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Working Party of National Experts on Science and Technology Indicators

MEASURING R&D IN DEVELOPING COUNTRIES

Annex to the Frascati Manual

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FOREWORD

The preparation of an annex to the *Frascati Manual* on how to use OECD guidelines to measure R&D in developing economies was co-ordinated by the UNESCO Institute for Statistics (UIS) in partnership with the OECD Secretariat. Building on the existing *Oslo Manual* annex on innovation surveys in developing countries (www.oecd.org/sti/oslomanual), this new document provides a contribution to the work on and input to the OECD Strategy for Development.

The OECD Working Party of National Experts on Science and Technology Indicators (NESTI) discussed in 2011 and agreed in principle to an earlier version of the proposed annex. This final version incorporates the specific technical comments raised by NESTI delegates on the draft. Delegates to the Committee for Science and Technological Policy (CSTP) agreed that this document should be declassified and published as an online annex to the OECD *Frascati Manual* (*www.oecd.org/sti/frascatimanual*).

MEASURING R&D IN DEVELOPING COUNTRIES

1. Introduction and rationale

1. The *Frascati Manual* (FM) was originally written by and for the national experts in OECD member countries who collect and issue national R&D data (*Frascati Manual*, §1). Over the years, it has become the standard of conduct for R&D surveys and data collection not only in the OECD and the European Union, but also in other UN member states, for example through the S&T surveys of the UNESCO Institute for Statistics (UIS). Despite its widespread use, significant usage gaps remain, especially in Africa, Central and South Asia, and Latin America and the Caribbean. There is worldwide interest in the nature and role of R&D in developing countries and their potential implications for measurement within the guidelines set out in the *Frascati Manual*.

2. This annex addresses these particular issues by providing suggestions to practitioners in developing countries on how to apply the *Frascati Manual* given their specific circumstances in order to meet their own contextual needs while ensuring international comparability of results. It maintains the standard definition of R&D and considers a number of issues of special relevance to emerging economies and developing countries. Bearing in mind resource constraints within these countries, suggestions are also offered on how to minimise the complexity and burden of surveys while maintaining international comparability.

3. The preparation of this annex was co-ordinated by the UIS.[1] Working papers were commissioned from a number of experts[2] and these were discussed at two workshops: the first in Montreal, Canada in December 2007 and a second in Windhoek, Namibia in September 2009. The proposals in this annex have benefited from ongoing work on S&T indicators carried out by the OECD, Eurostat for the European Union, RICYT in Latin America, the AU-NEPAD S&T Secretariat in Africa and by the UIS through its worldwide capacity building activities. This annex has also benefited from discussions at the OECD Working Party of National Experts on Science and Technology Indicators (NESTI) and the advice of its members which has led to this final configuration.

2. R&D in developing countries

2.1 Main characteristics

4. From a global perspective, R&D is concentrated in the European Union, the United States and Japan. Within the developing world, R&D is also concentrated in a relatively small group of countries in each region, notably the BRICS (Brazil, Russia, India, China and South Africa). However, a shift in the global distribution of R&D is under way. This is reflected in increases in the gross domestic expenditure on R&D (GERD), the volume of internationally indexed scientific publications, and patenting activity in developing countries.

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1. An expanded version of this annex has been published as a UIS Technical Guide (UIS, 2010). Acknowledgement is due to Michael Kahn, who wrote the initial version of this annex.

2. See Arber *et al* (2008), Gaillard (2008) and Kahn *et al* (2008).

5. Across most OECD countries, the business enterprise sector accounts for the largest share of GERD. This has also become an important feature in some emerging economies, but in many developing economies, business enterprise R&D expenditure (BERD) is often much smaller than in the Government and Higher education sectors.

6. 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. Businesses that undertake occasional or informal R&D (FM §14 and 64) can still fulfil the criterion of "creative work undertaken on a systematic basis" if their R&D projects "have specific goals and a budget" (FM §435). Such type of R&D may also occur in other sectors such as in academic teaching hospitals, in addition to the (possibly rare) occurrence of R&D in the set of productive units which are not part of any formal/institutional registers from an administrative or statistical point of view (*i.e.* what is often described as the informal sector).

7. Usage of and interest in S&T statistics can extend beyond the national level of government, business and policy analysts, to include other players such as the international donor community, multinational corporations and foreign higher education institutions. The latter may also have important roles in local R&D and use these statistics as well.

2.2 National context

8. Emerging economies and developing countries are a heterogeneous group whose innovation systems and associated R&D measurement systems exhibit wide variety both internally – by region, institution, sector and even project – and internationally.

9. The starting point for a first R&D survey would entail the identification of the main R&D performers and S&T institutions (academies, associations, trade unions, journals, invisible colleges, etc.). This also requires an understanding of the working conditions facing researchers, the role of international donor and funding agencies, the prevalent sources of funds, the research outputs (publications, papers and patents), and the nature of scientific co-operation and agreements. Information on these contextual factors can contribute to the design and conduct of the survey.

3. Measurement of R&D expenditure

10. R&D activities are undergoing significant changes in many developing countries. R&D has tended to be largely funded by national governments, but new sources of funds are emerging. Foundations, non-governmental organisations (NGOs) and, in particular, foreign organisations play increasingly important roles in this capacity. The contribution of businesses (domestic and foreign) appears to be growing across a wider range of developing countries.

11. The innovation systems of emerging economies and developing countries may be fluid and in some cases depend on a relatively small number of very disparate institutions which account for a relatively large share of the total R&D activity. This may result in high volatility and inconsistency in statistics over time as the resources available to these institutions rise or fall, and their focus shifts between projects and across disciplines. Many of these new sources of funding may go directly to individuals and groups rather than institutions (Gaillard, 2008) and therefore remain unaccounted for and are seldom declared, including for statistical purposes.

12. As a general rule of thumb in modern organisations, the current expenditure associated with each labour unit is of the same order of magnitude as the cost of employment – the labour cost. This can be of help to countries needing to estimate R&D expenditure in the absence of other sources. The labour cost added to other forms of current expenditure and capital expenditure, the sum of which needs to be adjusted by the FTE/Headcount ratio, then yields the total expenditure on R&D.

13. Although the *Frascati Manual* recommends the collection of primary data through direct surveys, in developing countries, the use of secondary data from the national budget and the budgetary records of public R&D performing units has been a widely adopted practice for obtaining a rough estimate of GERD. The problems in using budget data, rather than survey data, are well documented in the main body of the *Frascati Manual* (*e.g.* §413-421, 428). In particular, care should be taken to ensure that such transfers are not 'double counted' as expenditure of both the funding body and the performing institution. In some countries, especially the former centrally planned economies, the sources of funds accounted for in the budget are incompatible with *Frascati Manual* recommendations.

4. Measurement of R&D personnel

4.1 Headcounts and full-time equivalence

14. The collection of data on full-time equivalents (FTE) for R&D personnel can provide useful information in its own right on the human resources devoted to R&D. This information should be used to support the estimation of R&D labour costs. Estimating the time spent on research and hence the calculation of the FTE for R&D personnel is fraught with difficulties, particularly in the higher education sector where it often plays an important role. While Annex 2 of the *Frascati Manual* provides guidelines on estimating FTE in the HE sector, some issues may be of particular concern for developing countries.

15. To help reduce respondent fatigue, higher education statistics could be a source of data for the R&D survey. However, care should be taken to ensure that definitions remain consistent (*e.g.* "academic staff" is not the same as "R&D personnel" or "researcher"). It is also important to note that the subject field classifications of national higher education statistics may also differ from the international Fields of Science classification.

16. In some higher education systems, academic staff contracts specify the amount of time to be dedicated to conducting research. The *Frascati Manual* recognises that such administrative data may be used as a source for estimating FTEs in the HE sector (*Frascati Manual* Annex 2 §31). In such cases, estimates should be made with caution as there may be a significant divergence between what contracts stipulate and the actual time devoted to research relative to other activities because of contract enforcement difficulties or personnel constraints. Whenever possible an assessment should be made of the sources of bias and how they may impact on the figures.

17. Accounting for the time contribution of doctoral students and their tutors to R&D presents a particular challenge (FM §305; 316-324; 332). Although Master's students may undertake original research, the FM §323 specifies that only ISCED level 6 (*i.e.* doctoral level) students should be included on the basis that this is the only group for which the estimation of research full time equivalence can be achieved with reasonable chances of success. 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 if they deem so to be appropriate for internal monitoring and policy purposes.

18. As university systems have expanded, academic staff may hold part-time contracts to teach or conduct research at more than one university (what has been described as the "taxi-professor") or occasionally even on a *pro bono* basis. Estimating the FTE of "taxi-professors" poses a problem and might only be possible through interviews and time use surveys.

19. In certain developing countries, salaried researchers may not have research budgets or unpaid researchers may undertake research, so efforts should be made to quantify their contribution (for example unpaid PhD students).

20. In some countries, the published researcher FTE figure is higher than the head count. Such a situation may arise where researchers might have multiple full-time or part-time research positions in various institutions, leading to overestimations. These cases are usually difficult to detect without detailed crosschecks or contacting the institutions concerned. Double counting may arise if a statistical agency considers the primary place of work of a researcher as an equivalent of his (or her) full-time job ('one unit') while other occupations are added. The problem could be solved by the introduction of a procedure where persons with extra jobs could be counted in one (primary) place only. To help resolve this issue, metadata must provide a note to clarify the procedure that is followed.

4.2 International mobility

21. Researchers in "foreign-owned or foreign-controlled institutions" present characteristics that might differentiate them from the ones in national institutions and "visiting" researchers are another significant phenomenon to be taken into account. Correctly determining the stock of R&D personnel may require data on length of stay in the country as well as residential status. Additional data on citizenship and country of birth will allow measuring the extent of "brain circulation".

22. In some countries, researchers spend a considerable period working abroad whilst still retaining their position at home. Such arrangements include being on a leave of absence and carry a risk of double counting the person in their home and temporary foreign domicile. It is recommended that where problems of accurately identifying researchers and the time spent on research domestically are of particular importance, they be addressed in part through interviews by peers who understand local circumstances.

5. Specific fields of R&D activity

5.1 Traditional knowledge

23. The interaction between traditional knowledge and R&D activities requires careful demarcation for the purposes of measuring R&D in developing countries. Traditional knowledge (TK) has been defined 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 existence of a valuable stock of traditional knowledge can be a powerful incentive for domestic and foreign organisations to set up R&D activities in developing countries.

24. Notwithstanding the clear importance of TK, for the purpose of measuring research and development, the approach should be consistent with the *Frascati* definition of "creative work undertaken on a systematic basis in order to increase the stock of knowledge [or] the use of this stock of knowledge to devise new applications". 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.

25. Examples of different types of activities involving traditional knowledge that should be counted as *contributing to R&D* are as follows:

- An R&D project may entail a scientific-based approach to establishing the content of TK, in disciplines such as ethno-science (ethno-botany, ethno-pedology, ethno-forestry, ethno-veterinary medicine, and ethno-ecology) or cognitive anthropology. In this case, R&D methods within established disciplines are used to study TK.

- The application of scientific methods to identify the active principle of local health remedies and/or their effectiveness for certain medical conditions. In this case, R&D methods are applied directly to TK products with the purpose of expanding the stock of scientific knowledge.
- Activities undertaken by traditional knowledge practitioners to expand the stock of traditional knowledge, through the combined use of traditional and other, scientific methods. These activities must meet the standard criteria for being countable as R&D.

26. Examples of traditional knowledge activities that would be *excluded* from R&D include the following:

- The regular/continued use of traditional knowledge by practitioners, for example in treating ailments or managing crops.
- The routine development of products based on traditional knowledge.
- The storage and communication of TK in traditional ways (by the test of novelty).

5.2 Clinical trials

27. The internationalisation and outsourcing of R&D, the decentralisation of laboratories, activities of pharmaceutical companies and their need to conduct clinical trials among a wide population of potential users, make clinical trials a major growth area worldwide of particular relevance to developing countries.

28. Clinical trials (FM §130) in phases 1, 2 and 3 may involve a significant amount of resources relative to total R&D expenditure in developing countries. The R&D expenditure associated with clinical trials will be allocated to the applicable Fields of Science. However, it may still be useful to display the efforts associated with clinical trials in phases 1, 2 and 3 as a separate entity in the reporting of the R&D surveys.

29. In order to identify clinical trials occurring in a given country at a specific moment, R&D statisticians have access to various databases such as national registers of clinical trials.[3] One of the most comprehensive registers from the United States (*http://clinicaltrials.gov/*) includes a thorough guide to clinical trials by country. The World Health Organization (WHO) has established the International Clinical Trials Registry Platform (ICTRP), which aims to facilitate the registration of information on all clinical trials and public access to that information by integrating data from registers worldwide.

30. Funding for clinical trials in developing countries mostly comes from abroad and is distributed among a number of local parties such as:

- Local subsidiaries of a multinational pharmaceutical company;
- Universities and academic teaching hospitals;
- Government research institutes;

3. For example, the Australian New Zealand Clinical Trials Registry (ANZCTR) (*www.anzctr.org.au/*), the Chinese Clinical Trial Register (ChiCTR) (*www.chictr.org/*), Clinical Trials Registry - India (CTRI) (*www.ctri.in/*), ISRCTN.org (*www.isrctn.org/*), the Netherlands National Trial Register (NTR) (*www.trialregister.nl/*), the Sri Lanka Clinical Trials Registry (SLCTR) (*www.slctr.lk/*), all provide data to ICTRP. Other examples of registries are *www.controlled-trials.com* for Europe, the Latin American Ongoing Clinical Trials Register (LATINREC) *www.latinrec.org/*, and the South African National Clinical Trials Register (*www.sanctr.gov.za/*).

- Individual medical practitioners and researchers;
- Medical clinics;
- Local and international private-non-profit (PNP) organisations.

31. Identifying R&D personnel in the extended clinical trials value chain, and specifically within the phases that can be described as R&D, may be difficult as their involvement is occasional and harbours a risk of double counting (*i.e.* as personnel in the trial and as academic staff).

32. As a rule of thumb, if the functions of the R&D personnel involved are difficult to establish, the following convention could be used as an approximation:

- Medical doctors and other professionals with at least ISCED 5A degrees who are involved in phases 1 to 3 clinical trials should be considered researchers;
- Nurses and other staff with qualifications below ISCED 5A should be categorised as technicians.

33. Where no estimate of the research headcount beyond the core team is possible, the extended research value chain may be subsumed under the heading 'other current expenditure' – this, however, leads to an underestimation of the researcher headcount. It is also important to carefully attribute the expenditure and FTE to the correct sectors (higher education, business, PNP).

5.3 Industrial activities: reverse engineering and incremental changes

34. If reverse engineering is carried out in the framework of an R&D project to develop a new (and different) product, it should be considered as R&D. When reverse engineering is not conducted in the framework of an R&D project, it should be considered as an innovation activity other than R&D (Oslo Manual, §525).

35. Minor or incremental changes are the most frequent type of innovation activity in emerging economies and developing countries (Oslo Manual, §499). Activities leading to minor, incremental changes or adaptations should in principle not be counted as R&D activities unless they are part of, or result from, a formal R&D project in the firm.

5.4 Research in the Social Sciences and Humanities

36. Although the *Frascati Manual* recommends that the Social Sciences and Humanities (SSH) be included in R&D totals, research in SSH tends to be under-reported around the world. Some countries exclude R&D in SSH from their business sector surveys so that R&D in SSH relates only to activities in the higher education sector, government sector and PNP organisations.

37. Development research, research on sustainable development and mitigation of climate change often include elements of R&D in SSH. As such, they should be considered R&D, but only as long as they are in the *development and testing* phase, and be then allocated to the appropriate Field of Science.

38. In terms of what should be excluded from R&D, the *Frascati Manual* (FM §143) emphasises the test of novelty: "projects of a routine nature, in which social scientists bring established methodologies, principles and models of the social sciences to bear on a particular problem, cannot be classified as research". FM §144 provides examples of such excluded activities.

39. Evaluation and impact assessment may constitute R&D if they are part of an R&D project or if the methodology meets the test of novelty. This may include for example field experiments on development policies that use randomised control techniques.[4]

6. Foreign and internationally-controlled entities

40. Foreign and internationally controlled research institutions operate research facilities in many countries and are staffed by local and foreign researchers. They receive funding from diverse offshore and local sources that may involve high concentrations of resources. In small national innovation systems, such facilities may dominate national R&D indicators. Thus, demarcating these R&D performing units may be advisable for data collection and reporting purposes.

6.1 Extra-territorial bodies

41. Some of these institutions may be "extra-territorial bodies". R&D performed within these organisations does not count as part of the host country's GERD even when they have facilities and operations within the country's borders.[5] This treatment of extra-territorial bodies is consistent with the System of National Accounts and is principally based on the existence of a Public International Law agreement, although some practical demarcation rules may be needed for example in the case of mixed-use of facilities owned by such organisations (*e.g.* in the case of astronomical observatories). International organisations are included in this extraterritorial category, as are vehicles, ships, aircraft and space satellites operated by foreign entities and testing grounds acquired by such entities (FM §229 and §230).

6.2 Foreign owned/controlled institutions in GERD

42. R&D performed within foreign-owned or foreign-controlled companies, universities or non-for-profit organisations not covered by Public International Law agreements and thus part of GERD should in the first instance be classified to the business, higher education or PNP sectors, respectively. When such R&D is extensive, countries might choose to separately identify foreign owned/controlled institutions within each performing sector in the *Frascati Manual* and report their joint contribution to a country's GERD (for example as a "Foreign-controlled Institutions" sub-sector).

43. In the business sector, a definition of foreign owned enterprises is provided by FM §181, whereby 'foreign' entails more than 50% ownership and voting power, either directly or indirectly through subsidiaries.

44. The globalisation of higher education services is leading many universities from industrialised countries to operate campuses abroad. The precise relationship between these foreign universities and the host system will vary from country to country. Every effort should be made to capture their R&D efforts and contribution to the local production of doctoral students. Since they operate on national territory with the agreement of the education authorities, this effort should form part of higher education expenditure on R&D (HERD) and GERD.

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4. See for example Duflo (2006).

5. Although they have no general basis in law for surveying foreign entities, host countries may nonetheless have an interest in documenting the R&D activities undertaken by extra-territorial organisations in their own territory, particularly with the aim of demarcating what is GERD and what is not, as collaboration patterns and staff mobility may blur the boundary. Similar survey instruments to those used for domestic units may be used to that effect if there are bilateral agreements that allow for that to be the case.

45. Under the above circumstances, the conditions for R&D activities and the governance of research may be subject to volatility. R&D projects may be managed in a centralised way from headquarters, with researchers moving into the countries for short-term assignments, thereby making it difficult to account for R&D personnel and expenditure. The impact of this process on the orientation and scale of national R&D requires further study in order to develop adequate methodologies for its measurement.

46. These practices are consistent with current guidance in the *Frascati Manual* but may require more detailed data collection in developing countries to ensure that the characteristics of R&D are captured and consistent policy-relevant statistical indicators are produced. Consideration might also be given to the specification of Gross National Expenditure on R&D (GNERD), in addition to GERD (FM §426-427).

7. Other sectoral classification issues

47. State-owned enterprises play a major role in R&D in many emerging economies and developing countries as well as in some industrialised countries. Their precise relationship with government or even academies and universities is complex. Their shareholding may be opaque and reporting standards vary by country, resulting in comparability problems with respect to their sectoral allocation.

48. In some countries, public enterprises dominate R&D expenditure and may even create quasi-independent R&D institutes. In other developing countries, entities with a formal "enterprise" status may act as typical governmental research institutions. FM §165 uses the "production for the market" test to decide in which sector to classify R&D performers. Application of this test suggests that the R&D expenditures within such public firms must be classified as *performed by enterprises in the R&D services industry (ISIC Rev. 3.1 Division 73).*

49. The allocation of the R&D activities of state-owned enterprises, university-owned companies and national scientific academies by sector will have a marked influence on the distribution of GERD (FM §163-168). The choice regarding the sectoral allocation of state laboratories is a matter of convention that varies by country.

50. Where there are strong linkages between PNP organisations and government, it may not be always clear which sector a particular non-profit organisation belongs to. Non-profit organisations serving business should be allocated to the business enterprise sector, while those serving households and individuals should be classified to the PNP sector. Because many of the latter are often funded by government, the demarcation with the government sector should be based on the degree of control that the latter can exert on how the non-for- profit body operates (FM §167-168).

51. An issue specific to the higher education (HE) sector is that the increasing number of private universities may not always be reflected in estimates of R&D expenditure and personnel. Depending on local priorities, it might be useful to distinguish between "public HE" and "private HE" to examine this phenomenon and other related issues in more detail (FM §227-228). These two sub-categories constitute separate lines within the HE sector and should be summed up to produce an internationally comparable total for the HE sector as a whole.

8. Strengthening R&D statistical systems

8.1 Institutionalising R&D statistics

52. Establishing a sound and sustainable R&D statistical system requires institutional stability, a predictable budget, a dependable infrastructure, dedicated staff and provision for their continuous development.[6]

53. The necessary legal framework to require survey participation and the confidentiality of data must be enacted. Where the survey takes place under the aegis of a National Statistics Office (NSO), this principle is usually in place. However, if an independent agency carries out the survey, the approval and support of the NSO is essential.

54. Codification of survey procedures, routines and the way that exceptions are resolved is pivotal to the handover of responsibility from exiting staff to newcomers. The existence of a "survey champion" would be a natural asset.

8.2 Establishing registers

55. It is important to set the scope of the survey at the outset. A register of government departments, research institutes and statutory bodies serves to identify the possible R&D performers in the government sector; while a list of accredited higher education institutions will suffice for the higher education sector. In principle, a census should be conducted to reveal the R&D performed in these two sectors.

56. The identification of large R&D performers and successfully capturing their R&D characteristics is cost-effective while identifying the numerous smaller performers follows the law of diminishing returns.

57. A good starting point is to approach the largest firms and to meet with their chief financial officer or chief technology officer. Such knowledgeable informants can generally assist in identifying other R&D performers in their industry sub-sectors. R&D surveys are inherently labour intensive. Close co-operation with government departments responsible for R&D tax incentives, import facilitation and export promotion, and price controls may assist in identifying other R&D performers. Chambers of Commerce and trade associations may also be useful sources of information. Depending on the relationship between government agencies that provide funding, higher education institutes and business organisations, it might also be possible to identify R&D performers from the databases of grant makers.

58. Other sources of information could be academic and learned societies; S&T services institutions; registers or databases of scientists and engineers; databases of scientific publications, patents and other IP documents; as well as business registers. Care should be taken when using business registers as they may not adequately cover some segments such as small enterprises and the PNP sector, hindering the construction of the framework and the estimation of missing data.

59. In some domains, a Science and Technology Management Information System (STMIS) may exist and thus provide an overview of the research system and a framework for establishing registers as sample frames for R&D surveys.

60. Identifying the R&D performers among the many PNP organisations presents similar problems as those in the business sector. Once again, size matters and a careful targeted survey should suffice.

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6. In line with the UN's Fundamental Principles of Official Statistics.

61. Although the *Frascati Manual* does not recommend to use secondary sources for compiling R&D data, these may provide valuable information that countries can exploit to identify R&D performers in the country and could provide a basis for estimations (as highlighted in FM §429). The accuracy of these estimates should be assessed for each source. Examples of secondary sources include:

- Annual reports of R&D performers;
- Ethics clearance registers;
- Applications for anthropological research;
- Registers of grants;
- Publication databases, both national and international;
- S&T Management Information Systems and other databases of researchers;
- Professional association registers (medical, legal, engineering, etc.);
- Registers of clinical trials; agricultural field trials; trials of GMOs;
- Registers of the main foreign donors involved in funding R&D;
- University accreditation databases.

8.3 Survey procedures and estimation

62. Particular attention needs to be paid to questionnaire design and frequency. The use of other countries' questionnaires may be a good starting point, but there will be a need for adaptation to local situations.

63. Depending on the resources available and complexity of the different sectors, unique questionnaires might be designed for each sector. Once the first designs are approved, the questionnaires should be piloted as the first step towards larger dissemination. In general, the expertise of the NSO can be a key resource in this process. However, it should be recognised that the R&D survey is labour intensive and may require graduate field staff to maintain accuracy. Such resources may not be readily available at the NSO.

64. While the use of combined R&D and innovation surveys (or other surveys, such as industrial or labour surveys) to obtain business enterprise R&D data can be cost effective, the relatively low occurrence of R&D in businesses needs to be taken into account when selecting the sample.

65. Thorough training of interviewers is required so that they understand, and can explain the technical definitions and concepts involved in R&D. This will increase response rates and the quality of the data received.

66. An essential aspect of survey procedure is to ensure full documentation of the life history of each survey return through detailed annotation. Documentation should include queries, their resolution, and the date of the incident, who handled the query, reasons for interpolation or extrapolation of data, and the methods of imputation. Proper document management lays the foundation for metadata provision and a smooth handover to newly appointed survey staff.

67. Appropriate procedures need to be developed for estimating missing data, particularly in the first few survey rounds when no previous information is available and data quality can still be low or difficult to assess.

68. Once a valid and reliable first survey has been conducted, it becomes feasible to use this data set to inform the imputation and extrapolation of data items in subsequent surveys.

8.4 Demonstrating value and building support

69. A first survey based on a short questionnaire offers a ‘quick win’ for the survey champion, the intended users, and the team involved. The survey instrument must carefully balance the need for comprehensive information against the cost of the survey.

70. Survey coverage and the response rate are important to data quality and survey integrity. In order to improve the support of respondents, close communication should be maintained with them through the survey cycle, and especially in the follow-up when the results are disseminated. Consideration could be given to setting up a forum that brings together data users and other stakeholders.

71. It is recognised that in some countries, universities are autonomous and might be reluctant to provide information to the government. Accordingly, the support of university leadership must be obtained as a precursor to the survey fieldwork.

72. Once regular surveys are in place, subsequent surveys may include more detailed questions to inform the science planning process. These might cover matters such as the FTE by Field of Science, data on migration, and on R&D collaboration.

73. Countries might also institute a separate module to collect data on barriers to R&D, such as lack of resources, out-of-date equipment or lack of Internet access. This would provide more information on the problems faced by researchers and while not addressing the accuracy of data on time spent on research, would allow policy-makers to address the barriers that prevent researchers from focussing on their work.

74. Ultimately, the value of creating and maintaining a survey time series lies in its use as the evidence base for formulating and monitoring science policy. One-off surveys have some value but a series is necessary to identify trends. Communicating the results of surveys to government and other stakeholders should therefore be given high priority.

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