Chapter 9

Higher education R&D

The Higher education sector, because of its policy relevance, is unique to the manual and has no counterpart in the System of National Accounts (SNA). This chapter defines the Higher education sector and in doing this, draws upon existing definitions of tertiary education programmes, and of formal education. As the objective of the definition is to capture all research and experimental development (R&D) activity in the sector, the definition includes all research institutes, centres, experimental stations and clinics that have their R&D activities under the direct control of, or administered by, tertiary education institutions. The Higher education sector differs across countries so the first task is to identify the institutions belonging to the sector and then to collect and report the R&D statistics in such a way as to support international comparison. The chapter provides guidance on identifying institutions in the sector and on measuring R&D expenditures, flows between institutions within and external to the sector and the human resources committed to R&D in the sector.

9.1. Introduction

9.1 The Higher education sector is unique to this manual and has no counterpart in the System of National Accounts (SNA) (EC et al., 2009). Institutions belonging to the Higher education sector can also be classified to any of the SNA sectors, depending on their characteristics. The reason for defining this sector is the policy relevance of information on its R&D performing institutions.

9.2 Education statistics are well established and are guided by the International Standard Classification of Education (ISCED) as well as by the manual on concepts, definitions and classifications for the UNESCO, OECD, Eurostat data collection on formal education (UOE, 2014). The UOE Manual uses the same definition of R&D as does this manual.

9.3 In education statistics, education programmes are classified according to ISCED, and tertiary education is defined as ISCED levels 5, 6, 7 and 8. In this manual, institutions that satisfy the definition of the Higher education sector are classified to that sector. These are two quite different processes, and it will become clear that, in this manual, tertiary education and higher education are not the same.

9.4 As the definition of the sector given in Section 9.2 shows, the institutions in the Higher education sector of this manual are not only those that provided formal tertiary education programmes, but there are also research institutes, centres, experimental stations and clinics that may or may not provide education programmes, but which satisfy a condition defined in Chapter 3 and explained further in the next section.

9.5 As the Higher education sector differs across countries, the first task is to identify the institutions belonging to the sector and then to collect and report the R&D statistics in such a way as to support international comparison. This is particularly important for statistics on the performance of R&D in the Higher education sector. How this is done is the subject of this chapter.

9.2. Coverage of the Higher education sector

9.6 This sector is composed of:

- all universities, colleges of technology and other institutions providing formal tertiary education programmes, whatever their source of finance or legal status
- all research institutes, centres, experimental stations and clinics that have their R&D activities under the direct control of, or administered by, tertiary education institutions.

9.7 To be more specific, the sector includes all units (institutions) whose primary activity is to provide formal tertiary education programmes, ISCED levels 5, 6, 7, or 8, regardless of their legal status (UNESCO-UIS, 2012: 83). Formal education is defined in ISCED (UNESCO-UIS 2012, paras. 36-42), and it is part of the definition of the Higher education sector to include education programmes that are recognised by the relevant national education or equivalent authorities and to exclude programmes that are not. This manual uses the term "education services" rather than "education programmes", but the two terms are considered to be equivalent. As noted in the definition, this sector's coverage is extended in this manual to take into account the performance of R&D by providers of tertiary programmes in other non-market institutions, such as certain types of research institutes and clinics where all R&D activity takes place under the direct control of the tertiary education institution(s) and can thus be considered, for practical purposes, to be part of their intramural R&D.

9.8 The above definition specifies the coverage of the sector (see also Chapter 3, Section 3.5). The decision tree in Figure 3.1 of Chapter 3 indicates the sectors used in this manual to which the institutions in the Higher education sector would be assigned if the sector did not exist. As the Business enterprise, Government and Private non-profit sectors are close to SNA sectors, Figure 3.1 is also indicative of how institutions in the Higher education sector would be assigned to the corresponding SNA sectors.

9.9 A major distinction recommended for institutions in the Higher education sector is whether they are classified as public or private. Within the latter, it is also important for SNA bridging purposes to be able to distinguish whether the higher education institution belongs to the SNA corporate, general government or NPISH (non-profit institutions serving households) sector. This is discussed further in Section 9.2 below on Public and private institutions and international comparisons.

9.10 As indicated in Chapter 3 (Section 3.4) and Chapter 8, the classification between public and private is made according to whether a government entity has ultimate control over the institution. Ultimate control, as defined in those chapters, is decided with reference to which institution has the power to determine the general policies and activities of the institution and to appoint the officers managing the institution. Since many institutions are under the operational control of a governing body, the constitution of that body will also have a bearing on the classification.

9.11 The core of the sector in all countries is made up of universities and colleges of technology. Where the treatment varies, it is with respect to other tertiary education institutions and above all to several types of institutions linked to universities and colleges. Three categories are considered below:

- tertiary education institutions
- university hospitals and clinics
- "borderline" research institutions.

Tertiary education institutions

9.12 The sector includes all establishments for which the primary activity is to provide formal tertiary education, regardless of their legal status. These may be corporations or quasi-corporations, either private or belonging to a government unit, market NPIs (non-profit institutions) or NPIs controlled and mainly financed by government or by NPISHs (non-profit institutions serving households). As noted above, the core is made up of universities and colleges of technology. Not all tertiary institutions perform R&D, and there may be some institutions at the upper secondary or post-secondary non-tertiary level (ISCED 3 or 4) that perform R&D. Depending on the governance and funding of these institutions, they may be included in the Higher education sector, but these inclusions should be made clear when the data are reported. Some countries have institutions of tertiary education with a vocational focus. Their purpose is teaching, and they do not perform R&D. They may be excluded from surveys of the sector.

University hospitals and clinics

9.13 Although not formally defined, the concept of a university hospital is normally applied to hospitals that are affiliated to a university, although many other types of linkages and arrangements are often referred to as university hospitals. By combining health, education and research activities, and being subject to different forms of governance arrangements, their classification can pose a number of conceptual and practical challenges.

9.14 Inclusion of most types of university hospitals and clinics in the Higher education sector is justified both because they are tertiary education institutions in their own right (teaching hospitals) and/or because they are research units "associated with" higher education institutions (e.g. advanced medical care in clinics at universities).

9.15 R&D in university hospitals and clinics can be funded from many sources: from the university's general "block grant", i.e. public general university funds (GUF); the hospital's own internal funds (e.g. revenue from patients for treatment or general government block grants related to health provision); direct government funds for R&D (e.g. from a medical research council); as well as private funds, such as philanthropists or business support for clinical trials.

9.16 Where all or nearly all activities in a hospital/medical institution have a teaching/training component, the entire institution should be included as part of the Higher education sector. If, on the other hand, only a few of the clinics/departments within a hospital/medical institution have a higher education component, only these teaching/training clinics/departments should be classified in the Higher education sector. All other non-teaching/ training clinics/departments should, as a general rule, be included in the appropriate sector (Business enterprise, Government or Private non-profit sector). The relevant

SNA institutional classification should also be captured whenever possible for bridging purposes. Care must be taken to avoid the double counting of R&D activities between the sectors concerned.

9.17 It can be challenging to distinguish between universities and university hospitals and clinics. However, it is recommended to split the two groups of institutions when reporting R&D expenditure and personnel. In line with the recommendation made in Chapter 3 to tag institutions by economic activity (United Nations, 2008), the tagging of health institutions within the higher education system can assist with the production of statistics for university hospitals and clinics.

Borderline research institutions

9.18 There are institutions that are at the borderlines between the Higher education and other institutional sectors. These present specific classification challenges, which may be addressed in different ways. The decision tree in Chapter 3 provides guidance. Generally, the provision of higher education is considered a decisive criterion for their classification in the Higher education sector. Funding, administration, control and location, as well as the integration in university budgets are also used to support classification. For those countries holding complete institutional registers, the use of the ISIC class (United Nations, 2008) is also of practical use.

9.19 Some examples of borderline institutions commonly encountered are given below.

Institutions involved in higher education funding

9.20 A number of institutions having an important role in funding, such as higher education councils or similar institutions, may be included in the sector when they also provide formal tertiary education services or are controlled or administered by and serve universities.

"Mission or subject-oriented" research institutes

9.21 Universities are major centres of research, and when countries have wished to expand their R&D in specific fields, universities have frequently been considered appropriate locations for new institutes and units. Many such units are principally government-financed and may be mission-oriented research units; others are financed by Private non-profit sector funds and by the Business enterprise sector. Examples can be units established to meet national priorities regarding environment, life sciences, medicine or science and engineering; often they have a time-limited horizon. When they are set up to be managed by universities or university departments, these can be considered as belonging to the Higher education sector. Whatever the choice, it is important to report on the institutions that are included in the sector.

Institutions linked to universities

9.22 A higher education institution may have "links" with other research institutes that are not directly concerned with teaching or that have other non-R&D functions, such as consulting, for example through the mobility of personnel between the higher education institution and the research institute concerned, or the sharing of facilities between institutes classified in different sectors. These institutes may be classified according to other criteria, such as control and finance or services rendered.

9.23 In some countries, borderline institutions may have a private legal status and carry out contract research for other sectors, or they may be government-financed research institutions. It is difficult to decide, in such cases, whether the links between the units are strong enough to justify including the "external" unit in the Higher education sector.

Institutes with researchers affiliated to universities

9.24 There are institutes that are generally funded and controlled by governments, such as academies of sciences or national research councils, and that also employ researchers affiliated with universities. Generally, these are classified in the Government sector, especially when they are independent of the university and not integrated in university budgets. It may happen however that they are considered part of the Higher education sector when these institutes and their researchers are involved in teaching activities.

Other cases

9.25 "Research, science or technology parks" located at or near universities and colleges host a range of entities that are goods and services producers and R&D performers. For such groupings, it is recommended not to use physical location and use of common resources as criteria for classifying these units in the Higher education sector. Units that are controlled and hosted in these parks and mainly financed by government should be included in the Government sector; those controlled and mainly financed by the Private non-profit sector should be included in the Private non-profit sector; while enterprises and other units serving enterprises should be classified in the Business enterprise sector.

9.26 Units controlled or administered by tertiary teaching units (including teaching hospitals), as defined above, that are not primarily market producers should be included in the Higher education sector. If they are primarily market producers, they should be included in the Business enterprise sector despite any links with higher education units (Chapter 3, Fig. 3.1).

9.27 In line with Chapter 3 guidance, institutions that are non-market producers and are affiliated with or have all their R&D activity controlled by higher education institutions should be considered as belonging to the Higher education sector, while spin-offs involving university personnel that are market producers are to be classified with the Business enterprise sector.

Public and private institutions and international comparisons

9.28 As recommended in Chapter 3, classifying institutions as public or private provides information of policy relevance and facilitates the comparison with SNA sectors and subsectors. This is therefore recommended in the case of Higher education institutions.

9.29 In addition to the breakdown between public and private institutions, it is useful, for the purpose of international comparisons, to know the breakdown between universities proper, university hospitals and other tertiary education institutions.

9.30 All statistical units in this sector should therefore be classified by the most appropriate profile, as presented in Table 9.1. Where there is difficulty in making the assignment, this should be reported along with its implications.

Table 9.1. **Profiles of higher education institutions**

Type of institution	Public	Private
A. Tertiary level education institutions		
A.1. Education institutions		
- Universities		
- Other tertiary level education institutions		
A.2. University research institutes or centres		
A.3. University hospitals and clinics		
B. Research organisations the R&D of which is controlled by higher education institutions		

9.31 Reporting R&D expenditure and personnel in the Higher education sector, by type of institution according to the categories in the above table, is therefore encouraged.

9.3. Identification of R&D in the Higher education sector

9.32 For survey purposes, R&D must be distinguished from a wide range of related activities with a scientific and technological basis. These other activities can be very closely linked to R&D both through flows of information and funding and in terms of operations, institutions and personnel, but as far as possible, they should be excluded when measuring R&D. In the Higher education sector there are some challenging sector-specific activities with regard to the concept of R&D. These are in particular related to education and training and specialised health care (university hospitals).

Borderline between R&D and education and training

9.33 In institutions of higher education, research and teaching are always very closely linked, as most academic staff does both, and many buildings, as well as much equipment, serve both purposes.

9.34 As a main rule, in line with guidance in Chapter 2, all education and training of personnel in the natural sciences, engineering, medicine, agriculture, the social sciences and the humanities and the arts in universities and special institutions of higher education should be excluded from R&D. However, research by students at the doctoral level carried out at universities should be counted, whenever possible, as a part of R&D personnel and expenditures. In some cases, students following a research master's programme (ISCED 7, Section 9.4.) and their associated R&D expenditures may also be counted in some appropriate form (personnel cost/other current costs; internal or external R&D personnel) under the guidance provided in Chapters 4 and 5.

9.35 Because the results of research feed into teaching, and because information and experience gained in teaching can often result in an input to research, it is difficult to define where the education and training activities of higher education staff and their students end and where R&D activities begin, and vice versa. Fulfilment of the five criteria in the R&D definition distinguishes R&D from routine teaching and other work-related activities. Deciding whether or not to consider as R&D those scientific activities that are the by-products of educational or training activities presents a problem.

9.36 The following cases are considered:

- doctoral students at ISCED level 8, master's students at ISCED level 7 and their activities
- supervision of students by university staff
- personal education of academic staff (own reading).

Doctoral students at ISCED level 8 and master's students at ISCED level 7

9.37 It is particularly difficult to establish the boundaries between education and training activities and R&D for doctoral students. Both the activities of doctoral students and of their teachers and supervisors need to be taken into consideration.

9.38 Parts of the curricula for studies at ISCED level 8 are highly structured, involving, for instance, study schemes, set courses and compulsory laboratory work. Here, the teacher transmits knowledge and provides training in research methods. Students who fall under this heading typically attend compulsory courses, study the literature on the subject and learn research methodology. These activities do not fulfil the criterion of novelty specified in the definition of R&D.

9.39 In addition, in order to obtain a final qualification at ISCED level 8 (ISCED level 7 for research masters students), students are also expected to prove their competence by undertaking relatively independent study, usually containing the elements of novelty required for R&D projects and presenting their results. These activities should, therefore, be classified as R&D, as should any supervision by the teacher. In addition to R&D performed within the framework

of postgraduate education courses, it is possible for both teachers and students to be engaged in other R&D projects.

9.40 Furthermore, students at this level are often attached to, or directly employed by, the establishment in which they study and have contracts or similar engagements that oblige them to teach at lower levels or to perform other activities, such as specialised medical care, while allowing them to continue their studies and to do research.

9.41 Some borderlines between R&D and education at ISCED level 8 and level 7 are illustrated in Table 9.2. The more practical problems of applying these concepts are dealt with in Chapter 5 (R&D Personnel), in particular, Section 5.2 on the treatment of doctoral and master's level students.

Table 9.2. **Classification of activities of teachers and doctoral students at ISCED level 8 and master's students at ISCED level 7**

	Education and Training at levels 7-8	R&D	Other activities
Non-student teaching personnel	Teaching students at levels 7-8	Supervision of R&D projects required for student qualification at levels 7-8	Teaching at levels lower than level 7
	Training students at levels 7-8 in R&D methodology, laboratory work, etc.	Supervision of other R&D projects and performance of own R&D projects	Other activities
Doctoral students and masters students at ISCED level 7	Following course work for formal qualification	Performing and writing up independent studies (R&D projects) required for attaining formal qualification	Teaching at lower levels
		Any other R&D activities	Other activities

Supervision of students by university staff

9.42 Closely allied to the problem of identifying the R&D element of doctoral students' work is that of extracting the R&D component of the time spent by academic supervisors on supervising these students and their research projects. The same applies to the shorter term master's students at ISCED level 7.

9.43 Such supervision activities should be included in R&D only if they are equivalent to the direction and management of a specific R&D project containing a sufficient element of novelty and having as its objective the production of new knowledge. In such cases, both the academic staff member's supervision and the student's work should be included as R&D. If the supervision deals merely with the teaching of R&D methods and the reading and correction of theses and dissertations or the work of undergraduate students, it should be excluded from R&D.

Personal education of academic staff (own reading)

9.44 This activity covers time spent on activities such as continued professional learning ("own reading"), research-related training (for example on equipment), and attendance at conferences and seminars.

9.45 In distinguishing R&D from related activities, the question of whether "own reading" should be included as part of R&D activities is often raised. It is certainly part of the general professional development of research staff and, in the long term, the knowledge and experience gained are incorporated into the researcher's thinking about, if not into the actual implementation of, R&D. Own reading, in fact, constitutes a cumulative process, and when the information gained from this activity is translated into research activity, it should be measured as R&D.

9.46 However, only personal education (including "own reading") carried out specifically for a research project should be considered as an R&D activity. In general, attendance at conferences cannot be considered R&D, but the presenting of the researcher's own research may be counted as R&D.

Specialised health care

9.47 In university hospitals where the training of medical students is an important activity in addition to the primary activity of health care, the activities of teaching, R&D and medical care (both advanced and routine) are frequently closely linked. "Specialised health care" is an activity that is normally to be excluded from R&D. However, there may be an element of R&D in specialised health care, when carried out, for example, in university hospitals. It is difficult for university doctors and their assistants to evaluate the part of their overall activities that is exclusively R&D. If, however, time and money spent on routine medical care are included in the R&D statistics, R&D resources in the medical sciences will be overestimated. Usually, such specialised health care is not considered R&D, and all medical care not directly linked to a specific R&D project should be excluded from the R&D statistics.

9.48 However, a particular project may be R&D if undertaken for one reason, but not if carried out for another, as shown in the following example: In the field of medicine, a routine autopsy on the causes of death is the practice of medical care and is not R&D; a special investigation of a particular mortality to establish the side effects of certain cancer treatments is R&D. Similarly, routine tests such as blood and bacteriological tests carried out for doctors are not R&D, whereas a special programme of blood tests in connection with the introduction of a new drug is R&D.

9.49 University hospitals may also be involved in clinical trials. Further guidelines on identifying R&D in clinical trials are given in Chapter 2.

R&D in the social sciences, humanities and the arts

9.50 A large share of R&D in the social sciences and humanities is being conducted in the Higher education sector. Guidelines on the boundaries and exclusions related to R&D in the social sciences and the humanities are given in Chapter 2.

9.51 Much of the research on, for and in the arts is also conducted in the Higher education sector. Chapter 2 provides guidelines on what should be considered as R&D in the field of the arts.

9.4. Measuring expenditures and personnel in the higher education sector

9.52 This section is aimed at giving guidelines on the main variables and breakdowns to be collected, with special emphasis on the specificities encountered in the Higher education sector. Section 9.5 will complete the overall picture by describing the methods commonly used (e.g. direct surveys, administrative data and R&D coefficients) for collecting and estimating these variables and breakdowns.

9.53 The main aggregate statistic used to describe R&D performance within the Higher education sector is HERD, Higher education Expenditure on R&D. HERD represents the component of Gross domestic expenditure on R&D (GERD) (see Chapter 4) incurred by units belonging to the Higher education sector. It is the measure of intramural R&D expenditures in the Higher education sector during a specific reference period.

Higher education expenditure on intramural R&D (HERD) by type of costs

9.54 In line with Chapter 4 of this manual, HERD should be broken down by current and capital expenditures, which in turn consist of labour and other current costs, on the one hand, and on the other hand, expenditures on fixed assets used for R&D, such as machinery/equipment and land/buildings.

9.55 If no data are directly available for each of these R&D components for a certain unit, an estimate must be made on the basis of the information on total expenditure.

9.56 Labour costs (i.e. salaries and all associated costs) represent a significant portion of the total R&D expenditure in the Higher education sector. In principle, R&D labour costs should be linked to the time spent on R&D, the full-time equivalent (FTE) measure. Information on total labour costs is usually available or calculated on the basis of one or several of the following data sources:

- point on the salary scale for each researcher, technician or other member of the staff, and the scale itself
- labour costs by category of personnel
- labour costs by category of personnel, field of R&D, and possibly department.

9.57 Labour costs include the actual or imputed contributions to pension funds and other social security payments for R&D personnel. They need not be visible in the statistical unit's bookkeeping accounts. Even when no transactions are involved, an attempt should be made to estimate these costs. To avoid double counting, labour costs do not include pension payments to former R&D employees.

9.58 Information on **other current costs** is usually available by department or equivalent and often concerns resources at the disposal of these units for the purchase of items such as documents, minor equipment, subscriptions to scientific journals, travelling costs, etc. The reporting units are usually asked to

estimate the R&D share of these costs on the basis of "intended use". The part that is not available by department (overhead costs such as water, electricity, rent, maintenance, general administration, etc.) has to be distributed among the institutional units concerned. If "intended use" is not feasible as a criterion, the same distribution coefficients as for labour costs may be used. (See Section 9.5 below for a discussion on "R&D coefficients".) The shares of R&D may also be determined on the basis of conventions or the value judgement of the reporting units.

9.59 The imputation of **real estate and facility management** costs of higher education institutions differs across countries. This is due to the fact that educational or research buildings and lands can be either owned, used free of charge or rented by the institutions. Likewise, energy costs can be imputed following different methods. As a result, international comparisons of current and capital expenditures will be affected by the country-specific treatment of these costs. For reasons of international comparability and to obtain realistic costs, it may be desirable to include a notional amount that represents an actual payment. This might serve as an estimated "market value", to be included in other current costs.

9.60 Information on **total capital expenditure on machinery and equipment** is usually available at the level of the institution. In many surveys, the shares accounted for by R&D activities are estimated by the institutes according to the "intended use" of the equipment. R&D coefficients (see Section 9.5) are of less use for estimating the shares of R&D in machinery and equipment than for estimating various types of current expenditure. The share of R&D in investments in machinery and equipment may also be based on conventions or on value judgements, as for certain types of other current costs discussed above.

9.61 Information on **total capital expenditure on land and buildings** is usually available only at the level of the institute or the university. R&D coefficients are seldom used to estimate the shares of R&D in these investments. Here again, the R&D data are often estimated on the basis of the intended use of the facilities.

HERD by source of funds

General

9.62 As noted in Chapter 4, funds for R&D performed in the Higher education sector come from different sources.

- The main source in many countries is traditionally a proportion of the publicly funded block grant known as public general university funds (GUF) that public higher education institutions receive to support all activities. The different activities of the staff in higher education institutions – teaching, R&D, administration, health care, etc. – are in general not specifically identified for separate payment from these grants, which, in a general way, cover the payment of a wide range of work-related activities.

- In addition, R&D funds are received in the form of grants or contracts from other sources such as ministries, departments and other public institutions, including research councils, as well as from private non-profit institutions, industry and the Rest of the world.
- Some universities may also have internal funds (such as income from endowments, income from student fees, etc.) that they ultimately dedicate to pay for R&D performance.

9.63 In this manual, GUF is defined as the R&D funding share coming from the general grant that universities receive from the central government (federal) ministry of education or the corresponding regional (state) or local (municipal) authorities in support of their overall research/teaching activities.

9.64 Time-use studies and other methods used to identify the R&D share of universities' total activities usually concern only GUF. External funds are often for R&D but may be used for other purposes as well. For each project funded by external sources, therefore, the survey respondent often has to evaluate whether or not it funds research, if the information is not available from central administration registers.

9.65 Some external funds (especially funds from foundations and research councils) are not always fully included in the central accounting records of the universities. Some research contracts may in fact go directly to a university institute or to individual professors. To obtain as broad coverage as possible, in some cases data on institutes' external funds have to be taken from funders' accounts (although this manual recommends the principle of performer-based reporting as the preferred approach) or should, at least, be double-checked against those accounts. Funder-based data usually give only expenditures, and the problem of acquiring the corresponding R&D personnel data is therefore a difficult one.

9.66 Accounting procedures will therefore largely determine how well the sources of R&D funds can be separately defined and identified. Producers of R&D statistics are dependent on the detail available in such accounts. A further complication in identifying the sources of R&D funds is the fact that outside organisations do not always pay the "full market cost", however defined, of the R&D carried out for them in institutions of higher education.

9.67 All countries commonly encounter problems in the accurate coverage of R&D funding sources, but the main area of lack of international comparability concerns distinguishing between GUF and other sources of public R&D income.

Separation of general university funds from other funding sources

9.68 Some of the problems of identifying what part of these grants is attributable to R&D have already been discussed above. This identification process is an intrinsic part of the methodology employed in each country. Inconsistencies arise because different countries classify the R&D component of GUF differently.

9.69 A separate category, GUF, has been defined for the Higher education sector so as to take account of the special funding mechanisms for R&D, as compared to other sectors. Most countries are of the view that, as R&D forms an intrinsic part of the activities of higher education institutions, any funds allocated to a tertiary education institution have an inbuilt and automatic R&D component. On this interpretation, such funds are classified as GUF.

9.70 In adding up national totals, these data are usually included in subtotals of government funding on the grounds that government is the original source and foresees that a significant portion of the general funds provided will be devoted to R&D.

9.71 However, it is the prerogative of universities to decide how much money to dedicate to R&D out of their general resource pool, which contains both public general university funds and own sources. On this basis, some countries argue that the sums concerned could be first credited to higher education as a source of funds. Some countries use this convention when reporting data at the national level.

9.72 By convention, the R&D content of these public general university funds should be credited to government as a source of funds, and this is the approach recommended for international comparisons. In any case, GUF should be separately reported, as indicated in Chapter 4. Social security, pension provisions and other relevant costs (real or imputed) should be taken into account and be credited to GUF. For clarity, government-financed GERD is divided into two sub-categories: direct government funds and GUF. For the calculation of GUF, see Section 9.5 below.

Other internal funds

9.73 Income from endowments, shareholdings and property, plus surplus from the sale of non-R&D services such as fees and tuition from individual students, subscriptions to journals and the sale of serum or agricultural produce, should be considered as internal funds. Although national accounting practices will dictate how easily all this can be identified, such R&D income ("retained receipts") can, notably in the case of private universities, be a considerable source of income and should be classified as internal funds.

External funds

9.74 In addition to GUF, units in the Government, Business enterprise and Private non-profit sectors provide money for higher education R&D in the form of earmarked research contracts or research grants. Such funding may also be received from the Rest of the world. These sources of research funds are more readily identified and do not, in general, pose major problems for the producers of statistics, who can readily classify them as direct sources of funds.

Recommendations

9.75 To enhance the international comparability of higher education R&D statistics, it is preferable to disaggregate the sources of funds as much as possible; this largely depends on the availability of information from central accounting records in institutions of higher education.

9.76 A problem for international comparability occurs when data for GUF are not separately reported and are classified by different countries either with the Higher education sector's internal funds or with the Government sector.

9.77 Whenever such type of funding exists, GUF should be reported separately within the category of funds from the Government sector, and not as funds from Higher education.

Expenditures on extramural R&D

9.78 The increasing complexity of how R&D activities are organised is challenging for the Higher education sector as well as for the other sectors. In large cooperative R&D-projects, universities may receive a grant from government or other organisations and pass through part of the grant to other partners in the project. Therefore it is also desirable to collect the amount of R&D funds passed through (via subcontracts and sub-grants) to extramural R&D performers in the Higher education sector so as to avoid double counting (see Chapter 4, Section 4.3). As noted in Chapter 4, flows of funds provided to other departments in the same Higher education institutions should not be considered extramural R&D, as the different departments are part of the same statistical unit.

R&D linkages with the Rest of the world

9.79 The Higher education sector participates in R&D globalisation activities as defined in Chapter 11 on R&D Globalisation. This section provides details on four international aspects of the Higher education sector: R&D funding to/from the Rest of the world; foreign-owned branch campuses; branch campuses abroad; and foreign students. R&D statistics related to these activities may be useful to understand: the globalisation of scientific research in certain fields of R&D; for analysis or policy making in or about emerging markets (especially regarding foreign-owned campuses); and for educational policy or research purposes.

9.80 Higher education institutions should provide information on all types of R&D funding to or from organisations located outside the compiling country.

9.81 The scope covers all of a reporting country's domestic educational activity (i.e. within its own territory), regardless of the ownership or sponsorship of the institutions concerned and the education delivery mechanism. Higher education institutions have established branches or campuses outside their borders. To the extent that foreign-owned branch campuses inside the compiling country and branch campuses abroad (i.e. in the Rest of the world)

owned by domestic education institutions perform R&D, HERD surveys may include supplementary information about these campuses (see Section 9.3 of this chapter for information on the boundaries between R&D and education/teaching).

9.82 For the purpose of this manual, a foreign-owned branch campus (FBC) is defined as a tertiary education institution that is inside the compiling country; that is owned, at least in part, by an entity located (or resident) outside the compiling country (termed a "foreign education provider"); that operates in the name of the foreign education provider; that engages in at least some face-to-face teaching; and that provides access to an entire academic programme leading to a credential awarded by the foreign education provider. As part of the identifying information (for possible R&D tabulations, as feasible), HERD surveys may inquire whether or not a respondent that falls within the scope of the survey is a foreign-owned branch campus.

9.83 For the purpose of this manual, a branch campus abroad (BCA) is defined as a tertiary education institution that is owned, at least in part, by a local higher education institution (i.e. resident inside the compiling country) but is located in the Rest of the world (resident outside the compiling country); that operates in the name of the local higher education institution; that engages in at least some face-to-face teaching; and that provides access to an entire academic programme leading to a credential awarded by the local higher education institution. HERD surveys may ask information about a) the country location of foreign branch campuses (called host countries); b) whether or not these foreign branch campuses performed R&D in their host countries (binary or yes/no question); and c) the amount of R&D performance in the currency of the compiling country. If an institution has several such campuses in a given country, R&D information may be consolidated at the host country level for reporting purposes, if such consolidation facilitates responses. The details by field of R&D may be at higher levels of aggregation for these campuses.

9.84 R&D performed by FBCs is part of the domestic HERD performance totals of the compiling country. However, R&D performed in BCAs cannot be included in the domestic HERD performance totals of the compiling country, and instead could be separately identified and tabulated as R&D performed in the Rest of the world by tertiary education institutions outside the compiling country's education institutions.

9.85 Apart from the desirable separate identification of these campuses using the definitions above, R&D expenditures and human resources statistics for these units should be collected following the guidance elsewhere in this chapter.

9.86 Since BCAs are outside the compiling country, collecting or editing information may be particularly difficult. Getting information on the latter is thus considered a secondary priority, but encouraged. For example, information on outward global activities by the Higher education sector, such as R&D-performing foreign campuses, may be of special interest for respondent institutions.

9.87 Another aspect of the globalisation of tertiary education institutions is the extent of foreign student enrolment. **Foreign students** (sometimes called international students) are defined as non-citizens of the country in which they study (see Section 4.6.1 of Volume 1, UOE Manual). Research carried out at universities by **all** students at both the doctoral level and the ISCED 7 master's level should be counted in R&D expenditures, regardless of the students' citizenship status or sponsors' nationality.

Categories of R&D personnel

9.88 The R&D personnel categories to be reported for the Higher education sector do not differ from those of the other R&D performing sectors and are defined in Chapter 5 of this manual. In particular, the reference classification for reporting R&D personnel by educational level is the *International Standard Classification of Education (ISCED 2011)*.

9.89 The notion of "R&D personnel" and even sometimes of "researcher" may however not be commonly used and understood in tertiary level institutions and may need to be approximated with academic titles. It may also be useful to report data on researchers by academic grade for shedding light on seniority in research / academic careers.

9.90 Where possible, it is proposed to use the following classification of seniority grades for reporting data on researchers in the Higher education sector (EC, 2013) where academic titles apply. The categories include typical positions for each group:

- Category A: The single highest grade/post at which research is normally conducted.
  - Example: "Full professor".
- Category B: Researchers working in positions not as senior as top position (A) but more senior than newly qualified doctoral graduates (ISCED level 8).
  - Examples: "Associate professor" or "senior researcher".
- Category C: The first grade/post into which a newly qualified doctoral graduate would normally be recruited.
  - Examples: "Assistant professor" or "post-doctoral fellow".
- Category D: Either doctoral students at the ISCED level 8 who are engaged as researchers, or researchers working in posts that do not normally require a doctorate degree.
  - Examples: "PhD students" or "junior researchers" (without a PhD).

9.91 Master's students may be counted as researchers (see Chapter 5) if they are following a research master's programme at ISCED-2011 level 7, i.e. in "programmes leading to the award of research qualifications that are designed explicitly to train participants in conducting original research but are below the level of a doctoral degree". The definition states that "these programmes will

often meet many of the same criteria as an ISCED level 8 programme, although they tend to be of shorter duration (cumulative duration of five to six years from the start of tertiary education), typically lack the level of independence required of students seeking an advanced research qualification, and prepare for entry into ISCED level 8 programmes". Those master's students counted as researchers will normally fall under category D above.

9.92 However, it is important that only master's students receiving payment, directly or indirectly, for their R&D activity are included in R&D personnel (see Chapter 5, Section 5.2).

9.5. Methods for compiling R&D expenditure and personnel in the Higher education sector

9.93 This section gives general information on the methods used for calculating and estimating R&D expenditures and R&D personnel in the Higher education sector. Different approaches are illustrated in the framework for compiling HERD statistics (Figure 9.1). There is a special focus on methods to estimate R&D, in particular GUF, which may constitute an essential funding component in the Higher education sector. Normally these funds include an important part of the R&D funding, but the R&D share of GUF is often unknown to the universities themselves.

General methodology

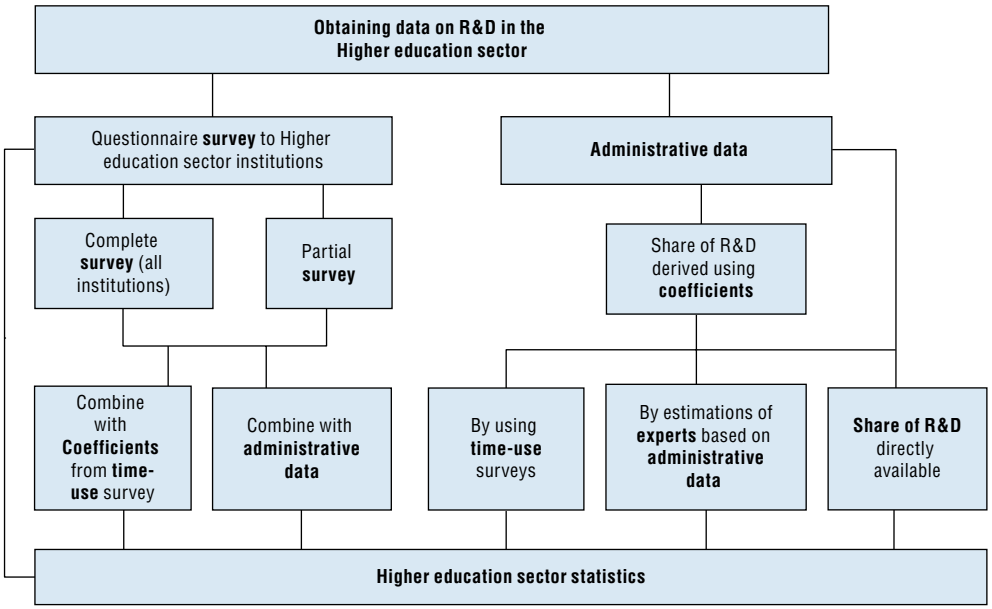
9.94 The Higher education sector is a very heterogeneous sector, and countries' higher education systems and institutions are organised in many different ways. This is challenging for the compilation of R&D statistics, and there are large variations between countries with regard to statistical methodology. In practice this means that different methods may be used for compiling good quality R&D statistics.

9.95 The framework for compiling HERD statistics provides options for statisticians to consider when choosing the method most suitable for their institution for producing R&D statistics for the Higher education sector, in accordance with the available resources in the statistical organisation (use of a survey or not), the quality and availability of administrative data for the higher education institutions and the availability of data at the preferred type of statistical unit, institute or department. Time-use surveys are important elements of the Higher education sector R&D statistics in many countries, and may be combined with an institutional R&D survey (full or partial) or with administrative data alone, or with a combination of survey and administrative data.

9.96 The different methods for obtaining data are illustrated in the framework in Figure 9.1. An important prerequisite for using administrative data is their quality in terms of data availability, reliability and timeliness (see below).

Methodologies range from institutional surveys (full or partial) to administrative data and the different combinations of these data sources, often combined with R&D coefficients from time-use surveys.

Figure 9.1 **Framework for compiling statistics for the Higher education sector**



The statistical unit

9.97 While institutional units are more or less clearly defined in the Higher education sector (see Section 9.3 and Chapter 3, Section 3.2.), it is more challenging to define *statistical units*, i.e. the entities *for which* information is sought. There is no unique rule that can be given here, as educational systems differ widely across countries.

9.98 Whenever possible, statistical units in the Higher education sector are classified into six major fields of research and development (FORD), as follows:

- natural sciences
- engineering and technology
- medical and health sciences
- agricultural and veterinary sciences
- social sciences
- humanities and arts.

9.99 The major R&D fields, together with sub-fields, are presented in Chapter 2.

9.100 While the major fields are clearly defined, the level of disaggregation within each component is left to each country's discretion. In the Higher education sector, where detailed administrative information is available, a detailed FORD classification can be used as an institutional classification.

9.101 Since higher education institutions are often involved in more than one of the six major fields of R&D, this type of information may be available at more disaggregated levels of reporting units such as departments, research institutes, "centres", faculties, hospitals or colleges.

9.102 In some countries ministries for education can provide the information on higher education institutions. This can also be done by regional authorities. Surveys often ask the institutions themselves. In many cases it will be necessary to break down to the level of university departments. It is crucial to find the right reporting units for extracting the R&D data from overall figures.

Survey data

9.103 Regular, systematic and harmonised special surveys are the preferred mechanism for collecting data on R&D. However, when satisfactory administrative records are available and the statistical surveys are considered too burdensome, it may be appropriate to use other approaches. This applies in particular to the Higher education sector.

9.104 Information on R&D in the Higher education sector may be obtained from two different main sources: surveys (the survey-based method) and administrative data. Often a combination of the two methods is used. There are many advantages to the survey-based method, for example for identifying the content of R&D and for allocating the R&D activity to the field of R&D, the type of R&D, etc.

9.105 To enhance and ensure international comparability, this section gives some methodological guidelines for conducting R&D surveys. As R&D survey methodologies and procedures are well established in many countries, the guidelines are quite general so as to be as widely applicable as possible. These methodologies supplement those discussed in Chapter 6.

Scope of R&D surveys

9.106 In theory, R&D surveys should identify and measure the total financial and personnel resources devoted to all R&D activities within all R&D performing units in the Higher education sector. R&D surveys are mainly addressed to R&D performing units, which may also fund R&D performed in other units.

Identifying the target population and survey respondents

9.107 R&D data compilers may not always be able to undertake an exhaustive and reliable survey of all possible R&D performers within this sector. Generally, there are many constraints on the extent of surveys. For example, the number of respondents may have to be restricted to keep costs down; an R&D survey may have to be taken in conjunction with another survey with acceptable, but not ideal, respondents; and surveys of some groups may require the participation of other agencies with different data needs and hence different questions for respondents. It is therefore not possible to make detailed recommendations on survey methods that would be equally relevant to all countries, as the size and structure of national R&D capacities vary widely.

9.108 The surveys and estimation procedures in the Higher education sector 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 (see Section 9.2). If possible, it is often preferable to rely on subunits, such as departments or institutes of the university, as reporting units.

University hospitals and clinics

9.109 Hospitals/healthcare institutions are a special category. Some countries may find it satisfactory to include hospitals and healthcare institutions in regular R&D surveys, using the standard questionnaire for the sector concerned. Additional guidance on the boundaries between research and healthcare activities and on the treatment of clinical trials may be supplied within the questionnaires, consistent with the definitions and criteria provided in Chapter 2.

9.110 Where university hospitals are administratively and financially integrated very closely with teaching establishments, they may be treated together for the purposes of R&D surveys/data compilation. If they are separate units with separate accounts and administrations, they may receive a specific questionnaire if more appropriate, or a standard R&D questionnaire. For university hospitals (or parts thereof) that are not integrated with teaching establishments, a specific survey may be useful. If this is not possible, the standard R&D questionnaire may be used.

9.111 Whatever survey approach is used, care should be taken to ensure the coherent treatment of R&D in units/projects under joint management by two or more entities, by persons receiving two salaries from different entities, and by persons working at hospitals but employed by other institutions.

9.112 The survey questionnaire must include a minimum number of basic questions on the R&D activity in order to produce harmonised and comparable statistics for transmission to international organisations. Owing to

the response burden, the questionnaire should be logically structured and as simple and short as possible, with clear definitions and instructions. Generally, the longer the questionnaire is, the lower the response rates. Most countries use electronic questionnaires, available online (see Chapter 6 for more details on survey methodology).

Administrative data

9.113 Administrative data are a common source for R&D statistics in the Higher education sector (see the previous framework discussion and Figure 9.1). Examples of administrative data are accounting data from higher education institutions, registers of employed personnel, data from R&D funding organisations, etc.

9.114 Although the majority of countries base their R&D statistics on a survey – full or partial – some countries base their R&D statistics for the Higher education sector solely on administrative data. Many countries also use a mix of the two methods. In general, the use of registers and administrative data for statistical purposes will be less resource-intensive than a survey and will ease the burden on respondents. Increasing the availability and quality of administrative data with a view to extending their use and streamlining the production of R&D statistics should therefore be considered an important goal.

9.115 However, the clear advantages of surveys should not be underestimated, particularly in terms of identifying the R&D content in different activities, the distribution of R&D by fields of R&D or the type of R&D, etc. A combination of survey and administrative data is commonly used as the approach for collecting R&D statistics in the Higher education sector, in combination with time-use surveys or other procedures for the estimation of the R&D component.

9.116 There are a number of ways in which administrative data may be used in the compilation of R&D statistics in the Higher education sector. If the concepts, definitions and coverage used by administrative data sources are sufficiently close to those contained in this manual, then the administrative data sources can be used as a primary source of information. More often, administrative data may be used in combination with R&D coefficients derived from time-use surveys (see Section 9.5.5.) in order to estimate the R&D content. Administrative data may also be used for the imputation of missing or inconsistent survey data and for control after data editing (see Chapter 6).

9.117 In many cases, data are derived from multiple administrative sources. The role of central administrations varies from country to country and from level to level – nationally at the ministry of education, regionally, locally or within the higher education institute itself. Regardless of the administrative level, such sources usually have a vast quantity of information as a result of activities carried out at that level. The administrative information held by central administrations in their files varies according to the function of

the particular administration. Ministries of education may have very broad overall information, while the finance officers of higher education institutions may have income and expenditure information associated with individual researchers and other staff. However, it may not be completely certain whether this information conforms to the definitions in this manual, which limits the possibilities for using it directly (although it could still be useful for deriving estimation coefficients – see below).

9.118 To identify the R&D in individual disciplines/fields of R&D may require information at the level of the researcher or institute/department at large institutions that carry out research in many disciplines. Information at the level of the institution is sufficient if its R&D is confined to a single field of R&D.

Estimation procedures

9.119 Surveys and the use of administrative data (if they are compiled using the same definitions and guidance recommended in this manual) are the preferred means for collecting information on the Higher education sector. However, they are not always suited to the resources, the legal framework or the needs of individual countries. If for some reason it is not possible to conduct a full survey or to use administrative data to calculate expenditure and personnel for the Higher education sector, estimation procedures are an alternative choice, in combination with survey data and/or administrative data.

R&D coefficients

Purpose of coefficients

9.120 R&D coefficients are a tool for calculating / estimating the shares of personnel and expenditure totals attributable to R&D performance. They are used especially for distributing total resources among research, teaching and other activities (including administration). They can be used to estimate total HERD or parts of it, such as GUF, or for estimating only R&D personnel totals.

Concepts

9.121 Coefficients may be derived in different ways as an alternative to more costly large-scale surveys, or as a supplement to surveys. The methods depend on the specific situations in countries; therefore there is no single best way for developing coefficients. Alternative methods are described below:

- use of administrative (register) data directly: relevant in a few countries, but not practical in most countries
- estimations of experts based on administrative data
- calculations on the basis of time-use surveys (see below for guidelines).

9.122 Reporting metadata on calculation methods used for coefficients should be considered for the purpose of quality control.

Methods

- R&D coefficients are used directly at an appropriate level (individual, institute, department, university) to estimate the share of R&D in total labour costs; if necessary, adjustments should be made to include the costs of various associated social security or retirement schemes.
- R&D coefficients can be expected to vary according to the teaching or research discipline, the occupational category of the personnel directly involved in R&D, and the type of institution in which the activity is performed. At the greatest level of detail, coefficients can be applied to the financial and personnel data of individual institutions.

Coefficients are typically applied in stages

- R&D coefficients applied to different categories of staff, if possible by discipline and institution, yield full-time equivalent (FTE) personnel estimates.
- These personnel estimates, converted to coefficients themselves, may be applied to financial data to provide R&D expenditure estimates.

9.123 In the absence of direct survey data, R&D coefficients offer the only way to estimate the share of R&D in labour costs. They play a significant role in estimating shares of R&D in other current costs, but are of minor importance in calculating shares of machinery and equipment or of land and buildings used for R&D.

9.124 When reporting data for international comparisons, R&D compilers are encouraged to indicate to which sets of expenditure and personnel data coefficients are applied to calculate R&D data, together with the actual coefficients used. These metadata could be collected every couple of years in parallel to the regular data collection and made available online.

Time-use surveys

9.125 If the necessary coefficients cannot be derived from other surveys or administrative data, time-use surveys are the recommended method to derive the necessary information for estimating the R&D component of FTEs and expenditures. To reduce the variation stemming from the various possible methods of conducting time-use surveys, guidelines for designing more uniform time-use surveys are proposed below on an optional basis.

Census or sample

9.126 Due to very different national situations (e.g. legal framework, size of country), a census cannot be recommended for all countries. When using a sample, it should be representative of the categories of employees considered in a typical academic year, and stratified by FORD.

Reporting unit

9.127 The preferred reporting unit for a time-use survey should be the individual researcher, not the university administration.

Categories of employees considered

9.128 The time-use surveys should consider at a minimum employed researchers (i.e. internal personnel; see Chapter 5) engaged in R&D activity in the higher education institutions, and possibly other R&D personnel, e.g. other researchers under contract (external R&D personnel), technicians and other supporting staff.

Type of activities

9.129 The proportion of time dedicated to R&D performance should be the focus of the survey. There should be a uniform and understandable list of activities asked for in the time-use survey, with three key activities:

1. R&D
   - R&D
   - Administration of R&D
2. Teaching
   - Teaching
   - Administration of teaching
3. Other work: All other work

9.130 Due to their specific needs, most countries collect more detailed information on a more comprehensive list of activities. It is recommended to allow for these activities to be categorised, or rolled-up, under one of the three key activities listed above.

Period of time

9.131 The reference period used in time-use questionnaires may differ widely across countries (i.e. whole year versus 1-2 typical weeks versus a survey on a rolling basis). If a comprehensive survey is not possible, it should be ensured that the estimates account for the various types of activities during the year and that they cover the whole year. All typical periods within one year should be covered. One possible approach is to consider a typical week during the lecture period and another typical week in the lecture-free period. Due to different systems in the organisation of higher education, the reference period should be individually chosen by each country.

Frequency of time-use surveys

9.132 It is desirable for the surveys to be regular; however, the feasibility of this will depend on the country's size, its legal framework and the resources it has available to carry out a survey. It is nevertheless proposed that the interval between two surveys should, if possible, not exceed five years.

Procedure in the intermediate years

9.133 If the period between surveys is longer than two years, a concept for now-casting the potential changes in coefficients, based for example on changes in the structure of university staff, could be envisaged.

Contractual working hours

9.134 As an introductory question to the time-use survey, it is recommended to collect information on the number of contractual working hours during the reference week (or weeks) and then report the relative distribution of the different activities as percentages. (See Chapter 5 for the definition of working hours.)

Calculation of GUF

9.135 Data on general university funds are often available from university records. An increasing number of countries collect GUF data through R&D surveys. In some instances, it is the total amount of the "block grant" that is collected through the survey, and the R&D share (i.e. GUF used for R&D) is subsequently estimated using coefficients derived from time-use surveys.

9.136 In countries where there is no HERD survey, data are compiled using a combination of different sources and applying coefficients that in most cases are derived from time-use surveys. In some cases, GUF is calculated by subtracting other sources of funding from HERD.

9.137 The main way time-use surveys and other methods to identify the R&D share of universities' total activities are used is for the calculation of GUF, which account for the majority of higher education R&D expenditure in many countries (see Section 9.4). The institutions' block grants from government cover all the basic activities: teaching, R&D, supervision, administration, rent and other overhead expenditures. As the R&D share of this funding is most often unknown to the universities themselves, the use of R&D coefficients is the most convenient method to calculate the R&D content of the activity. Different methods are used for this purpose.

9.6. Links with education statistics

9.138 Data on R&D expenditure in the Higher education sector are also collected in the framework of the UNESCO/OECD/Eurostat (UOE) data collection on education statistics. A joint UOE methodological manual (UOE, 2014), developed by education statisticians, outlines the concepts, definitions and classifications to be used for data reporting at the international level. The guidelines given in the UOE manual for reporting R&D data are based on the *Frascati Manual*. Education and R&D statisticians have collaborated for decades with a view to moving towards common guidelines in both manuals. This will continue. While it seems unavoidable that some data discrepancies remain due to the different nature of both data collections, experience has shown that coordination between data providers on both sides has a positive effect on the reduction of these discrepancies.

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