5.

- Question 16 on SEO. For this question, the respondent is required to look up the code for all objectives applicable to his/her organization in Appendix B of the questionnaire and copy this code in Question 16, together with the corresponding percentage. Appendix B should be included in the questionnaire. Since it applies to the model questionnaires for all sectors of performance, it is only included once in this Guide in Section 6.5.
- Question 17 on a regional breakdown of R&D expenditure.
- Questions 18 to 20 on extramural R&D.

STRICTLY CONFIDENTIAL

<LOGO OF INSTITUTION>

NATIONAL SURVEY OF RESEARCH AND EXPERIMENTAL DEVELOPMENT (R&D) INPUTS	
BUSINESS ENTERPRISE FINANCIAL YEAR: …….. (YYYY/YYYY)	
Organization	**Please modify address label (only if there is one)**

AUTHORITY
(NAME OF THE CENTRE/AGENCY/DIRECTORATE) is mandated to conduct a Survey of Inputs into research and experimental development (R&D) for the ……. (Ministry).

All data gathered for this survey are confidential. Only the survey team sees individual organization data. Raw data gathered for this survey is confidential except when an organization gives written permission for its data to be disclosed to other parties.

PURPOSE AND SCOPE OF SURVEY
The R&D survey collects data on the inputs into R&D activities performed IN-HOUSE by all organizations (including higher education, government, business and not-for profit). The data are used for planning and monitoring purposes and for measuring international competitiveness.

This survey covers the Financial Year: DD/MM/YYY to DD/MM/YYYY (or your nearest complete financial year).

DUE DATE
Kindly complete and return this questionnaire by ..... to: R&D Survey, [full address]

ASSISTANCE
To assist you with queries kindly contact one of the survey managers:

Name	Contact Number	Email

PERSON COMPLETING THE QUESTIONNAIRE:

Organization		**Tel**	( )
Name (with title)		**Fax**	( )
Designation		**Cell**	( )
Date		**Email**	
Signature		**Website**	

THE FOLLOWING DEFINITIONS ARE IMPORTANT IN THE COMPLETION OF THE SURVEY QUESTIONNAIRE:

Definition of R&D:
This survey follows the *Frascati Manual* guidelines for conducting surveys on the inputs to R&D (OECD, 2002).
It defines research and experimental development (R&D) as:

- **Research** is creative work and original investigation undertaken on a systematic basis to gain new knowledge, including knowledge of humanity, culture and society.
- **Experimental development** is the application of research findings or their scientific knowledge for the creation of new or significantly improved products, applications or processes.

The basic criterion for distinguishing R&D from related activities is the presence in R&D of an appreciable element of novelty and the resolution of scientific and/or technological uncertainty, i.e. when the solution to a problem is not readily apparent to someone familiar with the basic stock of commonly used knowledge and techniques in the area concerned.

Scope of survey:

- The survey requests data **on R&D performed IN-HOUSE by your organization** in the national territory.
- Part five includes some questions on extramural R&D.

R&D in business:
Any activity classified as R&D is characterised by originality; it should have investigation as a primary objective and should have the potential to produce results that are sufficiently general for humanity's stock of knowledge (theoretical and/or practical) to be recognisably increased.

R&D includes – but is not limited to:
Activities of personnel who are obviously engaged in R&D.
In addition, research activity includes:

- The provision of professional, technical, administrative or clerical support and/or assistance to personnel directly engaged in R&D.
- The management of personnel who are either directly engaged in R&D or are providing professional, technical or clerical support or assistance to those R&D activities of students undertaking postgraduate research courses.
- Software development where the aim of the project is the systematic resolution of a scientific uncertainty.
- Research work in the natural sciences, engineering, medical sciences, agricultural sciences, social sciences and the humanities.
- R&D carried out as a participant in any unincorporated joint venture.
- Prototypes and pilot plants, as long as long as the primary objective is to make further improvements.
- Industrial design and drawing but only if required for R&D.
- R&D projects performed on contract for other legal entities, such as businesses.
- “Feedback R&D” directed at solving problems occurring beyond the original R&D phase – for example, technical problems arising during initial production runs.

R&D excludes:
The following specific activities are excluded except where they are used primarily for the support of or as part of R&D activities performed in this reporting unit:

- Scientific and technical information services.
- Engineering and technical services.
- General purpose or routine data collection.
- Standardisation and routine testing.
- Feasibility studies (except into R&D projects).
- Specialised routine medical care, for example routine pathology services.
- The commercial, legal and administrative aspects of patenting, copyrighting or licensing activities.
- Routine computer programming, systems work or software maintenance where there are no technological uncertainties to be resolved.

Examples:

- Investigating electrical conduction in crystals is basic research; application of crystallography to the properties of alloys is applied research.
- New chip designs involve development.
- Investigating the limiting factors in chip element placement lies at the border between basic and applied research, and increasingly involves nanotechnology.
- Much service R&D involves software development where the completion of the project is dependent on a scientific or technological advance and the aim of the project is the systematic resolution of a scientific or technological uncertainty.

Borderline cases:

- The greatest source of error in measuring R&D is the difficulty of locating the cut-off point between experimental development and the related activities required to realise an innovation.
- Care must be taken to exclude activities that although undoubtedly a part of the innovation process, rarely involve any R&D, e.g. patent filing and licensing, market research, manufacturing start-up, tooling up and redesign for the manufacturing process.
- It is also difficult to define precisely the cut-off point between experimental development and pre-production development, such as producing user demonstration models and testing, and production that is applicable to all industrial situations. If the primary objective is to make further technical improvements on the product or process, then the work falls 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.

PART 1: GENERAL INFORMATION

1a. Registered name of company	

1b. Trading as (if applicable)	

2a. If you are reporting R&D for subsidiary companies (e.g. as a head office with several subsidiary companies), please list the companies below (append a page if required).

2b. List the principal activities and/or National Classification/International Standard Industrial Classification (ISIC) code (see Appendix C) from which your company derives its <u>main income</u>.

Activities	ISIC	Company income obtained (%)

3. Parent Company (if applicable) with % ownership

Parent company	% ownership
	%

4. Approximate foreign/local ownership split (By ultimate ownership if complex holding structures exist.)

EU	%
USA	%
China	%
Other	%
Domestic	%
TOTAL	**100%**

5. Financial year (dd/mm/yyyy) for which you are reporting in this survey

From	**to**

6. Total number of employees						

7. Gross sales revenue or turnover (local currency '000 excl. VAT[13])						

8. Did the reporting unit perform any <u>IN-HOUSE R&D</u> during the financial year?

Yes	☐	**Continue with Question 9.**
No	☐	**Proceed to Part 5 if you paid for R&D to other parties (optional).**
	☐	**If the organization/unit does *not* do any In-House and/or any extramural R&D, tick this box and return the questionnaire as a NIL response.**

[13] VAT = Value-added tax

PART 2: IN-HOUSE R&D PERSONNEL

R&D PERSONNEL

- **Report against the categories listed below for all personnel employed directly in R&D or providing direct R&D services/support for at least 5% of their time. Do not count any staff NOT supporting research.**
- **Please report the average number of persons engaged in R&D during the reference year.**
- **Please include permanent, temporary, full-time, part-time and contract staff.**

Researchers

- Researchers are professionals engaged in the conception or creation of new knowledge, products, processes, methods and systems and also in the planning and management of the projects concerned.

- Researchers include managers and administrators engaged in the planning and management of the scientific and technical aspects of a researcher's work. Their rank is usually equal or superior to that of persons directly employed as researchers and they are often former or part-time researchers.

- Excluded are managers and directors concerned primarily with budgets and human resources rather than project management or content (include in other personnel directly supporting R&D).

Technicians directly supporting R&D

- Persons performing technical tasks in support of R&D, normally under the direction and supervision of a researcher.

Other personnel directly supporting R&D

- Other supporting staff includes skilled and unskilled crafts persons, secretarial and clerical staff participating in R&D projects or directly associated with such projects.

- Included are executives and directors concerned primarily with budgets and human resources in support of research rather than project management.

Note:

- Do not include personnel indirectly supporting R&D. Typical examples are transportation, storage, cleaning, repair, maintenance and security activities, as well as administration and clerical activities undertaken not exclusively for R&D (such as the activities of central finance and personnel departments).

- Allowance for these should be made under "overheads in R&D expenditure" ("other current expenditure" in Question 11B) but such persons should not be included as R&D personnel.

9. HEADCOUNT OF R&D PERSONNEL

CALCULATING HEADCOUNT (HC) DATA

HC data cover the total number of persons who are mainly or partially employed in R&D. This includes staff employed both full-time and part-time on R&D activities.

9.1 Headcount of all R&D personnel according to three categories and highest qualification

(1) RESEARCHERS

Highest qualification	**M**	**F**	**TOTAL**
Doctoral or equivalent level (**ISCED level 8**)			
Master's or equivalent level (**ISCED level 7**)			
Bachelor's or equivalent level (**ISCED level 6**)			
Short-cycle tertiary education (**ISCED level 5**)			
All other qualifications, including post-secondary non-tertiary programmes **(ISCED 4)** and upper secondary programmes **(ISCED 3)**			
TOTAL RESEARCHERS (1)			

Carry subtotals over to Q 10

(2) TECHNICIANS

Highest qualification	**M**	**F**	**TOTAL**
Doctoral or equivalent level (**ISCED level 8**)			
Master's or equivalent level (**ISCED level 7**)			
Bachelor's or equivalent level (**ISCED level 6**)			
Short-cycle tertiary education (**ISCED level 5**)			
All other qualifications, including post-secondary non-tertiary programmes **(ISCED 4)** and upper secondary programmes **(ISCED 3)**			
TOTAL TECHNICIANS (2)			

Carry subtotals over to Q 10

(3) OTHER SUPPORT STAFF

Highest qualification	**M**	**F**	**TOTAL**
Doctoral or equivalent level (**ISCED level 8**)			
Master's or equivalent level (**ISCED level 7**)			
Bachelor's or equivalent level (**ISCED level 6**)			
Short-cycle tertiary education (**ISCED level 5**)			
All other qualifications, including post-secondary non-tertiary programmes **(ISCED 4)** and upper secondary programmes **(ISCED 3)**			
TOTAL OTHER SUPPORT STAFF (3)			

Carry subtotals over to Q 10

	M	**F**	**TOTAL**
TOTAL R&D PERSONNEL (1+2+3)			

9.2 Headcount of all R&D personnel according to three categories and fields of science

(1) RESEARCHERS

Field of science	**M**	**F**	**TOTAL**
Natural sciences			
Engineering and technology			
Medical and health sciences			
Agricultural sciences			
Social sciences			
Humanities			
Not specified elsewhere			
TOTAL RESEARCHERS (same as 9.1)			

(2) TECHNICIANS

Field of science	**M**	**F**	**TOTAL**
Natural sciences			
Engineering and technology			
Medical and health sciences			
Agricultural sciences			
Social sciences			
Humanities			
Not specified elsewhere			
TOTAL TECHNICIANS (same as 9.1)			

(3) OTHER SUPPORT STAFF

Field of science	**M**	**F**	**TOTAL**
Natural sciences			
Engineering and technology			
Medical and health sciences			
Agricultural sciences			
Social sciences			
Humanities			
Not specified elsewhere			
TOTAL OTHER SUPPORT STAFF (same as 9.1)			

9.3 Headcount of all R&D personnel according to three categories and age (optional)

(1) RESEARCHERS

Age	**M**	**F**	**TOTAL**
Under 25 years			
25-34 years			
35-44 years			
45-54 years			
55-64 years			
65 years and more			
Unknown			
TOTAL RESEARCHERS (same as 9.1)			

(2) TECHNICIANS

Age	**M**	**F**	**TOTAL**
Under 25 years			
25-34 years			
35-44 years			
45-54 years			
55-64 years			
65 years and more			
Unknown			
TOTAL TECHNICIANS (same as 9.1)			

(3) OTHER SUPPORT STAFF

Age	**M**	**F**	**TOTAL**
Under 25 years			
25-34 years			
35-44 years			
45-54 years			
55-64 years			
65 years and more			
Unknown			
TOTAL OTHER SUPPORT STAFF (same as 9.1)			

10. RESEARCH FULL-TIME EQUIVALENTS (FTEs) AND COST TO BUSINESS ENTERPRISES

Provide an estimate of <u>person-years of effort on R&D (or full-time equivalents)</u>, according to the categories below.

Using the male and female headcounts of all R&D personnel reported for in Question 4, provide the research full-time equivalents (time devoted to R&D). Then, calculate the total labour costs of R&D using the average annual full cost-to-company for full-time staff (including annual wages and salaries and all associated costs or fringe benefits, such as bonus payments, contributions to pension and medical aid funds, payroll tax, unemployment insurance fund and all other statutory payments) per category below.

CALCULATING FULL-TIME EQUIVALENT (FTE) PERSONS

FTE data measure the volume of human resources in R&D. One FTE may be thought of as one person-year. That is 1 FTE is equal to 1 person working full-time on R&D for a period of 1 year or more persons working part-time or for a shorter period corresponding to one person-year.

For the purpose of this survey, an employee can work a maximum of 1 FTE in a year.

The following is a theoretical approach to calculating FTE:

FTE: (Dedication to the employment: Full-time/Part-time) x (Portion of the year active on R&D) x (Time or portion spent on R&D)

Examples are the following:

- A full-time employee spending 100% of time on R&D during a year: (1 x 1 x 1) = 1 FTE
- A full-time employee spending 30% of time on R&D during a year: (1 x 1 x 0.3) = 0.3 FTE
- A full-time R&D worker who is spending 100% of time on R&D, is employed at an R&D institution for only six months: (1 x 0.5 x 1) = 0.5 FTE
- A full-time employee spending 40% of time on R&D during half of the year (person is only active for 6 months per year): (1 x 0.5 x 0.4) = 0.2 FTE
- A part-time employee (working 40% of a full-time year) engaged only in R&D (spending 100% of time on R&D) during a year: (0.4 x 1 x 1) = 0.4 FTE
- A part-time employee (working 40% of a full-time year) spending 60% of time on R&D during half of the year (person is only active for 6 months per year): (0.4 x 0.5 x 0.6) = 0.12 FTE
- 20 full time employees spending 40% of time on R&D during a year: 20 x (1 x 1 x 0.4) = 8 FTE

NOTE: Please calculate FTEs for all R&D personnel.

10.1 FTE by personnel category

Personnel category	Headcounts (From Q 9.1)			Full-time equivalent (FTE)		
	M	F	Tot	M	F	Tot

(1) RESEARCHERS

Doctoral or equivalent level (**ISCED level 8**)						
Master's or equivalent level (**ISCED level 7**)						
Bachelor's or equivalent level (**ISCED level 6**)						
Short-cycle tertiary education (**ISCED level 5**)						
All other qualifications, including post-secondary non-tertiary programmes **(ISCED 4)** and upper secondary programmes **(ISCED 3)**						
TOTAL RESEARCHERS (1)						

(2) TECHNICIANS

Doctoral or equivalent level (**ISCED level 8**)						
Master's or equivalent level (**ISCED level 7**)						
Bachelor's or equivalent level (**ISCED level 6**)						
Short-cycle tertiary education (**ISCED level 5**)						
All other qualifications, including post-secondary non-tertiary programmes **(ISCED 4)** and upper secondary programmes **(ISCED 3)**						
TOTAL TECHNICIANS (2)						

(3) OTHER SUPPORT STAFF

Doctoral or equivalent level (**ISCED level 8**)						
Master's or equivalent level (**ISCED level 7**)						
Bachelor's or equivalent level (**ISCED level 6**)						
Short-cycle tertiary education (**ISCED level 5**)						
All other qualifications, including post-secondary non-tertiary programmes **(ISCED 4)** and upper secondary programmes **(ISCED 3)**						
TOTAL OTHER SUPPORT STAFF (3)						

Personnel category	Headcounts (From Q 9.1)			Full-time equivalent (FTE)		
	M	F	Tot	M	F	Tot
TOTAL R&D PERSONNEL (1+2+3)						

10.2 FTE by field of science

Field of Science	Headcounts (From Q 9.2)			Full-time equivalent (FTE)		
	M	F	Tot	M	F	Tot
(1) RESEARCHERS						
Natural sciences						
Engineering and technology						
Medical and health sciences						
Agricultural sciences						
Social sciences						
Humanities						
Not specified elsewhere						
TOTAL RESEARCHERS (same as 10.1)						
(2) TECHNICIANS						
Natural sciences						
Engineering and technology						
Medical and health sciences						
Agricultural sciences						
Social sciences						
Humanities						
Not specified elsewhere						
TOTAL TECHNICIANS (same as 10.1)						
(3) OTHER SUPPORT STAFF						
Natural sciences						
Engineering and technology						
Medical and health sciences						
Agricultural sciences						
Social sciences						
Humanities						
Not specified elsewhere						
TOTAL OTHER SUPPORT STAFF (same as 10.1)						

10.3 FTE by personnel category and labour cost

Personnel categories	Full Time Equivalent (FTE) (From Q 10.1) (A)	Average annual labour cost per person Local Currency '000 (Excl. VAT) (B)	Calculated labour cost of R&D Local Curr. '000 (Excl. VAT) (A x B)
Total researchers (1)			
Total technicians (2)			
Total other support staff (3)			
TOTAL LABOUR COST (1+2+3)			

Carry subtotal over to Q 11A

PART 3: IN-HOUSE R&D EXPENDITURE

THE DEFINITION AND CALCULATION OF IN-HOUSE R&D EXPENDITURE

OTHER CURRENT EXPENDITURE

Including – but not limited to:

- Direct project costs, project consumables and running costs linked to research, such as materials, fuels and other inputs, including telephone and printing.
- Subsistence and travel expenses.
- Repair and maintenance expenses.
- Payments to outside organizations for use of specialised testing facilities, analytical work, engineering or other specialised services in support of R&D projects carried out by this reporting unit.
- Commission/consultant expenses for research projects carried out by this reporting unit.
- The relevant % of indirect and institutional costs and utility costs, such as rent, space charge, leasing and hiring expenses, furniture, water, electricity and any other overhead costs.
- The relevant % of labour costs of persons providing indirect services such as the head office, human resources, finances, security and maintenance personnel as well as staff of central libraries and IT departments.

Excluding:

- Contract R&D expenses where the research project is carried out elsewhere by others on behalf of this reporting unit.
- Payments for purchases of technical know-how (goodwill).
- Licence fees.
- Depreciation provisions.

- Where current expenses such as direct project costs and consumables are used solely for R&D, allocate the full cost of the items.
- If these current expenses are used for more than one activity, include only an estimate of the portion used for R&D.
- Only where such an estimate of the portion used for R&D is not available, such as indirect and utility costs and labour costs of staff providing indirect services, it is advised that respondents apply the percentage time that researchers in the reporting unit spent on R&D to the total of these current expenditures.
- So if the income and expenditure statement shows that the current expenditure for indirect and utility costs and labour costs of staff providing indirect services for the year was say USD 1,700,000 and that researchers on average spent 80% of their time to R&D, then this component of R&D current expenditure may be estimated as 0.8 x USD 1,700,000 = USD 1,360,000.

CAPITAL EXPENDITURE

The full cost of capital expenses must be reported in the year of purchase (do not depreciate).

Including – but not limited to:

- Expenditure on fixed assets used in the R&D projects of this reporting unit.
- Acquisition of software, including license fees, expected to be used for more than one year.
- Purchase of databases expected to be used for more than one year.
- Major repairs, improvements and modifications on land and buildings.
- Where a capital item is used solely for R&D, allocate the full cost of the item.

Excluding:

- Other repairs and maintenance expenses.
- Depreciation provisions.
- Proceeds from the sale of R&D assets.

- If the capital item is used for more than one activity, include only an estimate of the portion used for R&D. For example, a new piece of equipment that will be used for R&D (included), testing (excluded) and quality control (excluded). For instance, if the intended use of this new equipment for R&D purposes is 40% of the total usage (i.e. the other 60% for other activities), only 40% of the total equipment cost should be considered as relevant R&D expenditure.
- Only where such an estimate of the portion used for R&D is not available, apply the percentage time that researchers in the reporting unit spent on R&D to the cost of the item.

11. IN-HOUSE R&D EXPENDITURE

Compile expenditure on IN-HOUSE R&D during the fiscal year …<YYYY>... Include expenditure funded from all sources: internal and external (contracts and grants) and undertaken by the reporting unit on its own behalf or for other parties.
PLEASE NOTE*:* Extramural R&D should be reported under Part 5.

Purchase of equipment can, in theory, be classified as either capital or current expenditure. A distinction can therefore be made between "major" and "minor" equipment (to be included in "capital" and "current" expenditures respectively) by establishing some kind of monetary limitation. Please provide us with this limitation as used by your institution.	
Local currency:	

LABOUR COSTS OF R&D

		Local currency '000 excluding VAT
Total cost of R&D personnel (carried over from Question 10.3)	**A**	

OTHER CURRENT EXPENDITURE ON R&D
(See the definition of current expenditure and how to calculate current expenditure devoted to R&D on the previous page)

		Local currency '000 excluding VAT
Other current expenditure	**B**	

CAPITAL EXPENDITURE ON R&D
(See the definition of capital expenditure and how to calculate capital expenditure on R&D on the previous page)

		Local currency '000 excluding VAT
Vehicles, plant, machinery and equipment	**C**	
Land, buildings and other structures	**D**	
Software	**E**	

		Local currency '000 excluding VAT
TOTAL R&D EXPENDITURE (A + B + C + D + E)	**F**	

Carry total R&D expenditure (F) over to Question 12

12. SOURCES OF FUNDS FOR IN-HOUSE R&D

Provide a breakdown of the total R&D expenditure according to the sources of funds listed below (NOTE: Only the proportion of the money actually SPENT is required not the total income per source)

To adapt to national context

Company	**Local currency '000 excluding VAT**
Own funds	

Government (includes departments/ministries and grant-making Institutes)

Grants, especially general purpose, including studentships	
Contracts to perform directed R&D	
Government supported loans for R&D	

Other local businesses

Contracts to perform R&D	

Other national sources

Not-for-profit organizations (including foundations)	
Individual donations	
Higher education	

Foreign sources

Parent company	
Philanthropic organizations and foundations	
All other foreign sources	

	Local currency '000 excluding VAT
TOTAL R&D EXPENDITURE (to equal Question 11F)	

PART 4: CATEGORIES OF IN-HOUSE R&D EXPENDITURE

13. IN-HOUSE R&D EXPENDITURE BY TYPE OF R&D

Specify the percentage of: a) IN-HOUSE TOTAL R&D expenditure (both current costs and capital expenditure) by type of R&D and (optional) b) total IN-HOUSE R&D CURRENT expenditure (labour costs and other current cost) by type of R&D.

		Column b optional
Basic research		
• Work undertaken primarily to acquire new knowledge of the underlying foundations of phenomena and observable facts, without a specific application in view • Analyses of properties, structures and relationships with a view to formulating and testing hypotheses, theories or laws. • The results of basic research are usually published in peer-reviewed scientific journals.	a). Based on **total intramural expenditure** (Percentage)	b). Based on **only current expenditure** (Percentage)
Applied research		
• Original investigation to acquire new knowledge with a specific application in view. • Activities that determine the possible uses for the findings of basic research. • The results of applied research are intended primarily to be valid for a single or limited number of products, operations, methods or systems. • Applied research develops ideas into operational form. • Information or knowledge derived from applied research may be published in peer-reviewed journals or subjected to other forms of intellectual property protection.	a). Based on **total intramural expenditure** (Percentage)	b). Based on **only current expenditure** (Percentage)
Experimental development		
• Systematic work using existing knowledge for creating new or improved materials, products, processes or services, or improving substantially those already produced or installed.	a). Based on **total intramural expenditure** (Percentage)	b). Based on **only current expenditure** (Percentage)
TOTAL	**1 0 0**	**1 0 0**

14. DETAILED INDUSTRIAL BREAKDOWN (OPTIONAL)

Classify the actual industrial orientation of the R&D carried out by the business, according to the National Industrial Classification or ISIC with associated percentage expenditure (see Appendix C)

- ISICs indicate the classification that best describes company R&D according to the intended **use** of the product.

FoS codes			Percentage	
ISIC				
ISIC				
ISIC				
ISIC				
ISIC				
ISIC				

FoS codes				Percentage	
ISIC					
ISIC					
ISIC					
ISIC					
ISIC					
ISIC					
	Total		1	0	0

15. DETAILED FIELDS OF SCIENCE (FOS) (OPTIONAL)

Classify R&D according to two-digit field of science (FoS) with associated percentage expenditure (see Appendix A)

- The FoS Codes are based on recognised academic disciplines and emerging areas of study.

FoS codes			Percentage	
FoS				
FoS				
FoS				
FoS				
FoS				
FoS				

FoS codes				Percentage	
FoS					
FoS					
FoS					
FoS					
FoS					
FoS					
	Total		1	0	0

16. SOCIO-ECONOMIC OBJECTIVES (SEO) (OPTIONAL)

Classify R&D according to socio-economic objective with associated percentage expenditure (see Appendix B)

- The SEO classification provides an indication of the main beneficiary of your R&D activities.

SEO codes			Percentage	
SEO				
SEO				
SEO				
SEO				
SEO				
SEO				

SEO codes				Percentage	
SEO					
SEO					
SEO					
SEO					
SEO					
SEO					
	Total		1	0	0

17. FEDERAL STATE OR PROVINCIAL EXPENDITURE ON R&D (OPTIONAL)

Please indicate the geographic location (by federal state or province) where the department/unit carried out R&D activities and the percentage of the total R&D expenditure.

Distribution of R&D expenditure by federal state or province (create more rows if needed)
Please specify where R&D is actually performed rather than where it is managed/financed from.

Name	
Name	
Name	
Name	
Name	

Name	
Name	
Name	
Name	
Total	**100%**

PART 5: EXTRAMURAL R&D (OPTIONAL)

Extramural R&D refers to:

- Extramural expenditures are the sums a reporting unit paid or committed to pay to another organization for the performance of R&D during a specific period.
- This includes acquisition of R&D performed by and/or grants given to other organizations for performing R&D (FM § 408).

	Approximate value Local currency '000 (excl. VAT)
18. State details of extramural R&D paid **locally**	
19. State details of extramural R&D paid **abroad**	

20. If the amounts stated in Question 19 or 20 are in excess of 1 million units of national currency please indicate the name of the organization(s) that conducted the extramural R&D with the associated expenditure.

State details of extramural R&D paid **locally.**

Paid to:	**Approximate value Local currency '000s (excl. VAT)**

State details of extramural R&D paid **abroad.**

Paid to:	**Approximate value Local currency '000s (excl. VAT)**

THANK YOU FOR YOUR TIME AND EFFORT

6.4. Private non-profit sector

The model questionnaire for the private non-profit sector starts after this introduction. A Word-version of this questionnaire can be downloaded from the UIS website at this address: http://www.uis.unesco.org/ScienceTechnology/Pages/research-and-development-statistics.aspx.

Countries that adopt this questionnaire will need to adapt it to fit their national needs and circumstances. The following adaptations might be needed:

- The front page will need to be completely redone by the data collection agency.
- Countries may change the financial year to calendar year or any reference period of one year.
- In Part 2 on R&D personnel, the respondent is requested to report the average number of persons engaged in R&D during the reference year. This can be adapted to any other approach. However, it is recommended that the approach adopted for measuring HC data for R&D personnel be similar to that used for collecting other statistical HC series (employment, education) to which the R&D series are likely to be compared (FM §329).
- In Questions 8.1 and 9.1, countries may want to replace the levels of qualification, which are based on the 2011 version of ISCED, with the levels applicable to their country.
- Sources of funds in Question 11 can be adapted to suit local conditions.
- In Question 18 on the details of extramural R&D, the threshold needs to be adapted to national needs.

The cells in grey correspond to data that are either a summation or reported earlier in the questionnaire and should not be completed by the respondent. If the questionnaire is converted to a web-based questionnaire or Excel questionnaire, these cells should be calculated or carried over automatically.

Some questions are not needed to provide data to the UIS but are of interest nevertheless and can be included if so desired by the policymakers. This concerns the following questions:

- Question 8.3 on the age of R&D personnel.
- Question 13, which requests identification of ISIC codes. The full list of ISIC codes is included in Annex C, which should be included in this questionnaire. In this Guide, it is included in Section 6.5. Two versions are included: ISIC Rev. 3.1 and ISIC Rev. 4. The data collection agency should select the most appropriate for the country or replace it with a national classification.
- Question 14 on detailed FoS. For this question, the respondent is required to look up the detailed FoS codes for all academic disciplines and areas of study practised in his/her organization in Appendix A of the questionnaire and copy this code in Question 14 together with the corresponding percentage. Appendix A should be included in the questionnaire. Since it applies to the model questionnaires for all sectors of performance, it is only included once in this Guide in Section 6.5.

- Question 15 on SEO. For this question, the respondent is required to look up the code for all objectives applicable to his/her organization in Appendix B of the questionnaire and copy this code in Question 15 together with the corresponding percentage. Appendix B should be included in the questionnaire. Since it applies to the model questionnaires for all sectors of performance, it is only included once in this Guide in Section 6.5.
- Questions 16 to 18 on extramural R&D paid abroad.

STRICTLY CONFIDENTIAL

<LOGO OF INSTITUTION>

NATIONAL SURVEY OF RESEARCH AND EXPERIMENTAL DEVELOPMENT (R&D) INPUTS	
PRIVATE NON-PROFIT FINANCIAL YEAR: …….. (YYYY/YYYY)	
Organization	**Please modify address label (only if there is one)**

AUTHORITY
(NAME OF THE CENTRE/AGENCY/DIRECTORATE) is mandated to conduct a Survey of Inputs into research and experimental development (R&D) for the ……. (Ministry).

All data gathered for this survey are confidential. Only the survey team sees individual organization data. Raw data gathered for this survey is confidential except when an organization gives written permission for its data to be disclosed to other parties.

PURPOSE AND SCOPE OF SURVEY
The R&D survey collects data on the inputs into R&D activities performed IN-HOUSE by all organizations (including higher education, government, business and not-for profit). The data are used for planning and monitoring purposes and for measuring international competitiveness.

This survey covers the Financial Year: DD/MM/YYY to DD/MM/YYYY (or your nearest complete financial year).

DUE DATE
Kindly complete and return this questionnaire by ..... to: R&D Survey, [full address]

ASSISTANCE
To assist you with queries kindly contact one of the survey managers:

Name	Contact Number	Email

PERSON COMPLETING THE QUESTIONNAIRE:

Organization			**Tel**	( )
Name (with title)			**Fax**	( )
Designation			**Cell**	( )
Date			**Email**	
Signature			**Website**	

THE FOLLOWING DEFINITIONS ARE IMPORTANT IN THE COMPLETION OF THE SURVEY QUESTIONNAIRE:

Definition of R&D:
This survey follows the *Frascati Manual* guidelines for conducting surveys on the inputs to R&D (OECD, 2002).
It defines research and experimental development (R&D) as:

- **Research** is creative work and original investigation undertaken on a systematic basis to gain new knowledge, including knowledge of humanity, culture and society.
- **Experimental development** is the application of research findings or their scientific knowledge for the creation of new or significantly improved products, applications or processes.

The basic criterion for distinguishing R&D from related activities is the presence in R&D of an appreciable element of novelty and the resolution of scientific and/or technological uncertainty, i.e. when the solution to a problem is not readily apparent to someone familiar with the basic stock of commonly used knowledge and techniques in the area concerned.

Scope of survey:

- The survey requests data on **R&D performed IN-HOUSE by your organization** in the national territory.
- Part five includes some questions on extramural R&D.

R&D in private non-profit institutions:
Any activity classified as R&D is characterised by originality; it should have investigation as a primary objective and should have the potential to produce results that are sufficiently general for humanity's stock of knowledge (theoretical and/or practical) to be recognisably increased.

R&D includes – but is not limited to:
Activities of personnel who are obviously engaged in R&D.
In addition, research activity includes:

- The provision of professional, technical, administrative or clerical support and/or assistance to personnel directly engaged in R&D.
- The management of personnel who are either directly engaged in R&D or are providing professional, technical or clerical support or assistance to those R&D activities of students undertaking postgraduate research courses.
- Supervision and monitoring of postgraduate research courses, including students.
- Software development where the aim of the project is the systematic resolution of a scientific uncertainty.
- Research work in the natural sciences, engineering, medical sciences, agricultural sciences, social sciences and the humanities.
- R&D carried out as a participant in any unincorporated joint venture.
- R&D projects performed on contract for other legal entities, such as businesses.
- “Feedback R&D” directed at solving problems occurring beyond the original R&D phase – for example, technical problems arising during initial production runs.

R&D excludes:
The following specific activities are excluded except where they are used primarily for the support of or as part of R&D activities performed in this reporting unit:

- Scientific and technical information services.
- Engineering and technical services.
- General purpose or routine data collection.
- Standardisation and routine testing.
- Feasibility studies (except into R&D projects).
- Specialised routine medical care, for example routine pathology services.
- The commercial, legal and administrative aspects of patenting, copyrighting or licensing activities.
- Routine computer programming, systems work or software maintenance where there are no technological uncertainties to be resolved.

Examples:

- Investigating electrical conduction in crystals is basic research; application of crystallography to the properties of alloys is applied research.
- New chip designs involve development.
- Investigating the limiting factors in chip element placement lies at the border between basic and applied research, and increasingly involves nanotechnology.
- Much service R&D involves software development where the completion of the project is dependent on a scientific or technological advance and the aim of the project is the systematic resolution of a scientific or technological uncertainty.

PART 1: GENERAL INFORMATION

1. Organization/Institution	

2. Sub-unit (if applicable)	

3. Approximate foreign/local ownership split (By ultimate ownership if complex holding structures exist.)

Foreign	%
National	%
TOTAL	**100%**

4. Financial year (dd/mm/yyyy) for which you are reporting in this survey

From	**to**

5. Total number of employees (include staff on contract for six months or longer)						

6. Gross revenue (Local currency '000 excl. VAT[14])						

7. Did the reporting unit perform any <u>IN-HOUSE R&D</u> during the financial year?

Yes	☐	**Continue with Question 9.**
No	☐	**Proceed to Part 5 if you paid for R&D to other parties (optional).**
	☐	**If the organization/unit does *not* do any In-House and/or any extramural R&D, tick this box and return the questionnaire as a NIL response.**

[14] VAT = Value-added tax

PART 2: IN-HOUSE R&D PERSONNEL

R&D PERSONNEL

- **Report against the categories listed below for all personnel employed directly in R&D or providing direct R&D services/support for at least 5% of their time. Do not count any staff NOT supporting research.**
- **Please report the average number of persons engaged in R&D during the reference year.**
- **Please include permanent, temporary, full-time, part-time and contract staff.**

Researchers

- Researchers are professionals engaged in the conception or creation of new knowledge, products, processes, methods and systems, and also in the planning and management of the projects concerned.

- Researchers include managers and administrators engaged in the planning and management of the scientific and technical aspects of a researcher's work. Their rank is usually equal or superior to that of persons directly employed as researchers and they are often former or part-time researchers.

- Excluded are managers and directors concerned primarily with budgets and human resources, rather than project management or content (include in "other personnel directly supporting R&D").

Technicians directly supporting R&D

- Persons doing technical tasks in support of R&D, normally under the direction and supervision of a researcher.

Other personnel directly supporting R&D

- Other supporting staff includes skilled and unskilled crafts persons, secretarial and clerical staff participating in R&D projects or directly associated with such projects.

- Included are executives and directors concerned primarily with budgets and human resources in support of research rather than project management.

Note:

- Do not include personnel indirectly supporting R&D. Typical examples are transportation, storage, cleaning, repair, maintenance and security activities, as well as administration and clerical activities undertaken not exclusively for R&D (such as the activities of central finance and personnel departments).

- Allowance for these should be made under "overheads in R&D expenditure" ("other current expenditure" in Question 10B) but such persons should not be included as R&D personnel.

8. HEADCOUNT OF R&D PERSONNEL

CALCULATING HEADCOUNT (HC) DATA
HC data cover the total number of persons who are mainly or partially employed in R&D. This includes staff employed both full-time and part-time on R&D activities.

8.1 Headcount of all R&D personnel according to three categories and highest qualification

(1) RESEARCHERS

Highest qualification	**M**	**F**	**TOTAL**
Doctoral or equivalent level (**ISCED level 8**)			
Master's or equivalent level (**ISCED level 7**)			
Bachelor's or equivalent level (**ISCED level 6**)			
Short-cycle tertiary education (**ISCED level 5**)			
All other qualifications, including post-secondary non-tertiary programmes **(ISCED 4)** and upper secondary programmes **(ISCED 3)**			
TOTAL RESEARCHERS (1)			

Carry subtotals over to Q 9

(2) TECHNICIANS

Highest qualification	**M**	**F**	**TOTAL**
Doctoral or equivalent level (**ISCED level 8**)			
Master's or equivalent level (**ISCED level 7**)			
Bachelor's or equivalent level (**ISCED level 6**)			
Short-cycle tertiary education (**ISCED level 5**)			
All other qualifications, including post-secondary non-tertiary programmes **(ISCED 4)** and upper secondary programmes **(ISCED 3)**			
TOTAL TECHNICIANS (2)			

Carry subtotals over to Q 9

(3) OTHER SUPPORT STAFF

Highest qualification	**M**	**F**	**TOTAL**
Doctoral or equivalent level (**ISCED level 8**)			
Master's or equivalent level (**ISCED level 7**)			
Bachelor's or equivalent level (**ISCED level 6**)			
Short-cycle tertiary education (**ISCED level 5**)			
All other qualifications, including post-secondary non-tertiary programmes **(ISCED 4)** and upper secondary programmes **(ISCED 3)**			
TOTAL OTHER SUPPORT STAFF (3)			

Carry subtotals over to Q 9

	M	**F**	**TOTAL**
TOTAL R&D PERSONNEL (1+2+3)			

8.2 Headcount of all R&D personnel according to three categories and fields of science

(1) RESEARCHERS

Field of science	**M**	**F**	**TOTAL**
Natural sciences			
Engineering and technology			
Medical and health sciences			
Agricultural sciences			
Social sciences			
Humanities			
Not specified elsewhere			
TOTAL RESEARCHERS (same as 8.1)			

(2) TECHNICIANS

Field of science	**M**	**F**	**TOTAL**
Natural sciences			
Engineering and technology			
Medical and health sciences			
Agricultural sciences			
Social sciences			
Humanities			
Not specified elsewhere			
TOTAL TECHNICIANS (same as 8.1)			

(3) OTHER SUPPORT STAFF

Field of science	**M**	**F**	**TOTAL**
Natural sciences			
Engineering and technology			
Medical and health sciences			
Agricultural sciences			
Social sciences			
Humanities			
Not specified elsewhere			
TOTAL OTHER SUPPORT STAFF (same as 8.1)			

8.3 Headcount of all R&D personnel according to three categories and age (optional)

(1) RESEARCHERS

Age	**M**	**F**	**TOTAL**
Under 25 years			
25-34 years			
35-44 years			
45-54 years			
55-64 years			
65 years and more			
Unknown			
TOTAL RESEARCHERS (same as 8.1)			

(2) TECHNICIANS

Age	**M**	**F**	**TOTAL**
Under 25 years			
25-34 years			
35-44 years			
45-54 years			
55-64 years			
65 years and more			
Unknown			
TOTAL TECHNICIANS (same as 8.1)			

(3) OTHER SUPPORT STAFF

Age	**M**	**F**	**TOTAL**
Under 25 years			
25-34 years			
35-44 years			
45-54 years			
55-64 years			
65 years and more			
Unknown			
TOTAL OTHER SUPPORT STAFF (same as 8.1)			

9. RESEARCH FULL-TIME EQUIVALENTS (FTEs) AND COST TO PRIVATE NON-PROFIT INSTITUTIONS

Provide an estimate of <u>person-years of effort on R&D (or full-time equivalents)</u>, according to the categories below.

Using the male and female headcounts of all R&D personnel reported for in Question 4, provide the research full-time equivalents (time devoted to R&D). Then, calculate the total labour costs of R&D using the average annual full cost-to-institution for full-time staff (including annual wages and salaries and all associated costs or fringe benefits, such as bonus payments, contributions to pension and medical aid funds, payroll tax, unemployment insurance fund and all other statutory payments) per category below.

CALCULATING FULL-TIME EQUIVALENT (FTE) PERSONS

FTE data measure the volume of human resources in R&D. One FTE may be thought of as one person-year. That is 1 FTE is equal to 1 person working full-time on R&D for a period of 1 year or more persons working part-time or for a shorter period corresponding to one person-year.

For the purpose of this survey, an employee can work a maximum of 1 FTE in a year.

The following is a theoretical approach to calculating FTE:

FTE: (Dedication to the employment: Full-time/Part-time) x (Portion of the year active on R&D) x (Time or portion spent on R&D)

See the following examples:

- A full-time employee spending 100% of time on R&D during a year: (1 x 1 x 1) = 1 FTE
- A full-time employee spending 30% of time on R&D during a year: (1 x 1 x 0.3) = 0.3 FTE
- A full-time R&D worker who is spending 100% of time on R&D, is employed at an R&D institution for only six months: (1 x 0.5 x 1) = 0.5 FTE
- A full-time employee spending 40% of time on R&D during half of the year (person is only active for 6 months per year): (1 x 0.5 x 0.4) = 0.2 FTE
- A part-time employee (working 40% of a full-time year) engaged only in R&D (spending 100% of time on R&D) during a year: (0.4 x 1 x 1) = 0.4 FTE
- A part-time employee (working 40% of a full-time year) spending 60% of time on R&D during half of the year (person is only active for 6 months per year): (0.4 x 0.5 x 0.6) = 0.12 FTE
- 20 full-time employees spending 40% of time on R&D during a year: 20 x (1 x 1 x 0.4) = 8 FTE

NOTE: Please calculate FTEs for all R&D personnel.

9.1 FTE by personnel category

Personnel category	Headcounts (From Q 8.1)			Full-time equivalent (FTE)		
	M	F	Tot	M	F	Tot

(1) RESEARCHERS

Doctoral or equivalent level (**ISCED level 8**)						
Master's or equivalent level (**ISCED level 7**)						
Bachelor's or equivalent level (**ISCED level 6**)						
Short-cycle tertiary education (**ISCED level 5**)						
All other qualifications, including post-secondary non-tertiary programmes **(ISCED 4)** and upper secondary programmes **(ISCED 3)**						
TOTAL RESEARCHERS (1)						

(2) TECHNICIANS

Doctoral or equivalent level (**ISCED level 8**)						
Master's or equivalent level (**ISCED level 7**)						
Bachelor's or equivalent level (**ISCED level 6**)						
Short-cycle tertiary education (**ISCED level 5**)						
All other qualifications, including post-secondary non-tertiary programmes **(ISCED 4)** and upper secondary programmes **(ISCED 3)**						
TOTAL TECHNICIANS (2)						

(3) OTHER SUPPORT STAFF

Doctoral or equivalent level (**ISCED level 8**)						
Master's or equivalent level (**ISCED level 7**)						
Bachelor's or equivalent level (**ISCED level 6**)						
Short-cycle tertiary education (**ISCED level 5**)						
All other qualifications, including post-secondary non-tertiary programmes **(ISCED 4)** and upper secondary programmes **(ISCED 3)**						
TOTAL OTHER SUPPORT STAFF (3)						

Personnel category	Headcounts (From Q 9.1)			Full-time equivalent (FTE)		
	M	F	Tot	M	F	Tot
TOTAL R&D PERSONNEL (1+2+3)						

9.2 FTE by field of science

Field of science	Headcounts (From Q 8.2)			Full-time equivalent (FTE)		
	M	F	Tot	M	F	Tot
(1) RESEARCHERS						
Natural sciences						
Engineering and technology						
Medical and health sciences						
Agricultural sciences						
Social sciences						
Humanities						
Not specified elsewhere						
TOTAL RESEARCHERS (same as 9.1)						
(2) TECHNICIANS						
Natural sciences						
Engineering and technology						
Medical and health sciences						
Agricultural sciences						
Social sciences						
Humanities						
Not specified elsewhere						
TOTAL TECHNICIANS (same as 9.1)						
(3) OTHER SUPPORT STAFF						
Natural sciences						
Engineering and technology						
Medical and health sciences						
Agricultural sciences						
Social sciences						
Humanities						
Not specified elsewhere						
TOTAL OTHER SUPPORT STAFF (same as 9.1)						

9.3 FTE by personnel category and labour cost

Personnel categories	Full Time Equivalent (FTE) (From Q 9.1) (A)	Average annual labour cost per person Local Currency '000 (Excl. VAT) (B)	Calculated labour cost of R&D Local Curr. '000 (Excl. VAT) (A x B)
Total researchers (1)			
Total technicians (2)			
Total other support staff (3)			
TOTAL LABOUR COST (1+2+3)			

Carry subtotal over to Q 10A

PART 3: IN-HOUSE R&D EXPENDITURE

THE DEFINITION AND CALCULATION OF IN-HOUSE R&D EXPENDITURE

OTHER CURRENT EXPENDITURE

Including – but not limited to:

- Direct project costs, project consumables and running costs linked to research, such as materials, fuels and other inputs, including telephone and printing.
- Subsistence and travel expenses.
- Repair and maintenance expenses.
- Payments to outside organizations for use of specialised testing facilities, analytical work, engineering or other specialised services in support of R&D projects carried out by this reporting unit.
- Commission/consultant expenses for research projects carried out by this reporting unit.
- The relevant % of indirect and institutional costs and utility costs, such as rent, space charge, leasing and hiring expenses, furniture, water, electricity and any other overhead costs.
- The relevant % of labour costs of persons providing indirect services such as the head office, human resources, finances, security and maintenance personnel as well as staff of central libraries and IT departments.

Excluding:

- Contract R&D expenses where the research project is carried out elsewhere by others on behalf of this reporting unit.
- Payments for purchases of technical know-how (goodwill).
- Licence fees.
- Depreciation provisions.

- Where current expenses, such as direct project costs and consumables, are used solely for R&D, allocate the full cost of the items.
- If these current expenses are used for more than one activity, include only an estimate of the portion used for R&D.
- Only where such an estimate of the portion used for R&D is not available, such as indirect and utility costs and labour costs of staff providing indirect services, it is advised that respondents apply the percentage time that researchers in the reporting unit spent on R&D to the total of these current expenditures.
- So if the income and expenditure statement shows that the current expenditure for indirect and utility costs and labour costs of staff providing indirect services for the year was say USD 1,700,000 and that researchers on average spent 80% of their time to R&D, then this component of R&D current expenditure may be estimated as 0.8 x USD 1,700,000 = USD 1,360,000.

CAPITAL EXPENDITURE

The full cost of capital expenses must be reported in the year of purchase (do not depreciate).

Including – but not limited to:

- Expenditure on fixed assets used in the R&D projects of this reporting unit
- Acquisition of software, including license fees, expected to be used for more than one year
- Purchase of databases expected to be used for more than one year
- Major repairs, improvements and modifications on land and buildings
- Where a capital item is used solely for R&D, allocate the full cost of the item

Excluding:

- Other repairs and maintenance expenses.
- Depreciation provisions.
- Proceeds from the sale of R&D assets.

- If the capital item is used for more than one activity, include only an estimate of the portion used for R&D. For example, a new piece of equipment that will be used for R&D (included), testing (excluded) and quality control (excluded). For instance, if the intended use of this new equipment for R&D purposes is 40% of the total usage (i.e. the other 60% for other activities), only 40% of the total equipment cost should be considered as relevant R&D expenditure.
- Only where such an estimate of the portion used for R&D is not available, apply the percentage time that researchers in the reporting unit spent on R&D to the cost of the item.

10. IN-HOUSE R&D EXPENDITURE

Compile expenditure on IN-HOUSE R&D during the fiscal year …<YYYY>... Include expenditure funded from all sources: internal and external (contracts and grants) and undertaken by the reporting unit on its own behalf or for other parties.
PLEASE NOTE: Extramural R&D should be reported under Part 5.

Purchase of equipment can, in theory, be classified as either capital or current expenditure. A distinction can therefore be made between "major" and "minor" equipment (to be included in "capital" and "current" expenditures respectively) by establishing some kind of monetary limitation. Please provide us with this limitation as used by your institution.	
Local currency:	

LABOUR COSTS OF R&D

		Local currency '000 excluding VAT
Total cost of R&D personnel (carried over from Question 9.3)	**A**	

OTHER CURRENT EXPENDITURE ON R&D
(See the definition of current expenditure and how to calculate current expenditure devoted to R&D on the previous page)

		Local currency '000 excluding VAT
Other current expenditure	**B**	

CAPITAL EXPENDITURE ON R&D
(See the definition of capital expenditure and how to calculate capital expenditure on R&D on the previous page)

		Local currency '000 excluding VAT
Vehicles, plant, machinery and equipment	**C**	
Land, buildings and other structures	**D**	
Software	**E**	

		Local currency '000 excluding VAT
TOTAL R&D EXPENDITURE (A + B + C + D + E)	**F**	

Carry total R&D expenditure (F) over to Question 11

11. SOURCES OF FUNDS FOR IN-HOUSE R&D

Provide a breakdown of the total R&D expenditure according to the sources of funds listed below (NOTE: Only the proportion of the money actually SPENT is required not the total income per source)

To adapt to national context

Organization	Local currency '000 excluding VAT
Own funds	

Government (includes departments/ministries and grant-making institutes)

Grants, especially general purpose, including studentships	
Contracts to perform directed R&D	

Businesses

Contracts to perform R&D (domestic business only)	

Other national sources

Other not-for-profit organizations (including foundations)	
Individual donations	
Higher education	

Foreign sources

All foreign funds	

	Local currency '000 excluding VAT
TOTAL R&D EXPENDITURE (to equal Question 10F)	

PART 4: CATEGORIES OF IN-HOUSE R&D EXPENDITURE

12. IN-HOUSE R&D EXPENDITURE BY TYPE OF R&D

Specify the percentage of: a) IN-HOUSE <u>TOTAL R&D expenditure</u> (both current costs and capital expenditure) by type of R&D and (optional) b) total IN-HOUSE <u>R&D CURRENT expenditure</u> (labour costs and other current cost) by type of R&D.

		Column b optional
Basic research		
• Work undertaken primarily to acquire new knowledge of the underlying foundations of phenomena and observable facts, without a specific application in view • Analyses of properties, structures and relationships with a view to formulating and testing hypotheses, theories or laws. • The results of basic research are usually published in peer-reviewed scientific journals.	a). Based on **<u>total</u> intramural expenditure** (Percentage)	b). Based on **<u>only current expenditure</u>** (Percentage)
Applied research		
• Original investigation to acquire new knowledge with a specific application in view. • Activities that determine the possible uses for the findings of basic research. • The results of applied research are intended primarily to be valid for a single or limited number of products, operations, methods or systems. • Applied research develops ideas into operational form. • Information or knowledge derived from applied research may be published in peer-reviewed journals or subjected to other forms of intellectual property protection.	a). Based on **<u>total</u> intramural expenditure** (Percentage)	b). Based on **<u>only current expenditure</u>** (Percentage)
Experimental development		
• Systematic work using existing knowledge for creating new or improved materials, products, processes or services, or improving substantially those already produced or installed.	a). Based on **<u>total</u> intramural expenditure** (Percentage)	b). Based on **<u>only current expenditure</u>** (Percentage)
TOTAL	**1 0 0**	**1 0 0**

13. DETAILED FIELDS OF SCIENCE (FOS) (OPTIONAL)

Classify R&D according to two-digit field of science (FoS) with associated percentage expenditure (see Appendix A)

- The FoS codes are based on recognised academic disciplines and emerging areas of study.

FoS codes			Percentage		FoS codes			Percentage	
FoS					FoS				
FoS					FoS				
FoS					FoS				
FoS					FoS				
FoS					FoS				
FoS					FoS				
					Total		1	0	0

14. SOCIO-ECONOMIC OBJECTIVES (SEO) (OPTIONAL)

Classify R&D according to socio-economic objective with associated percentage expenditure (see Appendix B)

- The SEO classification provides an indication of the main beneficiary of your R&D activities.

SEO codes			Percentage		SEO codes			Percentage	
SEO					SEO				
SEO					SEO				
SEO					SEO				
SEO					SEO				
SEO					SEO				
SEO					SEO				
					Total		1	0	0

15. FEDERAL STATE OR PROVINCIAL EXPENDITURE ON R&D (OPTIONAL)

Please indicate the geographic location (by federal state or province) where the department/unit carried out R&D activities and the percentage of the total R&D expenditure.

Distribution of R&D expenditure by federal state or province (create more rows if needed)
Please specify where R&D is actually performed rather than where it is managed/financed from.

Name		Name	
Name		Name	
Name		Name	
Name		Name	
Name		**Total**	**100%**

PART 5: EXTRAMURAL R&D (OPTIONAL)

Extramural R&D refers to:

- Extramural expenditures are the sums a reporting unit paid or committed to pay to another organization for the performance of R&D during a specific period.
- This includes acquisition of R&D performed by and/or grants given to other organizations for performing R&D (FM § 408).

	Approximate value Local currency '000 (excl. VAT)
16. State details of extramural R&D paid **locally**	
17. State details of extramural R&D paid **abroad**	

18. If the amounts stated in Question 17 or 18 are in excess of 1 million units of national currency please indicate the name of the organization(s) that conducted the extramural R&D with the associated expenditure.

State details of extramural R&D paid for **locally.**

Paid to:	**Approximate value Local currency '000s (excl. VAT)**

State details of extramural R&D paid **abroad.**

Paid to:	**Approximate value Local currency '000s (excl. VAT)**

THANK YOU FOR YOUR TIME AND EFFORT

6.5. Appendices to the model questionnaires

Appendix A: Two-Digit Field of Science and Technology Classification

1. Natural sciences

1.1 Mathematics

- Pure mathematics, Applied mathematics; Statistics and probability (Includes research on statistical methodologies, but excludes research on applied statistics which should be classified under the relevant field of application (*e.g.* Economics, Sociology, etc.)

1.2 Computer and information sciences

- Computer sciences, information science and bioinformatics (hardware development to 2.2, social aspect to 5.8);

1.3 Physical sciences

- Atomic, molecular and chemical physics (physics of atoms and molecules including collisions, interaction with radiation; magnetic resonances; Moessbauer effect); Condensed matter physics (including formerly solid state physics, superconductivity); Particles and fields physics; Nuclear physics; Fluids and plasma physics (including surface physics); Optics (including laser optics and quantum optics), Acoustics; Astronomy (including astrophysics, space science);

1.4 Chemical sciences

- Organic chemistry; Inorganic and nuclear chemistry; Physical chemistry, Polymer science, Electrochemistry (dry cells, batteries, fuel cells, corrosion metals, electrolysis); Colloid chemistry; Analytical chemistry;

1.5 Earth and related Environmental sciences

- Geosciences, multidisciplinary; Mineralogy; Palaeontology; Geochemistry and geophysics; Physical geography; Geology; Volcanology; Environmental sciences (social aspects to 5.7);
- Meteorology and atmospheric sciences; climatic research;
- Oceanography, Hydrology, Water resources;

1.6 Biological sciences (Medical to be 3, and Agricultural to be 4)

- Cell biology, Microbiology; Virology; Biochemistry and molecular biology; Biochemical research methods; Mycology; Biophysics;
- Genetics and heredity (medical genetics to be 3); reproductive biology (medical aspects to be 3); developmental biology;
- Plant sciences, botany;
- Zoology, Ornithology, Entomology, Behavioural sciences biology;
- Marine biology, freshwater biology, limnology; Ecology; Biodiversity conservation;
- Biology (theoretical, mathematical, thermal, cryobiology, biological rhythm), Evolutionary biology; other biological topics;

1.7 Other natural sciences

2. Engineering and technology

2.1 Civil engineering

- Civil engineering; Architecture engineering; Construction engineering, Municipal and structural engineering; Transport engineering;

2.2 Electrical engineering, Electronic engineering, Information engineering

- Electrical and electronic engineering; Robotics and automatic control; Automation and control systems; Communication engineering and systems; telecommunications; Computer hardware and architecture;

2.3 Mechanical engineering

- Mechanical engineering; Applied mechanics; Thermodynamics;
- Aerospace engineering;
- Nuclear related engineering; (nuclear physics to be 1.3);
- Audio engineering, reliability analysis;

2.4 Chemical engineering

- Chemical engineering (plants, products); Chemical process engineering;

2.5 Materials engineering

- Materials engineering; Ceramics; Coating and films; Composites (including laminates, reinforced plastics, cermets, combined natural and synthetic fibre fabrics; filled composites); Paper and wood; textiles; including synthetic dyes, colours, fibres; (nanoscale materials to 2.10; biomaterials to be 2.9);

2.6 Medical engineering

- Medical engineering; Medical laboratory technology (including laboratory samples analysis; diagnostic technologies); (Biomaterials to be 2.9 [physical characteristics of living material as related to medical implants, devices, sensors]);

2.7 Environmental engineering

- Environmental and geological engineering, geotechnics; Petroleum engineering, (fuel, oils),Energy and fuels; Remote sensing; Mining and mineral processing; Marine engineering, sea vessels; Ocean engineering;

2.8 Environmental biotechnology

- Environmental biotechnology; Bioremediation, diagnostic biotechnologies (DNA chips and biosensing devices) in environmental management; environmental biotechnology related ethics;

2.9 Industrial biotechnology

- Industrial biotechnology; Bioprocessing technologies (industrial processes relying on biological agents to drive the process) biocatalysis, fermentation; bioproducts (products that are manufactured using biological material as feedstock) biomaterials, bioplastics, biofuels, bioderived bulk and fine chemicals, bio-derived novel materials;

2.10 Nano-technology

- Nano-materials [production and properties];
- Nano-processes [applications on nano-scale]; (biomaterials to be 2.9);

2.11 Other engineering and technologies

- Food and beverages;
- Other engineering and technologies;

3. Medical and Health sciences

3.1 Basic medicine

- Anatomy and morphology (plant science to be 1.6); Human genetics; Immunology; Neurosciences (including psychophysiology); Pharmacology and pharmacy; Medicinal chemistry; Toxicology; Physiology (including cytology); Pathology;

3.2 Clinical medicine

- Andrology; Obstetrics and gynaecology; Paediatrics; Cardiac and Cardiovascular systems; Peripheral vascular disease; Hematology; Respiratory systems; Critical care medicine and Emergency medicine; Anaesthesiology; Orthopaedics; Surgery; Radiology, nuclear medicine and medical imaging; Transplantation; Dentistry, oral surgery and medicine; Dermatology and venereal diseases; Allergy; Rheumatology; Endocrinology and metabolism (including diabetes, hormones); Gastroenterology and hepatology; Urology and nephrology; Oncology; Ophthalmology; Otorhinolaryngology; Psychiatry; Clinical neurology; Geriatrics and gerontology; General and internal medicine; other clinical medicine subjects; Integrative and complementary medicine (alternative practice systems);

3.3 Health sciences

- Health care sciences and services (including hospital administration, health care financing); Health policy and services;
- Nursing; Nutrition, Dietetics;
- Public and environmental health; Tropical medicine; Parasitology; Infectious diseases; epidemiology;
- Occupational health; Sport and fitness sciences;
- Social biomedical sciences (includes family planning, sexual health, psycho-oncology, political and social effects of biomedical research); Medical ethics; Substance abuse;

3.4 Medical biotechnology

- Health-related biotechnology; Technologies involving the manipulation of cells, tissues, organs or the whole organism (assisted reproduction); Technologies involving identifying the functioning of DNA, proteins and enzymes and how they influence the onset of disease and maintenance of well-being (gene-based diagnostics and therapeutic interventions (pharmacogenomics, gene-based therapeutics); Biomaterials (as related to medical implants, devices, sensors); Medical biotechnology related ethics;

3.5 Other medical sciences

- Forensic science
- Other medical sciences

4. Agricultural sciences

4.1 Agriculture, Forestry, and Fisheries

- Agriculture; Forestry; Fishery; Soil science; Horticulture, viticulture; Agronomy, plant breeding and plant protection; (Agricultural biotechnology to be 4.4)

4.2 Animal and Dairy science

- Animal and dairy science; (Animal biotechnology to be 4.4)
- Husbandry; Pets;

4.3 Veterinary science

4.4 Agricultural biotechnology

- Agricultural biotechnology and food biotechnology; GM technology (crops and livestock),livestock cloning, marker assisted selection, diagnostics (DNA chips and biosensing devices for the early/accurate detection of diseases) biomass feedstock production technologies, biopharming; agricultural biotechnology related ethics;

4.5 Other agricultural sciences

5. Social sciences

5.1 Psychology

- Psychology (including human - machine relations);
- Psychology, special (including therapy for learning, speech, hearing, visual and other physical and mental disabilities);

5.2 Economics and Business

- Economics, Econometrics; Industrial relations;
- Business and Management;

5.3 Educational sciences

- Education, general; including training, pedagogy, didactics;
- Education, special (to gifted persons, those with learning disabilities);

5.4 Sociology

- Sociology; Demography; Anthropology, ethnology,
- Social topics (Women's and gender studies; Social issues; Family studies, Social work);

5.5 Law

- Law, criminology, penology;

5.6 Political science

- Political science; public administration; organisation theory;

5.7 Social and economic geography

- Environmental sciences (social aspects); Cultural and economic geography; Urban studies (Planning and development); Transport planning and social aspects of transport (transport engineering to 2.1);

5.8 Media and communications

- Journalism; Information science (social aspects); Library science; Media and socio-cultural communication;

5.9 Other social sciences

- Social sciences, interdisciplinary;
- Other social sciences;

6. Humanities

6.1 History and Archaeology

- History (history of science and technology to be 6.3, history of specific sciences to be under the respective headings); Archaeology;

6.2 Languages and Literature

- General language studies; Specific languages; General literature studies; Literary theory; Specific literatures; Linguistics;

6.3 Philosophy, Ethics and Religion

- Philosophy, History and philosophy of science and technology;
- Ethics (except ethics related to specific subfields); Theology; Religious studies;

6.4 Arts (arts, history of arts, performing arts, music)

- Arts, Art history; Architectural design; Performing arts studies (Musicology, Theater science, Dramaturgy); Folklore studies;
- Studies on Film, Radio and Television;

6.5 Other humanities

Source: OECD (2007)

Appendix B: One-Digit Socio-Economic Objective Classification

1. Exploration and Exploitation of the Earth.
2. Environment.
3. Exploration and Exploitation of Space.
4. Transport, telecommunication and other infrastructures.
5. Energy.
6. Industrial production and technology.
7. Health.
8. Agriculture.
9. Education.
10. Culture, recreation, religion and mass media.
11. Political and social systems, structures and processes.
12. General advancement of knowledge.
13. Defence.

Source: Eurostat (2008)

Appendix C: International Standard Industrial Classification (ISIC) of All Economic Activities

Two versions of ISIC are included in this Appendix: first ISIC Rev. 3.1 followed by ISIC Rev. 4.

ISIC rev. 3.1

A - Agriculture, hunting and forestry
- 01 - Agriculture, hunting and related service activities
- 02 - Forestry, logging and related service activities

B - Fishing
- 05 - Fishing, aquaculture and service activities incidental to fishing

C - Mining and quarrying
- 10 - Mining of coal and lignite; extraction of peat
- 11 - Extraction of crude petroleum and natural gas; service activities incidental to oil and gas extraction, excluding surveying
- 12 - Mining of uranium and thorium ores
- 13 - Mining of metal ores
- 14 - Other mining and quarrying

D - Manufacturing
- 15 - Manufacture of food products and beverages
- 16 - Manufacture of tobacco products
- 17 - Manufacture of textiles
- 18 - Manufacture of wearing apparel; dressing and dyeing of fur
- 19 - Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear
- 20 - Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials
- 21 - Manufacture of paper and paper products
- 22 - Publishing, printing and reproduction of recorded media
- 23 - Manufacture of coke, refined petroleum products and nuclear fuel
- 24 - Manufacture of chemicals and chemical products
- 25 - Manufacture of rubber and plastics products
- 26 - Manufacture of other non-metallic mineral products
- 27 - Manufacture of basic metals
- 28 - Manufacture of fabricated metal products, except machinery and equipment
- 29 - Manufacture of machinery and equipment n.e.c.
- 30 - Manufacture of office, accounting and computing machinery
- 31 - Manufacture of electrical machinery and apparatus n.e.c.
- 32 - Manufacture of radio, television and communication equipment and apparatus
- 33 - Manufacture of medical, precision and optical instruments, watches and clocks
- 34 - Manufacture of motor vehicles, trailers and semi-trailers
- 35 - Manufacture of other transport equipment
- 36 - Manufacture of furniture; manufacturing n.e.c.
- 37 - Recycling

E - Electricity, gas and water supply
- 40 - Electricity, gas, steam and hot water supply
- 41 - Collection, purification and distribution of water

F - Construction
- 45 - Construction

G - Wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods
- 50 - Sale, maintenance and repair of motor vehicles and motorcycles; retail sale of automotive fuel
- 51 - Wholesale trade and commission trade, except of motor vehicles and motorcycles
- 52 - Retail trade, except of motor vehicles and motorcycles; repair of personal and household goods

H - Hotels and restaurants
- 55 - Hotels and restaurants

I - Transport, storage and communications
- 60 - Land transport; transport via pipelines
- 61 - Water transport
- 62 - Air transport
- 63 - Supporting and auxiliary transport activities; activities of travel agencies
- 64 - Post and telecommunications

J - Financial intermediation
- 65 - Financial intermediation, except insurance and pension funding
- 66 - Insurance and pension funding, except compulsory social security
- 67 - Activities auxiliary to financial intermediation

K - Real estate, renting and business activities
- 70 - Real estate activities
- 71 - Renting of machinery and equipment without operator and of personal and household goods
- 72 - Computer and related activities
- 73 - Research and development
- 74 - Other business activities

L - Public administration and defence; compulsory social security
- 75 - Public administration and defence; compulsory social security

M - Education
- 80 - Education

N - Health and social work
- 85 - Health and social work

O - Other community, social and personal service activities
- 90 - Sewage and refuse disposal, sanitation and similar activities
- 91 - Activities of membership organizations n.e.c.
- 92 - Recreational, cultural and sporting activities
- 93 - Other service activities

P - Activities of private households as employers and undifferentiated production activities of private households
- 95 - Activities of private households as employers of domestic staff
- 96 - Undifferentiated goods-producing activities of private households for own use
- 97 - Undifferentiated service-producing activities of private households for own use

Q - Extraterritorial organizations and bodies
- 99 - Extraterritorial organizations and bodies

Source: http://unstats.un.org/unsd/cr/registry/regcst.asp?Cl=17.

ISIC Rev. 4

A - Agriculture, forestry and fishing
- 01 - Crop and animal production, hunting and related service activities
- 02 - Forestry and logging
- 03 - Fishing and aquaculture

B - Mining and quarrying
- 05 - Mining of coal and lignite
- 06 - Extraction of crude petroleum and natural gas
- 07 - Mining of metal ores
- 08 - Other mining and quarrying
- 09 - Mining support service activities

C - Manufacturing
- 10 - Manufacture of food products
- 11 - Manufacture of beverages
- 12 - Manufacture of tobacco products
- 13 - Manufacture of textiles
- 14 - Manufacture of wearing apparel
- 15 - Manufacture of leather and related products
- 16 - Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials
- 17 - Manufacture of paper and paper products
- 18 - Printing and reproduction of recorded media
- 19 - Manufacture of coke and refined petroleum products
- 20 - Manufacture of chemicals and chemical products
- 21 - Manufacture of basic pharmaceutical products and pharmaceutical preparations
- 22 - Manufacture of rubber and plastics products
- 23 - Manufacture of other non-metallic mineral products
- 24 - Manufacture of basic metals
- 25 - Manufacture of fabricated metal products, except machinery and equipment
- 26 - Manufacture of computer, electronic and optical products
- 27 - Manufacture of electrical equipment
- 28 - Manufacture of machinery and equipment n.e.c.
- 29 - Manufacture of motor vehicles, trailers and semi-trailers
- 30 - Manufacture of other transport equipment
- 31 - Manufacture of furniture
- 32 - Other manufacturing
- 33 - Repair and installation of machinery and equipment

D - Electricity, gas, steam and air conditioning supply
- 35 - Electricity, gas, steam and air conditioning supply

E - Water supply; sewerage, waste management and remediation activities
- 36 - Water collection, treatment and supply
- 37 - Sewerage
- 38 - Waste collection, treatment and disposal activities; materials recovery
- 39 - Remediation activities and other waste management services

F - Construction
- 41 - Construction of buildings
- 42 - Civil engineering
- 43 - Specialized construction activities

G - Wholesale and retail trade; repair of motor vehicles and motorcycles
- 45 - Wholesale and retail trade and repair of motor vehicles and motorcycles
- 46 - Wholesale trade, except of motor vehicles and motorcycles
- 47 - Retail trade, except of motor vehicles and motorcycles

H - Transportation and storage
- 49 - Land transport and transport via pipelines
- 50 - Water transport
- 51 - Air transport

52 - Warehousing and support activities for transportation
53 - Postal and courier activities
I - Accommodation and food service activities
55 - Accommodation
56 - Food and beverage service activities
J - Information and communication
58 - Publishing activities
59 - Motion picture, video and television programme production, sound recording and music publishing activities
60 - Programming and broadcasting activities
61 - Telecommunications
62 - Computer programming, consultancy and related activities
63 - Information service activities
K - Financial and insurance activities
64 - Financial service activities, except insurance and pension funding
65 - Insurance, reinsurance and pension funding, except compulsory social security
66 - Activities auxiliary to financial service and insurance activities
L - Real estate activities
68 - Real estate activities
M - Professional, scientific and technical activities
69 - Legal and accounting activities
70 - Activities of head offices; management consultancy activities
71 - Architectural and engineering activities; technical testing and analysis
72 - Scientific research and development
73 - Advertising and market research
74 - Other professional, scientific and technical activities
75 - Veterinary activities
N - Administrative and support service activities
77 - Rental and leasing activities
78 - Employment activities
79 - Travel agency, tour operator, reservation service and related activities
80 - Security and investigation activities
81 - Services to buildings and landscape activities
82 - Office administrative, office support and other business support activities
O - Public administration and defence; compulsory social security
84 - Public administration and defence; compulsory social security
P - Education
85 - Education
Q - Human health and social work activities
86 - Human health activities
87 - Residential care activities
88 - Social work activities without accommodation
R - Arts, entertainment and recreation
90 - Creative, arts and entertainment activities
91 - Libraries, archives, museums and other cultural activities
92 - Gambling and betting activities
93 - Sports activities and amusement and recreation activities
S - Other service activities
94 - Activities of membership organizations
95 - Repair of computers and personal and household goods
96 - Other personal service activities
T - Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use
97 - Activities of households as employers of domestic personnel
98 - Undifferentiated goods- and services-producing activities of private households for own use

U - Activities of extraterritorial organizations and bodies
99 - Activities of extraterritorial organizations and bodies

Source: http://unstats.un.org/unsd/cr/registry/regcst.asp?Cl=27.

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Research and experimental development (R&D) plays a vital role in a country's economic development. It is an important component of technology absorption and adaptation. In order to assess needs and progress at national and international levels, reliable R&D data are required across various contexts. When policymakers are equipped with the right kind of information on financial and human resources, they are better placed for planning and monitoring national R&D activities.

The latest in a series of technical papers, this guide provides information for countries in the early stages of developing a survey to collect data on R&D. While the OECD's Frascati Manual has long served as the procedural guidebook in this field, the UNESCO Institute for Statistics (UIS) addresses the challenges of developing and conducting R&D surveys in developing countries.

The guide defines common R&D terminology and presents relevant indicators and what they measure. While addressing common issues encountered in data collection, the paper also provides a project management template, in addition to model questionnaires that countries can use to begin their collection activities.

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