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Measuring Scientific and Technological Services (STS): Draft Paper for Consultation

UNESCO

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

Tel: +1 514-343-6880
Email: uis.publications@unesco.org
http://www.uis.unesco.org

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About the UIS draft consultation on measuring scientific and technological services (STS)

UNESCO's "*Recommendation Concerning the International Standardization of Statistics on Science and Technology*" (UNESCO, 1978) defines Scientific and Technological Activities (STA) as those "systematic activities which are closely concerned with the generation, advancement, dissemination, and application of scientific and technical knowledge in all fields of science and technology". This concept was then further developed in the 1980s in other UNESCO manuals and guidance to include three non-overlapping components: 'Research and Experimental Development (R&D)', 'Scientific and Technological Education and Training (STET)' and 'Scientific and Technological Services (STS)'. While the Frascati Manual (OECD, 2015) which outlines the methodology to measure R&D has been updated regularly, the other two components of STA (STS and STET) have not been reviewed since that time. Concerns have been expressed that given the significant transformation of science and technology (S&T) systems worldwide in the last three decades, these two concepts (STS and STET) should be re-examined to ensure that they are clearly defined and delineated so that reliable (and policy-relevant) data can be collected in a way that yields internationally comparable results.

In this context, the UNESCO Institute for Statistics (UIS) launched a process to review the concept of STA beginning with STS, which are defined as those activities that contribute "to the generation, dissemination and application of scientific and technical knowledge" (UNESCO, 1984). This revision process has included the development of various proposals in close consultation with national statisticians and other S&T measurement experts over the last three years. A draft UIS Technical Paper on Measuring STS has now been prepared which aims at providing a better delineation of the relationship between STS and R&D, clarifying parts of the definition that were considered unclear, updating the terminology and definitions to better reflect the current status of S&T (including new technologies and policy priorities), while ensuring that the measurement guidance clearly reflects the broad scope of STS and maintains some continuity with earlier definitions. As a last step, the UIS is now carrying out a global consultation inviting final comments from the broader community of S&T data producers and users.

About the global consultation

The global consultation on the draft UIS Technical Paper on Measuring Scientific and Technological Services (STS) aims to gain the perspective of national and regional experts who produce and use S&T indicators. These inputs will be incorporated in the final draft of the paper, which will subsequently be published as a UIS Technical Paper.

Participants in the global consultation are invited to submit their comments/feedback in order to further improve the proposed text. The UIS will aim to integrate these to the highest possible extent. Please send these by email to uis.stsurvey@unesco.org by **31 December 2017**.

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Abbreviations

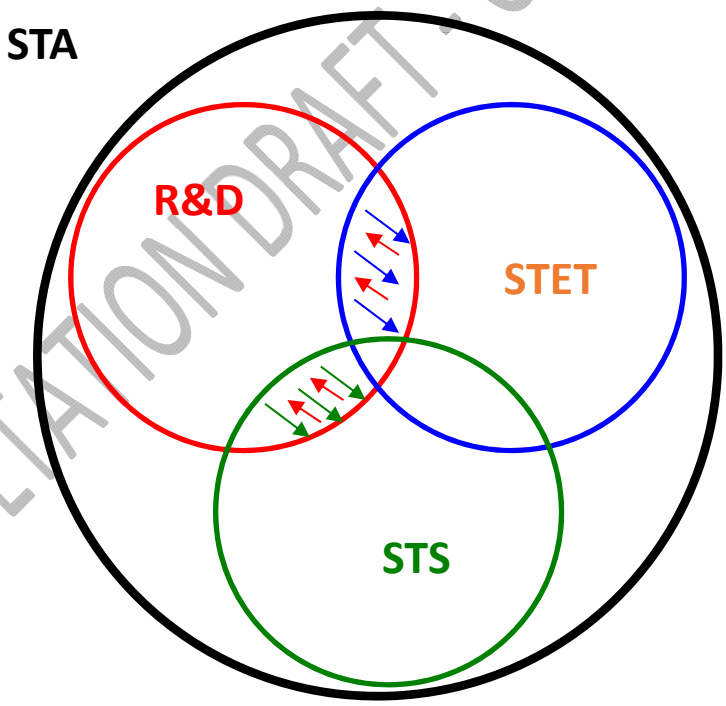
BES	Business Enterprise Sector
COFOG	Classification of the Functions of Government
FORD	Field of Research and Development
FTE	Full-Time Equivalents
GBARD	Government Budget Allocations for R&D
HES	Higher Education Sector
ISCED	International Standard Classification of Education
ISCO	International Standard Classification of Occupations
ISIC	International Standard Industrial Classification
NABS	Nomenclature for the Analysis and Comparison of Scientific Programmes and Budgets
NSE	Natural Sciences & Engineering
OECD	Organisation for Economic Co-operation and Development
PNP	Private Non-Profit Sector
R&D	Research and Experimental Development
SSHA	Social Sciences, Humanities and the Arts
STA	Scientific and Technological Activities
STEM	Science, Technology, Engineering and Mathematics
STET	Scientific and Technological Education and Training
STI	Science, Technology and Innovation
STS	Scientific and Technological Services
S&T	Science and Technology
UIS	UNESCO Institute for Statistics
UNESCO	United Nations Educational, Scientific and Cultural Organization

Executive Summary

As science and technology (S&T) become key enablers of more inclusive and sustainable development, as well as central pillars for innovation-led growth, there is a need to better measure the S&T investments and capabilities of organizations, regions, and countries. Research and Experimental Development (R&D) is a central activity as it is the formal generation of new knowledge and has been well measured since the 1950s, but it does not capture the full range of activities linked to S&T-based knowledge, particularly those related to its diffusion and application.

It is in this context that in the 1970s-80s UNESCO developed the concept of Scientific and Technological Activities (STA) which includes three components: (1) R&D; (2) Scientific and Technological Education and Training (STET) which measures investments in S&T human capital; and (3) Scientific and Technological Services (STS). Figure 1 below highlights how these 3 components are linked and the need to clarify possible boundary issues between them. As part of a broader ongoing review of the concept of STA carried out by the UNESCO Institute for Statistics (UIS), this Technical Paper revisits and updates the previous definition of STS (UNESCO, 1984) and provides practical guidance for its measurement.

Figure 1. STA and its sub-components



Source: UNESCO Institute for Statistics

As an outcome of the revision process, STS must fulfill *at least one* the following two conditions:

- they are based on the use of *scientific methods* but are outside the boundary of R&D, usually because they do not fulfill some R&D requirement, in particular novelty or creativity;
- they play a key role in *facilitating* the creation, diffusion and use of scientific and technical knowledge.

STS are thus defined as those activities "which contribute to the generation, dissemination and application of scientific and technical knowledge in all fields, including those that directly or indirectly support research and experimental development (R&D), but are outside the boundary of R&D."

STS cover 4 broad types of activities:

- S&T support activities;
- Scientific data collection and analysis;
- Governance, management and legal framework supporting S&T; and
- Preservation, interpretation and dissemination of scientific information and knowledge.

For measurement, it is recommended to combine a *functional* approach identifying relevant activities across all types of organizations, with an *institutional* one that prioritizes certain types of organizations, those known to be the main providers of STS.

It is recommended to collect STS data across all institutional sectors although some countries may prioritize the Government and Higher Education sectors if these account for the majority of national STS. Countries may use a combination of data sources including dedicated surveys, existing surveys (such as R&D for the business sector) and budgetary data.

In line with current practice, countries interested in collecting data on STS should prioritize *expenditure* figures which are more readily available using existing data sources, more reliable and better suited for estimation when needed. Data on *human resources* involved in providing STS are of lower priority regarding measurement and caution should be taken when producing such data given that STS personnel may also be carrying out R&D or other unrelated activities.

1. Introduction

1.1 Background

Science and technology (S&T) play a pivotal role in fostering innovation, growth and productivity which can lead to more inclusive socio-economic development and help eradicate poverty. S&T activities are key components of the 2030 Agenda for Sustainable Development, as both drivers and facilitators, as well as objectives in their own right.[1]

In order to assess the magnitude, nature and direction of S&T efforts in terms of both financial and human resources, various concepts and indicators have been developed over the years and codified in internationally-agreed measurement guidelines. Since the 1960s, UNESCO has played a key role in setting statistical standards for the collection of S&T-related data, as well as assisting countries in implementing these guidelines and disseminating the results of these efforts.

Among the many activities which relate to science and technology, Research and Experimental Development (R&D) plays a central role. R&D has been defined and measured in harmonized ways for more than 50 years and R&D statistics are widely used for policy-making and analysis in both advanced and developing countries (UNESCO/UIS, 2014; OECD, 2015). Although R&D investment remains a key element in understanding national and regional innovation systems, it is clear that there is a wide range of other S&T-based activities which fall outside the boundary of R&D but play a key role in the creation, diffusion and use of scientific knowledge and the technologies that embody this knowledge [2].

It is in this perspective that the broader concept of Scientific and Technological Activities (STA) was developed and formalized by UNESCO in the 1970s and 80s in order to capture a wide range of activities relating to facilitating, creating, diffusing and applying scientific and technical knowledge and methods. Even though until now, the measurement of STA has been mainly prioritized in countries with less well-developed formal research systems or where R&D activities are still limited to a few institutions or organizations (UNESCO, 1984), the activities included in this broad category are key elements of well-functioning national innovation systems and of relevance to all countries.

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1 Target 9.5 of the UN's Sustainable Development Goal 9 (Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation) aims to "enhance scientific research, upgrade the technological capabilities of industrial sectors in all countries, in particular developing countries, including, by 2030, encouraging innovation and substantially increasing the number of research and development workers per 1 million people and public and private research and development spending", Goal 12 includes "Support[ing] developing countries to strengthen their scientific and technological capacity to move towards more sustainable patterns of consumption and production" and Goal 17 calls for enhancing cooperation "on access to science, technology and innovation" (UN, 2015).

2 The *Frascati Manual* which defines R&D for the purpose of measurement (OECD, 2015) clarifies the link (and boundary) between R&D and related scientific and technological activities (see Paras. 2.88-2.89).

In addition to R&D, a key component of STA are Scientific and Technological Services (STS) which comprise services and activities that do not lead to the formal creation of new knowledge, but allow scientific knowledge to be developed, stored, transmitted and used. STS were defined alongside STA, but the definitions and guidance regarding their measurement had not been reviewed in the last 30 years.[3] Concerns had also been expressed that these concepts are not widely implemented in terms of data collection for various reasons including the fact that some of the concepts were not always clearly defined and delineated, leading to difficulties in collecting reliable data in a way that yields internationally comparable results.

The context for studies and the measurement of S&T has also changed during this period. S&T plays a now widely acknowledged role as a key engine of economic growth and socio-economic development across all groups of countries. Within these, services and the service sector have become much more prominent throughout their economies. Research and innovation systems have continued to evolve: internationalization and the global integration of local and national systems of innovation within the context of open science initiatives is proliferating. New actors and collaborative forms are emerging based on the growing importance of networks and multidisciplinary S&T co-operation. Internationally, S&T is recognized for its key central role in addressing new and emerging global challenges.

Alongside these changes, other S&T-related measurement frameworks and systems have emerged or evolved, reinforcing the urgency of revisiting and updating the definitions and measurement guidance for STS. This includes the development and implementation of new guidelines and manuals, changes in statistical systems and data collection methods, as well as growing demand for new policy-relevant indicators.

1.2 Revision process

It is in this context that the UNESCO Institute for Statistics (UIS) launched a process to review the concept of STA and its sub-components including examining their implementation in data collection activities at the national level.[4] The objective of the review was to identify problematic elements from both a conceptual and a practical view and, where necessary, to develop and update the international guidance for measurement. This began in 2011 with a consultation with national experts leading to some initial proposals in 2013. A further review and stock-taking exercise led to guiding principles for a revision which were presented at the 2014 meeting of the RICYT[5] Technical Committee in Buenos Aires (Argentina). A round of regional consultations and discussions at a UIS Expert Meeting in Montreal (Canada) in July 2015 led to a consensus on the direction and main features of the revision. Discussions at a November 2016 meeting of

3 The third component of STA is Scientific and Technological Education and Training (STET), which is also being reviewed.

4 During this review process, methodological guidance from various national statistical offices on the implementation of the concepts of STA/STS in their own data collection activities was also reviewed. Most was in line with existing UNESCO guidelines, although not all the guidelines were fully implemented and in some cases adaptations or variations were found, thus leading to substantial variation in coverage and limited cross-country data comparability.

5 Red de Indicadores de Ciencia y Tecnología Iberoamericana e Interamericana.

the UIS STI Advisory Board followed by a global consultation in 2017 with national experts finally led to the updated guidance contained in this Technical Paper.

Among the basic principles which guided the revision leading to this Technical Paper were:

- to follow a pragmatic approach focusing on clear guidance for data collectors. In particular, the need to clarify some of the concepts, to include specific examples and to better address the treatment of borderline cases.
- the need to update the language and terminology used in order to better reflect current priorities.
- to the extent possible, to maintain some continuity with existing definitions in order to ensure a certain degree of comparability with data previously collected. The definitions outlined in this Technical Paper attempt to build on previous ones in an incremental way.
- the need for a balanced approach that covers a broad set of activities of relevance to all countries and sector while ensuring that the concept measured is well defined and of analytical use.

With respect to the previous definition of STS, the main changes outlined in this Technical Paper are:

- a better delineation of the relation between STS and R&D;
- clarifying parts of the definition that were considered unclear, particularly regarding the nature of S&T services provided by certain types of organizations;
- update the terminology and definitions to better reflect the current status of S&T including new technologies and policy priorities;
- ensure that the measurement guidance clearly reflects the broad scope of STS and is relevant not just to Natural Sciences and Engineering (NSE), but also to Social Sciences, Humanities and the Arts (SSHA).

The Technical Paper is structured as follows. Section 2 covers the main concepts and definitions relating to STS. Section 3 develops a conceptual framework for defining STS for the purpose of measurement. Section 4 outlines a list-based definition of STS. Section 5 discusses measurement.

2. Concepts and definitions

2.1 Basic concepts

Scientific and technological services (STS) include a wide range of activities and are formally defined in section 3 of this Technical Paper. For the purposes of measurement, they are defined as a subcomponent of the broader concept of Scientific and Technological Activities (STA)[6] which also includes Research and Experimental Development (R&D)[7] as well as Scientific and Technical Education and Training (STET) (UNESCO, 1978 & 1984).

The main characteristic of STS is that they relate to *science and technology*, a broad concept which has no single definition, but is based on two distinct elements:

- *science* which relates to the study of natural and social phenomena using certain formal methods (systematic, empirical, replicable);
- *technology* which refers to the application of knowledge for practical purposes into products, materials, tools, processes, techniques, devices, etc.

The third notion within STS is that of *services* which in this context comprises various activities often carried out on behalf of third parties and which involves expenditure on (or human resources involved in providing) both goods (tangible) and services (intangible).

2.2 General approach

In their original formulation, STS were defined in relation to R&D, encompassing various activities of a scientific nature, but which for various reasons fall outside the boundary for R&D (see Annex 1).[8] In this Technical Paper, this definition is considered as a starting point, but expanded to a broader concept of STS including not only activities which have a direct/indirect link with R&D, but also others which play a key role in supporting or strengthening the desired outcomes of science, technology and innovation (STI) systems in a formal and systematic way, but are not connected to R&D.

As in the previous measurement guidance, a short definition of STS is developed (in section 3) which captures the essential features of STS. This definition is then complemented (in section 4) by a more detailed list of activities which facilitates the collection of data on STS. As in the past, this list of STS is not intended to be exhaustive, but to cover the most common and significant set of activities that should be considered by data collectors. The definitions (both short and long) aim at maintaining some continuity with existing concepts and data collection activities currently carried out by countries, while ensuring that they adequately reflect current issues and policy priorities regarding S&T, and take into account what is statistically feasible in terms of data collection.

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6 The overall concept of STA is also in the process of being reviewed by UNESCO/UIS.

7 Which is defined in the OECD *Frascati Manual* (OECD, 2015).

8 This original description is close to the concept of "Related Scientific [and Technological] Activities" (RSA/RSTA) which is used in some countries. This concept emphasizes their proximity to R&D and overlaps to a large extent with STS although in a narrower form.

3. A framework for defining STS

This section discusses the concept of STS in terms of its defining characteristics and its relation with R&D and other closely related concepts. This leads to a short definition for STS which is then complemented by a more detailed list-based definition in section 4.

3.1 STS and their relation to R&D

In the original definition, STS were primarily defined as those activities having a direct or indirect link with R&D, but without the "character of innovation" (novelty) (UNESCO, 1984). In order to clarify this link, it is useful to examine the current definition of R&D as formulated in the latest *Frascati Manual* (OECD, 2015).

R&D is defined as "creative and systematic work undertaken in order to increase the stock of knowledge – including knowledge of humankind, culture and society – and to devise new applications of available knowledge" (Para 2.5).

Frascati then outlines five precise criteria which an activity must fulfill in order to be considered as R&D (Chapter 2). It must be:

1. novel: aimed at new findings;
2. creative: based on original, not obvious, concepts and hypotheses;
3. uncertain: regarding final outcomes;
4. systematic: planned and budgeted; and
5. transferable/reproducible: leading to results that can be codified and replicated.

The *Frascati Manual* also clarifies the boundary of R&D with various related activities, some of which would be included in the scope of STS as it has been defined until now. In particular, it identifies:

- activities which are *fully outside* the scope of R&D including: pre-production development, after-sales service, patent and license work, routine testing, data collection and routine compliance with inspections, regulations, etc.
- activities which are *partly* R&D including industrial design, engineering and tooling up, trial production.

Frascati explicitly mentions borderline cases between R&D and STA when these are carried out in the same institution and provides the following advice:

- "Institutions or units of institutions and firms whose principal activity is R&D often have secondary, non-R&D activities (e.g. scientific and technical information, testing, quality control, analysis). Insofar as a secondary activity is undertaken primarily in the interests of R&D, it should be included in R&D; if the secondary activity is designed essentially to meet needs other than R&D, it should be excluded.
- Institutions whose main purpose is an R&D-related scientific activity often undertake some research in connection with this activity. Such research should be isolated and included when measuring R&D. " (Para. 2.88)

Therefore regarding STS, as a general rule when these activities are carried out as part of an R&D project, they should be considered as R&D (Paras. 2.89-2.98).

STS include various activities which are related to R&D, but fall outside the boundary of R&D, in particular:

- activities of a scientific nature which do not fulfill some of the criteria for R&D, notably those which lack novelty, creativity, or uncertainty;
- other non-scientific activities which facilitate the performance of R&D or the diffusion and use of its results.

Frascati also provides examples of various "Related Science & Technology Activities" in the Government sector which are outside the boundary of R&D and which can be included in STS: "the provision of technological services such as technical testing and standardisation, technology transfer [...], the preservation, storage and access to knowledge and scientific collections through libraries, databases and repositories" (Para. 8.28).

Regarding their link to R&D, different types of activities can be identified (see Figure 2), i.e. those concerned with:

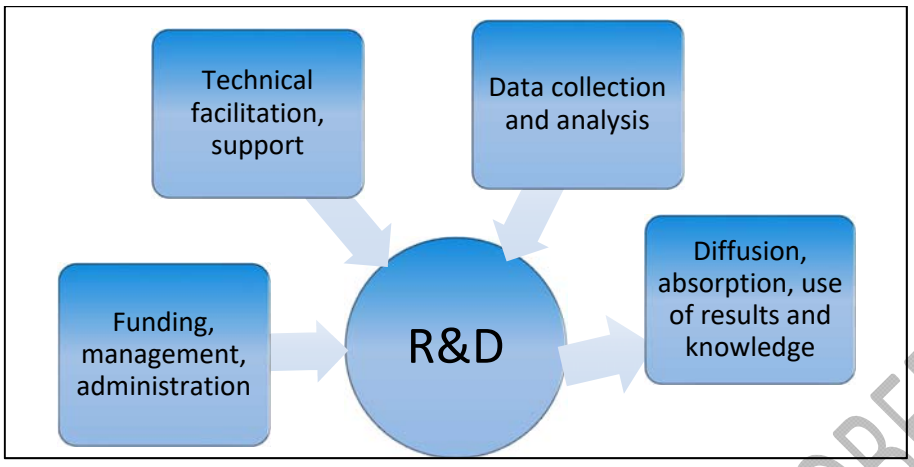
- the funding, management, and administration of S&T/innovation-related activities (including R&D), except for *scientific* and *technical* aspects of R&D projects which are part of R&D [9];
- scientific and technical activities carried out to facilitate and support R&D but which do not meet the criteria for R&D;
- routine data collection and analysis[10];
- the wider diffusion, absorption and use of the results and knowledge coming from R&D or other activities based on scientific methods.

Some of these activities directly support R&D in the sense of providing the necessary resources (e.g. managing R&D grants) or technical knowledge (e.g. routine testing or data collection) that enable or facilitate R&D efforts. These are distinct from R&D since they do not meet the required criteria, notably novelty or creativity. Others play a more indirect role such as facilitating the diffusion of results from previous R&D (or other scientific) activities, for example scientific museums.

9 See *Frascati* Paras. 5.6 and 5.38.

10 Unless they are an integral part of an R&D project, or when they represent new methods of collecting analyzing data, in which case they are part of R&D (see *Frascati* Paras. 2.50 and 2.90).

Figure 2. STS and their relation to R&D



STS can encompass the *primary* activity of an organization, or may be performed as *secondary* activities, as long as these are carried out in a formal and systematic way. In terms of the institutions which provide STS, these will often be organizations that also carry out R&D, either as a primary or secondary activity. It is therefore important to clearly delineate the boundary between these two concepts in terms of data reporting.

3.2 Key dimensions of STS

Although STS were originally defined by their relation to R&D, it is important to provide a clearer delineation of the diverse activities which should be considered within the boundary of STS. The following section discusses 3 broad dimensions which are captured in the concept of STS:

- STS and science as a *subject*;
- STS and science as a *method*;
- STS as key supports of the *S&T infrastructure*.

3.2.1 STS and science as a subject

A first set of activities relates to the systematic collection, cataloguing, preservation, promotion and dissemination of scientific information. These activities are usually carried out by specialized institutions, often in the Government sector, but also in the Higher Education, Business Enterprise and Private Non-Profit (PNP) sectors. These activities do not involve the *application* of technical or scientific knowledge, but rather the *collection, preservation and diffusion* of such knowledge. Some of these activities are aimed at general audiences, while others are aimed at more specialized ones including:

- education: zoos, museums of S&T, planetaria, aquariums, botanical gardens;
- information and advocacy: non-profit organizations, science centres, professional journals, science academies, professional scientific associations; and
- recognition: such as awards, prizes to promote S&T.

3.2.2 STS and science as a method

This includes various activities that use scientific methods and are often carried out in support of R&D, but do not fulfill some of the criteria to be included as R&D, notably novelty and creativity. An example are routine activities such as data collection, processing, analysis which do not involve new techniques or methodologies, or support activities such as routine testing or technical standard setting. These activities are often carried out by organizations that have the technical capability of carrying out R&D, so the boundary must be clearly drawn, in particular whether they meet the novelty criteria.

3.2.3 STS as supports of the S&T infrastructure

A final set of activities includes those of an administrative or legal nature that play a role in providing support for S&T activities (including R&D). These activities are part of national S&T governance systems and play a key role in S&T policy-making.

The *Frascati Manual* clarifies that activities relating to administration of R&D are outside the boundary, in particular the "raising, management and distribution of R&D grants" (*Frascati Manual*, Para. 2.121). Such activities should nonetheless be included in STS, alongside similar ones which provide administrative support to related domains such as innovation, as long as they include a clear science or technology component.

3.3 Key criteria for STS

Based on the previous definition and the issues discussed above, we consider the criteria below for setting the boundary for STS. These are activities which fulfill *at least one* of the following:

- they are based on the use of scientific methods but are outside the boundary of R&D, usually because they do not fulfill the key criteria of novelty or creativity; [science as a method]
- they play a key role in facilitating the creation, diffusion and use of scientific and technical knowledge [science as a subject or as a support of the S&T infrastructure].

Regarding the first criterion, STS include activities based on scientific methods, but that unlike R&D, do not create new knowledge, or that do not fulfill some of the other criteria for R&D. In addition to these, STS also include a number of activities which are not related to R&D, so it is important to clarify the scope of what should be included. In particular they comprise activities which aim to facilitate the creation, use and diffusion of scientific information and knowledge.

Based on this framework, STS are defined as follows:

> Scientific and technological services (STS) comprise activities which contribute to the generation, dissemination and application of scientific and technical knowledge in all fields, including those that directly or indirectly support research and experimental development (R&D), but are outside the boundary of R&D.

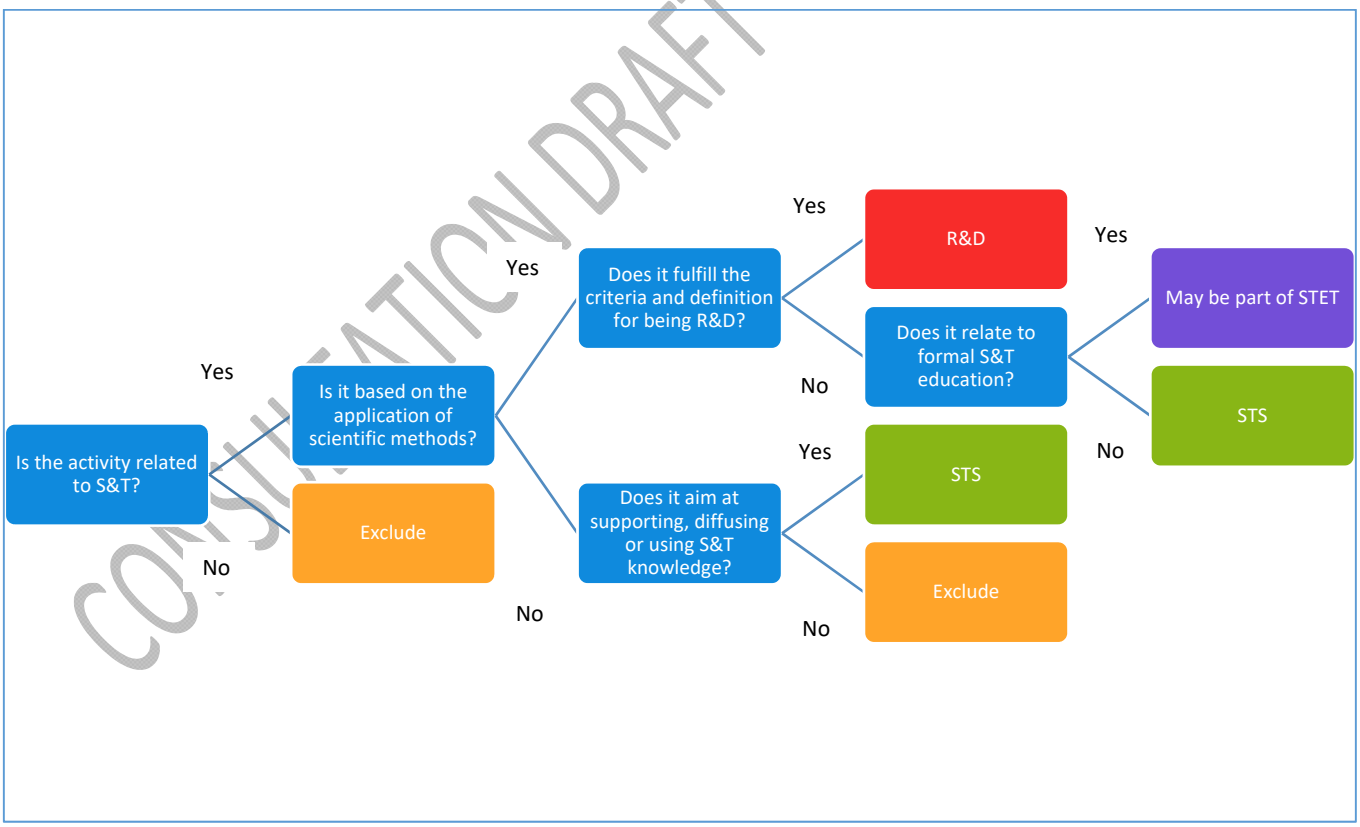
Regarding this short definition, it aims to maintain continuity with the previous one (see Annex) by establishing a link with R&D, as well as clarifying that the scope is broader since it includes other activities which are not related to R&D (or only very indirectly). The definition also mentions three stages of knowledge-based activities: creation, diffusion, use.

Regarding the scope of the definition, it should be noted that:

- R&D itself is excluded;
- STS include all fields of science/research in Natural Sciences and Engineering (NSE), and Social Sciences, Humanities and the Arts (SSHA);
- STS include activities carried out by organizations across all sectors, although for measurement purposes, some may be prioritized in terms of data collection (see Section 5).
- Activities intended solely to promote /advertise/ market STS should be excluded.
- In line with the key criteria previously delineated, activities which do not use scientific methods, do not focus on science as a subject area or are not directly supporting S&T, should not be considered STS.

The decision tree in Figure 3 may be helpful in deciding whether an activity is in scope of STS.

Figure 3. Identifying STS and related activities



3.4 STS and related concepts

3.4.1 Innovation

Although STS may contribute to innovation activities, the two concepts must be clearly distinguished. Innovation is currently defined for measurement purposes in the third edition of the *Oslo Manual* (OECD/Eurostat, 2005)[11] with a primary focus on the Business enterprise sector. In summary, it has to do with putting new or significantly improved products on the market or finding better ways (through new or significantly improved processes and methods) of getting products to the market (NASEM, 2017). Innovation is therefore defined in terms of:

- *novelty*: i.e. something that is new or significantly improved, at least to the firm introducing it; and
- *implementation*: it must have been introduced to the market, or used within the firm, for it to be an innovation.

[DN: if the revision of the OM is sufficiently advanced by the time this Technical Paper is finalized, the text will be updated to reflect the 4th version of the OM]

When comparing the two concepts, the key distinction is that innovation need not be based on scientific methods, involve the development or application of technologies, or relate to the broader criteria of aiming at facilitating the generation, diffusion, use of scientific knowledge. On the other hand, in practice a number of firms carrying out innovation activities (one of which is R&D), may also be providing or using STS, so innovation surveys may be a useful tool for identifying STS when it comes to measurement and identifying the target population (see section 5).

[DN: if the revision of the OM is sufficiently advanced by the time this Technical Paper is finalized, the text will be updated to reflect the revised list of innovation activities in the 4th version of the OM]

3.4.2 Commercialisation

Some of the organizations providing certain STS will also (or primarily) be involved in commercialisation activities relating to S&T-based knowledge. This refers to various processes aimed at bringing new ideas, inventions and products into the market. It is recommended that commercialisation activities not be included as a *separate* STS category, but that STS be identified within organizations engaged in the commercialization of technologies.

[11] The *Oslo Manual* is currently in the process of being revised. A fourth edition should be available in 2018.

4. A list-based definition of STS

In the previous definition of STS (UNESCO, 1984), nine separate categories were included (see Annex 1) combining two perspectives:

- *activities* of a scientific nature in terms of the *methods* used and their *subject matter*; and
- *S&T services* provided by *organizations* that play an important role in science and innovation systems, although the nature of these services was not clearly defined.

In order to simplify the framework for measuring STS, it is proposed to define four broad categories encompassing the previous list but also enlarging it, which correspond to clearly distinct types of activities as follows:

1. Technical S&T support activities;
2. Scientific data collection and analysis;
3. Governance, management and legal framework supporting S&T;
4. Preservation, interpretation and dissemination of scientific information and knowledge.

Table 1 below provides a list of STS based on these four categories.

Table 1. Scientific and Technological Services (STS)

A. Technical S&T support activities	B. Scientific data collection and analysis	C. Governance, management and legal framework supporting S&T	D. Preservation, interpretation and dissemination of scientific information and knowledge
A.1 Engineering, architectural, environmental, other technical advisory services	B.1 Surveying, prospecting and mapping	C.1 Administration, management, funding of S&T	D.1 Preservation, interpretation and dissemination of S&T-related knowledge
A.2 Metrology, standards	B.2 Astronomical and geophysical monitoring, environmental testing	C.2 Intellectual property protection	D.2 Publishing and translating of S&T books, journals and other forms of printed and electronic publications
A.3 Testing and quality control	B.3 Routine socio-economic data collection and analysis	C.3 Analytical studies supporting S&T policymaking	

The list of activities described in each of the following sections is aimed at providing the general boundary for each category and facilitate the identification of units to be included as part of data collection efforts. Countries may then further develop this list by providing additional details or identifying particular services/activities of particular national or regional relevance.

As a general guideline, the activities listed below use *established* methods or techniques. The development of *new or substantially improved* methods or equipment to carry out the activities described below should generally be considered R&D, and therefore be excluded from STS.[12]

The following section describes each of these four broad areas and includes the following guidance:

- Basic scope and definition;
- A more detailed list and description of the relevant activities/services for each of the four categories;
- Examples of organizations across institutional sectors specializing in such activities; when appropriate, reference is made to relevant statistical classifications (such as ISIC);
- Comments on the relevance and applicability across fields of science/research;
- Important exclusions and boundary issues.

4.1 Technical S&T support activities

These activities are closely related to R&D and involve the use of established scientific methods or technologies but do not meet some of the required criteria for R&D, particularly novelty and creativity. They are often carried out by organizations which also perform R&D in both the public and private sector and comprise the following three sets of activities:

A.1 Engineering, architectural, environmental, other technical advisory services;
A.2 Metrology, standards;
A.3 Testing and quality control.

A.1 Engineering, architectural, environmental, other technical advisory services

This category includes:

- Scientific and technological consulting services providing specialized advice and assistance including architectural, engineering design and drafting services.
- Technical consulting on S&T fields including agronomy and environmental management.
- The activities of organizations specialized in providing non-technical services that support technology development, diffusion and commercialization. This includes business incubators, science and technology parks, technology transfer offices, etc.

[12] ICT/Internet services are not identified as a separate category within STS; but are considered primarily as tools or instruments which are used for various other activities.

- Routine activities which are part of space exploration and exploitation such as those relating to the manufacturing and deployment of space equipment and sub-systems, space systems operators (satellite launch and operation) and other space-related services and products for consumers.[13]

This category excludes:

- Activities which are not of a technical or scientific nature (e.g. project planning, administration).
- Geophysical, geologic, seismic and geodetic surveying activities which should be included in category D.1 (Surveying, prospecting and mapping).

Clarifications and examples:

- Organizations carrying out these activities in the business sector would generally be classified in ISIC Rev.4 Class 7110 (Architectural and engineering activities and related technical consultancy) or 7490 (Other professional, scientific and technical activities n.e.c.).

A.2 Metrology, standards

This category includes:

- Scientific metrology which relates to the establishment, development and maintenance of unit systems and is carried out in a limited number of institutions around the world.
- Industrial or technical metrology which concerns the application of these standards to manufacturing and other processes at the national level and can be undertaken by various types of organizations including enterprises and government institutes (for example public or private metrology or calibration laboratories).
- Legal metrology which is concerned with measuring instruments and ensuring citizens of correct measurement results when used in official and commercial transactions. A number of organizations may undertake these activities at the national level, usually overseen by a national metrology institute.
- Setting and maintenance of measurement and technical standards. This includes the definition of units of measurement, the realization of units in practice by technical methods and the application of chains of traceability linking measurements to reference standards.

This category excludes:

[13] *Frascati* highlights that "much space activity may now be considered routine" (Para. 2.94) and would therefore be considered STS instead of R&D (except for the development of new equipment/technologies).

- Research in metrology and the development of new and improved measurement standards and measurement methods which should be included in R&D.[14]

A.3 Testing and quality control

This category includes:

- Physical, chemical and other routine analytical testing of materials and products.
- Certification of products including consumer goods, vehicles, etc.
- Scientific testing to meet regulatory requirements.[15]
- Scientific testing and analysis activities carried out by museums.

This category excludes:

- The development of new or substantially improved testing methods which should be included in R&D (see *Frascati*, Para 2.92).
- Specific non-routine testing carried out within R&D should be included with R&D (see *Frascati*, Paras. 2.16, 2.50).

Clarifications and examples:

- Organizations carrying out these activities in the business sector would generally be classified in ISIC Rev.4 Class 7120 (Technical testing and analysis) as well as 7500 (testing of animal specimens) and 8690 (medical laboratory testing).

4.2 Scientific data collection and analysis

These activities comprise a wide range of services which rely on routine scientific data collection and analysis in both natural sciences and engineering, as well as in the social sciences, humanities and the arts. Some of these activities may take place within the context of an R&D project and should therefore be excluded from STS.

B.1 Surveying, prospecting and mapping

B.2 Astronomical, meteorological, seismological monitoring

B.3 Routine socio-economic data collection

[14] *Frascati* clarifies that "the maintenance of national standards, the calibration of secondary standards and the routine testing and analysis of materials, components, products, processes, soils, atmosphere, etc.[...] are not R&D." (Para. 2.113).

[15] For example as part of "regulatory science" and similar science-based approaches to assess the compliance with and impacts of regulations.

B.1 Surveying, prospecting and mapping

This category includes:

- Geophysical, geologic and seismic surveying as well as geodetic surveying activities such as land and boundary surveying, hydrologic and subsurface surveying, and cartographic and spatial information activities (mapping).
- Exploration services in connection with oil and gas extraction, and prospecting services for mining activities.
- Surveying of fish and wildlife resources.

This category excludes:

- The development of new or substantially improved methods and equipment for carrying out such activities which should be included in R&D (see *Frascati*, Para. 2.97).

Clarifications and examples:

- Organizations carrying out these activities in the business sector would generally be classified in ISIC Rev.4 Class 7110 (Architectural and engineering activities and related technical consultancy).

B.2 Astronomical and geophysical monitoring, environmental testing

This category includes:

- The collection of routine astronomical and geophysical observations, as well as environmental testing and monitoring.

Clarifications and examples:

- Geophysics includes various sub-fields such as seismology, hydrology, meteorology, oceanography as well as environmental geophysics.
- Organizations carrying out these activities in the business sector would generally be classified in ISIC Rev.4 Class 7490 (Other professional, scientific and technical activities n.e.c).

B.3 Routine socio-economic data collection and analysis

This category includes:

- The systematic collection of data and information in the natural and social sciences usually for the purpose of compiling routine statistics, *e.g.* population censuses; production, consumption and trade statistics; STI statistics; market research and analysis; social and cultural statistics, etc.
- Systematic data collection and analysis using scientific methods by various means such as interviews, surveys (postal, electronic), focus groups, experiments, case studies, extracting data from existing records, etc.

This category excludes:

- New methods of collecting and processing data since they are part of R&D[16].

Clarifications and examples:

- Data should be available for use outside the organization collecting it, whether commercially or on a non-profit basis.
- These activities will often be carried out by national (or sub-national) statistical offices or other agencies responsible for official statistics, but also by research centers, Higher Education institutions, consulting firms, etc.

4.3 Governance, management and legal framework supporting S&T

These activities focus on providing and managing the financial, institutional and legal framework for developing and supporting S&T, including R&D activities.

C.1 Administration, management, funding of S&T

C.2 Intellectual property protection

C.3 Analytical studies supporting S&T policymaking

C.1 Administration, management, funding of S&T

The category includes:

- The raising, management, distribution and assessment of grants and other financial support mechanisms for S&T activities, including R&D (see *Frascati* Para. 2.121), but also support for other closely related domains such as innovation or technology development.
- The administration of educational support programmes focusing on S&T such as post-graduate scholarships.

This category excludes:

- The administration and management *of technical and scientific* aspects of R&D projects which are included in R&D.

Clarifications and examples:

- This category mainly includes Government and Higher Education institutions, but may also include private sector bodies such as non-profit foundations.

[16] See *Frascati* Para. 2.90.

C.2 Intellectual property protection

This category includes:

- Activities relating to the application and granting of patents, licenses and other forms of intellectual property (IP) protection such as industrial designs and utility models.
- Systematic work of a scientific, legal and administrative nature carried out by public bodies such as national IP/patent offices as well as private legal firms and IP departments within businesses.

This category excludes:

- New IP analytics methods (since they would be part of R&D), along with litigation costs related to IP protection.

Clarifications and examples:

- These activities are usually carried out by highly-skilled individuals, often with a scientific background, and involve the examination, review dissemination and preservation of technical information.

C.3 Analytical studies supporting S&T policymaking

This category includes:

- Policy and quantitative studies focusing on S&T-related topics and aimed at providing advice to S&T policy-makers.
- Technology foresight, evaluation, bibliometric studies and similar approaches using scientific methods to provide insights into S&T policymaking, for example studies on the economics of innovation, the funding and management of research systems, or inter-disciplinary studies carried out to advance science and innovation policy, including under the heading of the "science of science policy", unless they are clearly part of an R&D project.

Clarifications and examples:

- Unlike R&D, these studies are not aimed at developing new methods, but at providing empirical evidence using established methods that can inform and support S&T-related planning or policymaking.[17]
- These activities are carried out by a variety of actors including Government institutions (e.g. Ministries of Science/Innovation, science/research councils), research centres and think tanks, Higher Education institutions, and consulting and other private sector firms.

[17] The *Frascati Manual* (OECD, 2015) clarifies that although "scientific advisors play an important role within government [...] the application of established decision-making criteria to policy making does not represent R&D" (Para. 2.120).

4.4 Preservation, interpretation and dissemination of scientific information and knowledge

This category comprises specialized organizations and activities focusing on the preservation, interpretation and dissemination of scientific information to either the general public or to more technical audiences.

D.1 Preservation, interpretation and dissemination of S&T-related knowledge

D.2 Publishing, translating and archiving of S&T books, journals and other forms of printed and electronic publications

D.1 Preservation, interpretation and dissemination of S&T-related knowledge

This category includes:

- Activities of museums of science, technology and engineering, botanical and zoological gardens, aquariums, planetariums and other S&T collections.
- Museums, historical sites and other similar institutions focusing on the social sciences, and humanities such as anthropological, archaeological, ethnological, and geological collections.
- Activities of National Academies of Science or similar specialized institutions, and the activities of professional associations or scientific societies.
- Organizations involved in science prizes and awards, and those engaged in promoting public awareness and understanding of science, public engagement (citizen science) as well as careers in science.
- Non-formal S&T education activities such as those carried out in science centres.

This category excludes:

- Organizations specialised in funding and managing S&T programmes (including scholarships) which should be included in category B.1.
- Formal education in science and technology at the tertiary level which is part of STET.

Clarifications and examples:

- Regarding art museums, only scientific activities should be considered, and should be included in category A (S&T support services). This includes for example the use of scientific instruments and methods for testing and analysis.
- Some of these organizations may also be carrying out R&D activities which should be distinguished from STS.
- Many of the organizations carrying out these activities will be found in the Government or Private Non-Profit sectors, although some will also be found in the business sector, particularly in ISIC Rev.4 Class 9102 (Museums activities and operation of historical sites and buildings) and 9103 (Botanical and zoological gardens and nature reserves activities).

D.2 Publishing and translating of S&T books, journals and other forms of printed and electronic publications

This category includes:

- Services provided by libraries, archives, and other information and documentation centres specializing in S&T. This group covers organizations whose main function is to make existing S&T information available to users in printed or electronic form. General purpose institutions such as non-specialized public libraries should be excluded.
- Systematic work on the publication and translation of specialized S&T books, journals and other periodicals such as science magazines and news services, as well as electronic and online information platforms such as websites, databases, etc. This includes bibliometric and other scientometric databases. [18]
- Activities aimed at making scientific data, and research results accessible to a broader audience, particularly through online platforms (open science, open data).

This category excludes:

- Any activity regarding non-S&T books, journals, periodicals, databases as well as textbooks for school and university courses, as well as the preparation of the original report of research findings which should be considered as R&D.
- IT-based networks and infrastructure fully dedicated to research should also be excluded when they are part of R&D.

Clarifications and examples:

- Organizations carrying out these activities in the business sector would generally be classified in ISIC Rev.4 Class 5811 (Book publishing), 5812 (Publishing of directories and mailing lists), 5813 (Publishing of newspapers, journals and periodicals) and 5819 (Other publishing activities).

5. Measurement issues

This section reviews a number of issues related to the collection of data on STS. The objective of these recommendations is to ensure a reasonable level of international comparability while maintaining some continuity with ongoing data collection activities. Another guiding principle is to ensure compatibility with related data collection efforts, particularly regarding R&D.

5.1 Sectoral coverage and target population

STS can be performed by organizations across all institutional sectors. Nonetheless, in some countries, a large share of STS may be concentrated in institutions which are classified in the Government (Federal and sub-national) and Higher Education sectors. These sectors may therefore be prioritized in terms of measurement if performer-based sources (such as surveys) are used to collect data. To the extent possible

[18] Such as Scopus (Elsevier), Web of Science (Clarivate Analytics), Google Scholar, etc.

data should also be collected for units in the Business Enterprise and Private Non-profit sectors, particularly if they carry out a significant amount of STS or if they are involved in public-private partnerships that involve or support S&T activities. If the data collected excludes certain sectors, this should be clearly noted when data are reported. The definitions of institutional sectors for collecting data on STS should be consistent with those used for R&D as outlined in the *Frascati Manual* (Chapter 3).

STS are defined in terms of the nature of the *activities* regardless of the nature of the *organization* which carries out such activities and whether they carry out related activities such as R&D. Therefore, a *functional* approach based on the nature of the activities should be prioritized in terms of measurement:

- this requires identifying S&T activities across all types of organizations.
- typical examples of relevant activities include:
    - carrying out surveys and other forms of scientific data collection;
    - processing and dissemination of scientific information;
    - feasibility and other studies;
    - testing, metrology and standards.

In practice, it may be easier to complement this with an *institutional* approach based on the type of organization considered since in the case of some STS, they are mainly carried out by a limited number of such organizations (*e.g.* patent offices, standard setting bodies), and in most countries, many of these often will be Government/public sector organizations or bodies.

- Most of these organizations will mainly carry out STS, but some may also carry out R&D, so it is important to clearly identify these two activities within such organizations.
- STS will also be present in organizations mainly carrying out R&D or with significant research activities (*e.g.* research centers/labs, observatories, higher education institutions, science parks), so such organizations should also be included in the scope of surveys measuring STS.

In terms of identifying organizations performing STS, data collectors should therefore prioritize:

1. R&D performers. These organizations should already be included within the scope of R&D surveys. The main challenge for measurement concerns clarifying the boundary between R&D and STS. This includes many organizations listed under categories A.1, A.3.
2. Organizations specialized in providing STS. Some of these may also be covered by R&D statistics. Budgetary data broken down by socio-economic objectives (or fields of education/science/R&D) may also be useful for identifying such organizations, particularly those in the Government and Higher Education sectors. For the business sector, the references to industrial classification codes listed in the previous section may also be useful in identifying the target population. This includes many of the organizations listed under categories C.1, C.2, D.1, D.2.

3. Other organizations whose main activity is related to S&T. This includes Government or other official bodies involved in S&T policy-making or governance, for example those funding S&T activities. This includes many of the organizations listed under categories A.2, B.1, B.2
4. Other types of institutions not specializing in S&T which can in some cases be providing STS. This includes many of the organizations listed under categories B.3, D.3.

Various sources may be available at the national level to identify public sector organizations involved in S&T policy-making and providing STS. An example of a tool to help construct such an inventory and map the organizational structure of these institutions can be found in UNESCO's GO-SPIN framework and series of national studies (UNESCO, 2014).

5.2 Data sources

Similarly to R&D, the most commonly used source for collecting data on STS are surveys, followed by budgetary data[19]. Some countries carry out a dedicated survey, particularly when the coverage is limited to the Government sector. Other countries may use a combination of surveys covering STS as well as other topics (such as R&D). Since STS data should be collected for all sectors, a combination of approaches can be followed including:

- exploiting existing surveys already targeting R&D performing institutions where additional information on expenditure in various categories of STS can be collected[20] (this includes Government, Higher Education, the Business Enterprise and the PNP sector);
- using other performer-based data sources such as innovation surveys which can help identify STS in non R&D-performing organizations;
- using funder-based data such as S&T budgets from Government organizations. This is similar to the approach used for producing estimates of Government budget allocations on R&D (GBARD, see *Frascati Manual* Chapter 12). The use of detailed classifications of government expenditure/budgets by socio-economic objectives (such as NABS) or functions of Government (such as COFOG) can help identify particular institutions or programmes (see Annex 2);
- administrative sources can be used to complement or validate survey-based data, although a key concern is avoiding double-counting when funder and performer-based measures are combined; the use of such sources can help reduce the costs of collecting STS data, but concepts and definitions should be closely aligned with those used in surveys;[21]

19 Particularly in countries which currently only collect data for the Government and Higher Education sectors.

20 See for example UNESCO/UIS (2014) for guidance on conducting R&D surveys.

21 See for example section 6.4 in OECD (2015) for guidance on the use of administrative data for the purpose of collecting R&D statistics.

- business registers and national registers of Government (or non-profit) organizations can also be used to help define the target population, particularly in countries with a limited number of units involved in STS.

5.3 Units of measurement

5.3.1 STS expenditure data

Regarding STS, data collection efforts should prioritize producing estimates of STS expenditure. In order to avoid double-counting and to be consistent with R&D statistics, expenditure data should cover STS *performed* within the reporting unit (intramural STS) and not purchases of external STS (extramural STS) provided by third parties.

In line with common practice for R&D[22], STS expenditure data should include:

- current expenditure
  - labour costs: compensation for personnel providing STS;
  - other current costs (excluding amortization and depreciation): non-capital purchases of material, supplies, equipment and services.
- capital expenditures
  - land and buildings;
  - machinery and equipment;
  - capitalized computer software;
  - other intellectual property products.

When measuring STS in organizations which also carry out R&D, it is important to correctly allocate expenditures which may relate to both activities in order to avoid double counting, for example through the use of coefficients.

5.3.2 STS personnel data

Although expenditure is the main variable recommended for collecting STS data, countries may also wish to produce estimates of STS personnel. This section highlights the main approach to follow and some of the challenges.

In terms of the activities carried out, an individual can either:

1. carry out STS as their sole activity;
2. carry out STS as well as R&D and/or other activities such as STET;
3. not be involved in STS.

For case (2), R&D personnel data are widely available through *Frascati*-type surveys so in principle Full-time equivalents (FTEs) can be used to estimate the share of time spent on each type of activity.

22 See *Frascati Manual* Section 4.2

For case (1), either FTEs or Headcounts can be used to estimate STS personnel in those organizations which are reporting STS expenditure, but FTEs should be prioritized in order to obtain consistent estimates for various categories of personnel, particularly when STS data collection is combined with that for R&D in order to avoid double counting.

In the case of R&D, three occupational groups are identified based on R&D functions (*Frascati* Chapter 5): (a) Researchers; (b) Technicians and equivalent staff; and (c) Other supporting staff. In the case of STS it is not possible to establish a direct correspondence since STS cover a wide range of activities, some requiring specialized technical knowledge (similar to that of researchers and technicians), but others not. It is therefore recommended to estimate a total figure for STS personnel without a further breakdown by function or skill level. STS personnel would therefore constitute a fourth category in addition to the 3 groups which comprise R&D personnel.

Using the ISCO-08 classification (ILO, 2012), the following (non-exhaustive) list of occupations (at the 2-digit, sub-major group level) would likely be of particular relevance to STS:

- 21 Science and engineering professionals;
- 22 Health professionals;
- 25 ICT professionals;
- 31 Science and engineering associate professionals;
- 32 Health associate professionals;
- 35 Information and Communications Technicians;
- 61 Market-oriented Skilled Agricultural Workers;
- 62 Market-oriented Skilled Forestry, Fishery and Hunting Workers;
- 74 Electrical and Electronic Trades Workers.

A breakdown by level of qualification (based on ISCED levels of educational attainment) could also be used, particularly to distinguish personnel having completed tertiary education at various levels (see Annex Table 2.4).

5.4 Recommended breakdowns

Although a number of breakdowns of STS data may be of analytical use, it is important to focus on only a few to ensure good data reliability. Two broad groups can be identified, although national/regional circumstances or changes in policy priorities[23] may result in some deviation from these broad recommendations:

Higher priority breakdowns:

- broad categories relating to the list-based definition of STS, covering:
    1. Technical S&T support activities;
    2. Scientific data collection and analysis;
    3. Governance, management and legal framework supporting S&T;
    4. Preservation, interpretation and dissemination of scientific information and knowledge.
- institutional sector of performance (BES, GOV, HES, PNP).

Lower priority breakdowns:

- source of funds: internal vs. external sources; by institutional sector (BES, GOV, HE, PNP, ROW);
- socio-economic objectives, although this is mainly relevant for STS performed by institutions in the Government sector;
- fields of research and development (FORD) / fields of science and technology;
- breakdowns for STS personnel (gender, occupation, education).

[23] For example regarding measurement of progress towards reaching the SDGs.

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Annex 1. Previous definitions (1984)

Scientific and technological activities (STA)

"For statistical purposes, scientific and technological activities (STA) can be defined as all systematic activities which are closely concerned with the generation, advancement, dissemination and application of scientific and technical knowledge in all fields of science and technology, that is the natural sciences, engineering and technology, the medical and the agricultural sciences (NS), as well as the social sciences and humanities (SSH)."

Scientific and technological services (STS)

"Scientific and technological services (STS) can be defined as any activities concerned with scientific research and experimental development and contributing to the generation, dissemination and application of scientific and technical knowledge."

STS includes:

1. S&T services provided by libraries, archives, information and documentation centres, reference departments, scientific congress centres, data banks and information-processing departments.
2. S&T services provided by museums of science and/or technology, botanical and zoological gardens and other S&T collections (anthropological, archaeological, geological, etc.).
3. Systematic work on the translation and editing of S&T books and periodicals.
4. Topographical, geological and hydrological surveying; meteorological and seismological observations; surveying of soils and of plants; fish and wildlife resources; routine soil, atmosphere and water testing; the routine checking and monitoring of radioactivity levels.
5. Prospecting and related activities designed to locate and identify oil and mineral resources.
6. The gathering of information on human, social, economic and cultural phenomena, usually for the purpose of compiling routine statistics, *e.g.* population censuses; production, distribution, and consumption statistics; market studies; social and cultural statistics, etc.
7. Testing, standardization, metrology and quality control; regular routine work relating to the analysis, checking and testing, by recognized methods, of materials, products, devices and processes, together with the setting up and maintenance of standards and standards of measurement.
8. Regular routine work on the counselling of clients, other sections of an organization or independent users, designed to help them to make use of scientific, technological and management information.
9. Activities relating to patents and licenses.

Source: UNESCO, 1984a.

Annex 2. Statistical classifications

Annex Table 2.1. Frascati Manual Fields of R&D (FORD) classification

Broad classification	Second-level classification
1. Natural sciences	1.1 Mathematics 1.2 Computer and information sciences 1.3 Physical sciences 1.4 Chemical sciences 1.5 Earth and related environmental sciences 1.6 Biological sciences 1.7 Other natural sciences
2. Engineering and technology	2.1 Civil engineering 2.2 Electrical engineering, electronic engineering, information engineering 2.3 Mechanical engineering 2.4 Chemical engineering 2.5 Materials engineering 2.6 Medical engineering 2.7 Environmental engineering 2.8 Environmental biotechnology 2.9 Industrial biotechnology 2.10 Nano-technology 2.11 Other engineering and technologies
3. Medical and health sciences	3.1 Basic medicine 3.2 Clinical medicine 3.3 Health sciences 3.4 Medical biotechnology 3.5 Other medical science
4. Agricultural and veterinary sciences	4.1 Agriculture, forestry, and fisheries 4.2 Animal and dairy science 4.3 Veterinary science 4.4 Agricultural biotechnology 4.5 Other agricultural sciences
5. Social sciences	5.1 Psychology and cognitive sciences 5.2 Economics and business 5.3 Education 5.4 Sociology 5.5 Law 5.6 Political science 5.7 Social and economic geography 5.8 Media and communications 5.9 Other social sciences
6. Humanities and the arts	6.1 History and archaeology 6.2 Languages and literature 6.3 Philosophy, ethics and religion 6.4 Arts (arts, history of arts, performing arts, music) 6.5 Other humanities

Source: OECD, 2015

Annex Table 2.2. NABS 2007 Classification

EU Nomenclature for the Analysis and Comparison of Scientific Programmes and Budgets (NABS) 2007 Classification

Chapter 1 - Exploration and exploitation of the earth.
Chapter 2 - Environment.
Chapter 3 - Exploration and exploitation of space.
Chapter 4 - Transport, telecommunication and other infrastructures.
Chapter 5 - Energy.
Chapter 6 - Industrial production and technology.
Chapter 7 - Health.
Chapter 8 - Agriculture.
Chapter 9 - Education.
Chapter 10 - Culture, recreation, religion and mass media.
Chapter 11 - Political and social systems, structures and processes.
Chapter 12 - General advancement of knowledge: R&D financed from general university funds (GUF).
Chapter 13 - General advancement of knowledge: R&D financed from other sources than GUF.
Chapter 14 - Defence.

Source:
http://ec.europa.eu/eurostat/ramon/nomenclatures/index.cfm?TargetUrl=LST_NOM_DTL&StrNom=CL_NABS07&StrLanguageCode=EN&IntPcKey=&StrLayoutCode=HIERARCHIC

Annex Table 2.3. COFOG

UN/OECD COFOG (Classification of the Functions of Government)

01 - General public services
02 - Defence
03 - Public order and safety
04 - Economic affairs
05 - Environmental protection
06 - Housing and community amenities
07 - Health
08 - Recreation, culture and religion
09 - Education
10 - Social protection

Source: http://unstats.un.org/unsd/cr/registry/regcst.asp?Cl=4

Annex Table 2.4. ISCED levels of education (ISCED-2011)

ISCED-Attainment (ISCED-A)
0 - Less than primary education
1 - Primary education
2 - Lower secondary education
3 - Upper secondary education
4 - Post-secondary non-tertiary education
5 - Short-cycle tertiary education
6 - Bachelor's or equivalent level
7 - Master's or equivalent level
8 - Doctoral or equivalent level
9 - Not elsewhere classified

Source: UNESCO Institute for Statistics, 2012