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Manual on measuring Research and Development in ESA 2010

2014 edition

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Contents

Section 1: Purpose of the manual

1.1 National Accounts in the European Union are produced by Member States in a comparable and reliable way. This is particularly important for measures of the economy which have a key role to play in the economic and fiscal policy of the European Union. An example of a change affecting key measures is the expansion of the asset boundary in ESA 2010 from the one recognised under ESA 95. Research and Development (R&D) is scored as capital formation in the national accounts, and this expands the range of assets recognised as intellectual property products (IPPs).

1.2 This manual describes the sources and methods for producing estimates of R&D for the national accounts. It is widely accepted that R&D creates intellectual property products which are key in promoting industrial innovation and economic growth. So it is important that the national accounts include reliable and consistent estimates across Member States of the European Union. It is also widely accepted that this is an area where collecting the appropriate data is difficult. A range of assumptions is needed in the production methods. In these circumstances, where experience of producing robust estimates is limited, it is especially important that Member States have clear guidance on how best to tackle the challenges of collecting data from reliable statistical sources, and using the data to produce estimates of R&D which are consistent across Europe. This manual gives such guidance.

1.3 Experience has shown that worked numerical examples of changes from the previous standard are very useful to the Member State producers of national accounts. Setting out how the introduction of Research and Development as capital formation affects the various accounts and balance sheets in the national accounts, helps Member States introduce the changes in a consistent manner.

Section 2: Introduction

2.1 Intellectual property has the attributes of a capital good apart from physical presence: it lasts a long time, can be owned, and will provide expected future benefits which determine the current value of the intellectual property. It depreciates in value, but only through obsolescence, not wear and tear. However, a major challenge in measuring the value of intellectual property is that each product is by definition unique. The intangible nature of intellectual property gives rise to understandable measurement problems. For tangible capital goods such as computers, similar products are sold on the market at observable prices and quantities. This is not the case for the results of R&D. The performance of R&D results in ideas protected through secrecy, or legal devices such as copyrights and patents. This regulatory structure can be used to administer fees for the use of the copyrights and patents, but most R&D is used 'in-house' without such external market use.

2.2 Intellectual Property Products are not simply a variant on the more usual tangible assets represented in economic theory and the national accounts. IPPs are different in their very nature, and pose different conceptual, methodological and measurement challenges for economists and producers of national accounts.

2.3 R&D is defined in ESA 2010 as follows:

Research and Development is creative work undertaken on a systematic basis to increase the stock of knowledge, and use of this stock of knowledge for the purpose of discovering or developing new products, including improved versions or qualities of existing products, or discovering or developing new or more efficient processes of production.

A fuller description of the international standards for R&D and intellectual property products in general, is given in Annex 1.

Work leading up to the present manual

2.4 In the light of the changes to ESA 2010 compared to ESA 95, Eurostat set up two task forces on the capitalisation of R&D. The first task force met five times and produced a final report in 2009. The task force worked in partnership with an OECD task force also considering the topic and was able to agree in broad terms with the outcome of the OECD work - the Handbook on Deriving Capital Measures of Intellectual Property Products. One of the main products of the first Eurostat task force was a set of templates that Member States could use to submit data for their first estimates of R&D as capital formation. These tables focused on the use of data available through the surveys supporting the measurement of R&D according to the Frascati Manual framework.

2.5 A fuller description of the work of these two taskforces and the OECD handbook is given in Annex 2.

Section 3: R&D capitalisation

3.1 The performance of R&D gives rise to new Intellectual Property Products, classified as capital under ESA 2010. Given the limited trade in final R&D products, it is usually not possible to measure their value through a summation of market values. Most of R&D is carried out within an enterprise, for use within the enterprise and so no market price is observable. In cases such as the construction of buildings on own account, it is possible to establish a price for the output by examining the market for similar structures and imputing a value of output. The unique nature of each R&D product determines its value, and the lack of a market in comparable products requires the value of own-account R&D to be estimated through a sum of costs approach.

3.2 ESA 2010 paragraph 3.83 sets out how the output of R&D is measured.

The output of R&D services is measured as follows:

(a) R&D by specialised commercial research laboratories or institutes is valued at the revenue from sales, contracts, commissions, fees, etc. in the usual way;

(b) The output of R&D for use within the same enterprise is valued on the basis of the estimated basic prices that would be paid if the research were subcontracted. In the absence of a market for subcontracting R&D of a similar nature, it is valued as the sum of production costs plus a mark-up (except for non-market producers) for net operating surplus (NOS) or mixed income;

(c) R&D by government units, universities and non-profit research institutes is valued as the sum of costs of production. Revenues from the sale of R&D by non-market producers are to be recorded as revenues from secondary market input.

Expenditure on R&D is distinguished from that on education and training. Expenditure on R&D does not include the costs of developing software as a principal or secondary activity.

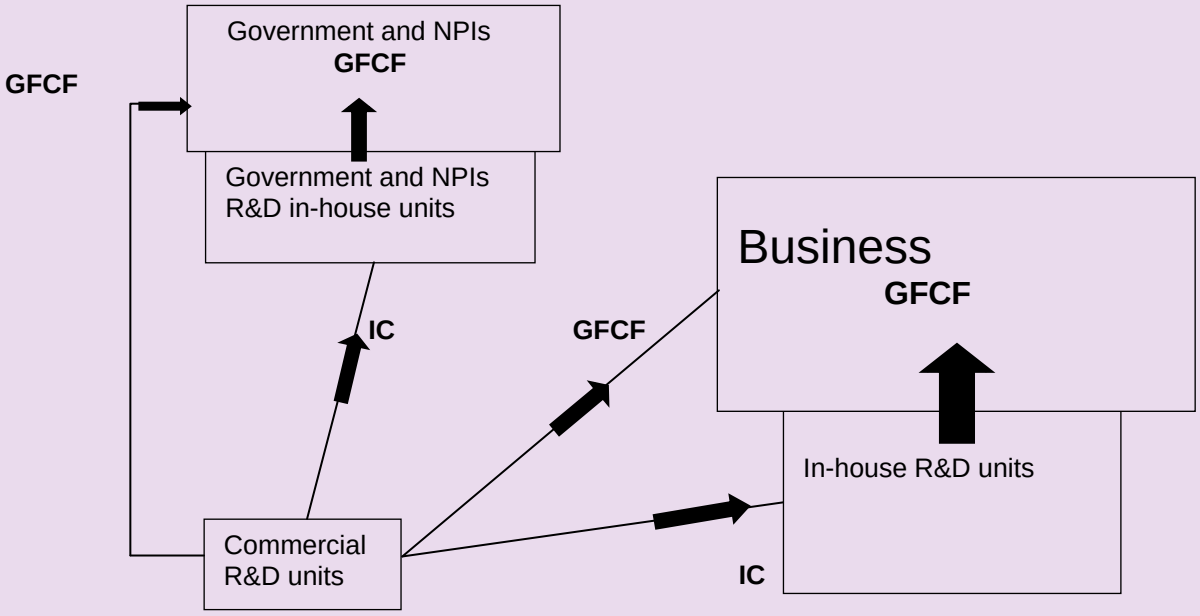
3.3 The production of R&D services, and the use of the resulting asset is the same as that for arts, entertainment and recreation services, as described in paragraph 3.86 of ESA 2010.

The production of books, recordings, films, software, tapes, disks, etc. is a two-stage process and is measured accordingly:

(a) The output from the production of originals — an intellectual property product — is measured by the price paid if sold, or, if not sold, by the basic price paid for similar originals, its production costs (including a mark-up for NOS) or the discounted value of the future receipts expected from using it in production;

(b) The owner of this asset may use it directly or to produce copies in subsequent periods. If the owner has licensed other producers to make use of the original in production, the fees, commissions, royalties etc. received from the licences are the output of services. However, the sale of the original is negative fixed capital formation.

Box 3.1 Example of the most common flows of R&D products between domestic sectors



The main production of R&D products occurs in the in-house R&D units of business. Under ESA 2010, these units are recognized as secondary units performing R&D and products created are acquired as capital formation by their main business.

Commercial R&D units perform R&D either on contract or speculatively. The majority is on contract, either directly for production business, or through sub-contracts for in-house R&D units.

Where the output of commercial R&D units goes to other commercial R&D units or in-house R&D units, it is treated as intermediate consumption as the product will be embedded as a component in a final R&D product. Where the output goes direct to a main production business, it is recognized as capital formation by the business.

Government and NPI units performing R&D will produce output which is considered to be held by the government and the NPIs themselves as capital assets, even although the use of these assets is normally freely available.

A relatively uncommon case is where a commercial unit produces and keeps an R&D product which it licenses out to other units. Then the commercial unit should show this output going to own account capital formation, and estimate its value through a sum of costs approach. This case is not illustrated above.

3.4 The recognition of R&D expenditure as capital formation will affect several entries in the sequence of accounts. For market producers where the R&D is carried out in-house for internal use, the value of the capital asset created is recognised as additional output, which results in an increase in capital formation as well as gross operating surplus. For non-market producers (government and NPISHs) the output is recognised as capital formation. The R&D spending will be reclassified from consumption expenditure to gross investment and the additional consumption of fixed capital will be recorded in consumption expenditure. As the output of non-market producers is calculated through summing of costs, this change does not cause any extra measured output in the year of formation, but the resulting addition to costs through the extra consumption of fixed capital during the life of the newly created asset, results in increased output and value added for the economic life of the asset. For market producers directly selling their products on the market, the main change is to recognise the acquisition of R&D products as capital formation. This directly increases the level of GDP and GNI.

3.5 The acquisition by R&D units of capital assets such as scientific equipment and buildings for use in the performance of the R&D services is already captured under ESA 95, and this does not change in ESA 2010.

3.6 The activity of allowing others to use intellectual property products and similar products for which a licensing fee is paid to the owner of the product is classified to Nace 77.40 (Leasing of intellectual property and similar products, except copyrighted works). Countries should cross-check with other data sources than the Frascati surveys in order to identify and record these activities in a comprehensive way.

3.7 The basis for using a sum of costs approach in estimating output of R&D is as follows.

An enterprise will incur costs in order to generate products and so collect revenue usually through one of the following ways:

(a) The original will be sold outright through complete change of ownership;

(b) The original will be retained, but copies will be sold which in themselves will be recognised as assets on acquisition by the buyer;

(c) The original will be retained, and revenue generated through short-term licence fees whereby licence holders can use the original, but with no acquisition of ownership rights as a stand-alone asset;

(d) The original will be retained, and no revenue will be generated through direct sale or licencing of the IPP. The IPP will be recorded as a capital asset, and deliver a stream of capital services to the main business so that revenue is generated through products manufactured on the basis of the R&D.

3.8 In incurring the costs of performing the R&D, the producer will look to cover the costs through all of these possibilities, depending on the nature of the business and the nature of the product. The business model is that although it is not possible to identify immediately after production which of the products will be a success and bring in revenue, on average and over time the business has prospered by generating enough successes along with the inevitable failures to be a going concern — to cover its costs and give a sufficient return to its owners. This model is the justification for using a sum of costs approach to estimating the value of the R&D output.

3.9 For non-market producers, there is no incentive to give a return to owners, but for market producers, the prices must be set to pay sufficient dividends to owners to keep them satisfied with performance. This explains why a mark-up equal to net operating surplus should be added to costs for market producers, but not for non-market producers.

3.10 In calculating the output through performance of R&D, there are several different cases to be considered.

(a) Own account R&D performance in a market producer enterprise.

This is where a secondary R&D unit is part of a larger enterprise, and its production is passed on to the principle, and where the successful products are used as capital assets in the production of the enterprise. This is the most usual case; accounting for 90 % of R&D output according to Australian estimates in 2009. In this case, the performance of R&D leads to the creation of an original R&D product, which on acquisition by the principal unit of the enterprise, is recorded in the national accounts as capital formation. It has been decided for practical measurement reasons that the capital formation should be recorded as the costs are incurred in the performance of R&D, rather than attempt to measure the build-up of work in progress before the acquisition of the capital asset is recognised as a transfer out of work in progress. Here the measurement of the output is straightforward — it is the sum of current costs (compensation of employment and payments for intermediate consumption), plus a contribution of capital services from other traditional capital assets such as buildings, machinery etc. The capital services are measured through the value of capital consumption of these assets. Finally for market producers, there is the extra 'cost' of a mark-up reflecting the need to generate enough operating surplus to meet the dividend expectations of the owners. This mark-up can be estimated through examination of the mark-up of commercial R&D units operating in the same area of technology. If such information does not exist, then the average net operating surplus of the parent industry of the in-house unit may be used.

(b) Own account R&D performance by a non-market unit.

The non-market unit will be non-profit, and often funded by government. Here the valuation of the R&D products will be as for case 1, but without the mark-up as there are no owner dividend expectations to be met.

(c) Performance of R&D on contract

Here the performance of R&D is paid for and the results handed over to the contractor on completion. The existence of payment for a product means that there is no need for the sum of costs approach, and the value of the output is simply the revenue received.

(d) Performance of R&D for speculative sale

As with any other product, in theory the product should be stored as an increase to stocks of finished goods until sold to be recorded as capital formation by the buyer. As there is no basis to price such unique products until they are sold, by convention output is either valued through the sum of costs approach, or output is not recorded until a sale is made. A reasonable approach for the national accounts is to accept a value through the cost approach, but look to revalue when a sale is achieved. Performance of R&D for speculative sale is unusual, and examples must be treated on an individual basis if the size warrants it.

(e) Performance of R&D by a commercial R&D unit, not for sale.

The R&D product will be held as a capital asset by the producer, and revenue obtained through the selling of copies for recognition as capital formation by the buyer, or by revenue from short-term licencing arrangements (licence payments covering a year or less). Here the costs approach as set out in case 1 is appropriate.

Where copies are sold to be recognised as capital assets, through licencing arrangements where the payments cover more than one year, then the production of copies is recognised as output. Given the unique nature of R&D products, and that the value to the owner of the original comes through retaining sole ownership, such outright sales of copies under long-term licencing arrangements could be rare in practise for R&D.

R&D capitalisation — Numerical example for a market producer

3.11 A corporation has an output of 50m euros, and total inputs of materials and fuel of 20m euros, and services of 10m euros. Compensation of all employees is 15m euros and so operating surplus is 5m euros. There is capital consumption of existing assets of 5. In one year, R&D is carried out within the corporation leading to the creation of intellectual property. For the R&D activity, part of materials and fuel used for this is 5m euros, services used is 5m euros and compensation of employees is 5m euros. Existing capital assets contribute 1 in CFC to the creation of the new R&D asset — it is assumed in this example that R&D assets newly recognised on the balance sheet under ESA 2010 do not contribute to the creation of new R&D, but do contribute in general terms to the output of the corporation.

3.12 To calculate the output of R&D, we sum the costs of undertaking R&D. They are materials (5) and services (5), compensation of employees (5), capital consumption of 1 from existing assets to the performance of the R&D, and an imputed mark-up of 1. So the output value of R&D is measured as intermediate consumption (5+5) + compensation of employees (5) + capital consumption (1) + mark-up (1) = 17.

Accounts

ESA 95 treatment — Market producer

Production account

Uses		Resources	
Materials and fuel	20	Output	50
Services	10		
Intermediate consumption	30		
Value added	20		

Generation of income account

Uses		Resources	
Compensation of employees	15	*Value added*	20
CFC	5		
Operating surplus, net	0		

Allocation of income account

Uses		Resources	
		Operating surplus, net	0
Balance of primary incomes, net	0		

Secondary distribution of income account

Uses		Resources	
		Balance of primary incomes, net	0
Disposable income, net	0		

Use of income accounts

Uses		Resources	
		Disposable income, net	0
Saving, net	0		

Capital account

Changes in assets		Changes in liabilities and net worth	
		Saving, net	0
CFC	– 5		
Net lending/borrowing	5		

ESA 2010 treatment, recognizing R&D as capital formation and valuing output of R&D at sum of costs

Production account

Uses			Resources		
	Main activity	R&D		Main activity	R&D
Materials	15	5		50	17
Services	5	5			
Intermediate consumption	20	10			
Value added	30	7			

Generation of income account

Uses			Resources		
	Main activity	R&D		Main activity	R&D
Compensation of employees	10	5	*Value added*	30	7
CFC	4	1			
Operating surplus, net	16	1			

Capital account

Changes in assets			Changes in liabilities and net worth		
	Main activity	R&D		Main activity	R&D
Capital formation (R&D)		17	*Saving, net*	16	1
CFC	– 4	– 1			
Net lending/borrowing	20	– 15			

ESA 2010 accounts, combining R&D with main activity — Market producer

Production account

Uses		Resources	
Materials and fuel	20	Output	67
Services	10		
Intermediate consumption	30		
Value added	37		

Generation of income account

Uses		Resources	
Compensation of employees	15	*Value added*	37
CFC	5		
Operating surplus, net	17		

Allocation of income account

Uses		Resources	
		Operating surplus, net	17
Balance of primary incomes, net	17		

Secondary distribution of income account

Uses		Resources	
		Balance of primary incomes, net	17
Disposable income, net	17		

Use of income accounts

Uses		Resources	
		Disposable income, net	17
Saving, net	17		

Capital account

Changes in assets		Changes in liabilities and net worth	
R&D	17	*Saving, net*	17
CFC	– 5		
Net lending/borrowing	5		

Changes of ESA 2010 accounts over ESA 95 accounts — Market producer

Production account

Uses		Resources	
Materials and fuel		Output	+ 17
Services			
Intermediate consumption			
Value added	+ 17		

Generation of income account

Uses		Resources	
Compensation of employees		*Value added*	+ 17
CFC			
Operating surplus, net	+ 17		

Allocation of income account

Uses		Resources	
		Operating surplus, net	+ 17
Balance of primary incomes, net	+ 17		

Secondary distribution of income account

Uses		Resources	
		Balance of primary incomes, net	+ 17
Disposable income, net	+ 17		

Use of income accounts

Uses		Resources	
		Disposable income, net	+ 17
Saving, net	+ 17		

Capital account

Changes in assets		Changes in liabilities and net worth	
R&D	+ 17	*Saving, net*	+ 17
Net lending/borrowing	+ 0		

3.13 The example shows that output, value added and operating surplus have risen by 17. The extra operating surplus feeds down to the capital account so that there is an extra 17 to pay for the new capital formation of 17, and net lending remains unchanged at 5.

R&D capitalisation — Numerical example for a non-market producer

3.14 Now consider the case where the producer is non-market — for example government. Then output is calculated as sum of costs, including capital consumption for assets held, but no mark-up is imputed.

3.15 Inputs of materials and fuel are 20m euros, with services input of 10m euros. Compensation of all employees is 15m euros, and capital consumption of existing capital assets is 5. In the period considered, R&D is carried out within government leading to the creation of intellectual property. For the R&D activity, the part of materials and fuel used for this is 5m euros, services used is 5m euros and compensation of employees is 5m euros. Of the CFC of 5, 1 is due to using existing assets for the performance of R&D.

Net tax revenue is assumed to be 50, to cover costs.

Under ESA 95, gross output is sum of input costs and so

Gross output = intermediate consumption (20 + 10) + compensation of employees (15) + CFC (5) = 50

ESA 95 treatment — Non-market producer, million EUR

Production account

Uses		Resources	
Materials and fuel	20	Output	50
Services	10		
Intermediate consumption	30		
Value added	20		

Generation of income account

Uses		Resources	
Compensation of employees	15	*Value added*	20
CFC	5		
Operating surplus, net			

Allocation of income account

Uses		Resources	
		Operating surplus, net	0
Balance of primary incomes, net	0		

Secondary distribution of income account

Uses		Resources	
		Balance of primary incomes, net	0
		Net tax revenue	50
Disposable income, net	50		

Use of income accounts

Uses		Resources	
Government final consumption	50	*Disposable income, net*	50
Saving, net	0		

Capital account

Changes in assets		Changes in liabilities and net worth	
CFC	– 5	*Saving, net*	0
Net lending/borrowing	5		

ESA 2010 treatment, recognizing R&D as capital formation for a non-market producer

3.16 The output of R&D is sum of input costs, with no mark-up.

So R&D output = Intermediate consumption (5+5) + compensation of employees (5) + CFC (1) for assets used in R&D performance.

So output going to GFCF = 10 + 5 + 1 = 16

Output going to government final consumption = Intermediate consumption (15+5) + compensation of employees (10) + CFC (4) = 34

3.17 The example following shows that output, in the year of creation of the R&D asset, value added and operating surplus remained the same. In the capital account there is capital formation of R&D of value 16, and an extra 16 to pay for the new capital formation of 16, so that net lending remains unchanged at 5.

In the year of R&D performance and asset creation, ESA 2010 accounts are

Production account

Uses			Resources		
	Main activity	R&D		Main activity	R&D
Materials	15	5	Non-market output (P.13)	34	
Services	5	5	Output for own final use (P.12)		16
Intermediate consumption	20	10			
Value added, gross	14	6			

Generation of income account

Uses			Resources		
	Main activity	R&D		Main activity	R&D
Compensation of employees	10	5	*Value added, gross*	14	6
CFC	4	1			
Operating surplus, net	0	0			

Allocation of income account

Uses			Resources		
	Main activity	R&D		Main activity	R&D
			Operating surplus, net	0	0
Balance of primary incomes, net	0	0			

Secondary distribution of income account

Uses			Resources		
	Main activity	R&D		Main activity	R&D
			Balance of primary incomes, net	0	0
			Net tax revenue	50	0
Disposable income, net	50	0			

Use of income account

Uses			Resources		
	Main activity	R&D		Main activity	R&D
			Disposable income, net	50	0
Government final consumption	34	0			
Saving, net	16	0			

Capital account

Changes in assets			Changes in liabilities and net worth		
	Main activity	R&D		Main activity	R&D
Capital formation (R&D)		16	*Saving, net*	16	0
CFC	– 4	– 1			
Net lending/borrowing	20	– 15			

ESA 2010 accounts combining R&D with main activity — Non-market producer

Production account

Uses		Resources	
Materials and fuel	20	Non-market output	34
Services	10	Output for own final use	16
Intermediate consumption	30		
Value added	20		

Generation of income account

Uses		Resources	
Compensation of employees	15	*Value added*	20
CFC	5		
Operating surplus, net	0		

Allocation of income account

Uses		Resources	
		Operating surplus, net	0
Balance of primary incomes, net	0		

Secondary distribution of income account

Uses		Resources	
		Balance of primary incomes, net	0
		Net tax revenue	50
Disposable income, net	50		

Use of income accounts

Uses		Resources	
Government final consumption	34	*Disposable income, net*	50
Saving, net	16		

Capital account

Changes in assets		Changes in liabilities and net worth	
Capital formation (R&D)	16	*Saving, net*	16
CFC	– 5		
Net lending/borrowing	5		

Changes of ESA 2010 accounts over ESA 95 accounts in year of creation of R&D asset

Production account

Uses		Resources	
Materials and fuel		Output	+ 0
Services			
Intermediate consumption			
Value added	+ 0		

Generation of income account

Uses		Resources	
Compensation of employees	+ 0	*Value added*	+ 0
CFC	+ 0		
Operating surplus, net	+ 0		

Allocation of income account

Uses		Resources	
		Operating surplus, net	+ 0
Balance of primary incomes, net	+ 0		

Secondary distribution of income account

Uses		Resources	
		Balance of primary incomes, net	+ 0
		Net tax revenue	+ 0
Disposable income, net	+ 0		

Use of income accounts

Uses		Resources	
Government final consumption	– 16	*Disposable income, net*	+ 0
Saving, net	+ 16		

Capital account

Changes in assets		Changes in liabilities and net worth	
Capital formation (R&D)	+ 16	*Saving, net*	+ 16
CFC	+ 0		
Net lending/borrowing	+ 0		

3.18 So there is no change to the level of GDP or GNI in the year of creation. However, the capital consumption of the R&D asset will sum to 16 over its future economic life, and so under ESA 2010 as opposed to ESA 95, this will result in an increase of that amount in the level of government output and value added over this period.

3.19 R&D can be carried out in an activity unit which stands alone, outside an enterprise and recognized as carrying out R&D activity according to the NACE 72 activity code. This is defined as scientific research and development services, and units will typically carry out work on contract for other activity headings. When a unit classified to NACE 72 works as a sub-contractor to another unit performing R&D, there is the possibility of double counting the value of capital formation. The R&D product created by sub-contracting will not provide capital services to the purchaser, but rather an R&D product which will be embedded in the final R&D product produced by the contractor. An example is the sub-contracting of wing design for an aircraft, and then incorporating that design in the whole aircraft blueprints. If both outputs were recorded as capital formation, there would be a double counting of the value of the wing design. To avoid this, acquisition of the R&D product produced by the sub-contractor is recorded as intermediate consumption — as a component of the final product rather than a capital asset which is used up in the production process through the provision of capital services.

3.20 This is different from the case where an enterprise which is mainly a producer of goods, sub-contracts R&D to a specialist and uses the resulting asset in the production of new R&D. In this case the acquisition of the sub-contracted R&D is recorded as capital formation and then the resulting stream of capital services included in the measurement of subsequent R&D products by the contracting-out enterprise. This is an exception to the normal situation, and for practical measurement, sub-contracted R&D for use by units themselves performing R&D will be treated as intermediate consumption.

3.21 A simple example will illustrate these issues. Consider a NACE 72 R&D unit sub-contracting the performance of R&D to a provider, through a contract of value of 10m. The NACE 72 unit employs staff to produce R&D products, and uses existing capital assets in the production process. The total costs as set out in previous examples in this section, will be intermediate consumption of materials, fuels and services, labour costs, and the cost of capital consumption of existing assets. Suppose these costs sum to 100m. Then the acquisition of the sub-contracted R&D will simply add an additional cost of 10m, and the estimate of the value of produced R&D by the contractor will rise to 110m. It is important that the output of the sub-contractor is not recognised as capital formation, but as a component input to the second contractor so that the value of the R&D is successfully captured in the final product and no double-counting occurs.

Section 4: Overview of sources

The sources for estimation of the capitalisation of R&D expenditure in the national accounts have been identified as follows:

4.1 Frascati Manual surveys

There exists a long-standing and reliable source of data on R&D in most European countries; the surveys conducted according to the Frascati Manual. The Frascati Manual (FM) is a guide to collecting data and producing statistics on the measurement of human and financial resources devoted to research and development, often referred to as R&D input data. As there is an insufficient market in trade in R&D, it is necessary to value R&D products as the sum of costs of carrying out the R&D. The surveys established to provide the statistics as prescribed by the Frascati Manual provide a basis for the estimation of R&D in national accounts. The main sources for Frascati Manual estimates of spending on R&D are surveys on the following:

(a) Government Expenditure on R&D (GovERD);

(b) Business Expenditure on R&D (BERD);

(c) Private non-profit making bodies' expenditure on R&D (PNPERD) and

(d) Higher Education expenditure on R&D (HERD)

4.2 There is also a data collection exercise from Government accounts called Government Budget Appropriations and outlays on R&D (GBAORD). This can provide more timely figures on government spending than those available from the R&D survey. It may also be well tied in with other estimates of government spending feeding into the national accounts, such as data supplied to the national accounts according to the classifications of functions of government (COFOG).

4.3 Administrative data e.g. government, university, bank records

As with many administrative sources, such sources are difficult to use in a statistical framework. Slightly different definitions of categories and key concepts can make the absorption of such data into national accounts problematic. Where the government data comes from accounting records, then this is more likely to be useful. A particular case is where the government records feed into official accounts, and so into national accounts estimates of high-profile estimates such as government final consumption, government capital formation, and related measures of government deficit and debt.

4.4 International trade in services surveys

These surveys have the benefit of new categories described in the Balance of Payments Manual (BPM6). For trade in R&D services, there are two distinct categories of payments:

(a) the use of R&D services and

(b) the transfer of ownership of R&D.

4.5 Both of these payments are classified in ESA 2010 within the overall category of 'Payments for International Trade in Services' and form part of the current account of the Balance of Payments. The category 'Research and Development' within the services payments in BPM6 is now reserved for payments in respect of transfer of ownership of R&D. Payments for the use of R&D products should be included with other such payments for the use of intellectual property products.

4.6 BPM6 recognises the difficulty in separating payments for the use of non-produced assets such as trademark revenue which are classed as royalties — transfers of income — and payments for the use of produced assets such as R&D. The pragmatic recommendation is that without detailed information, payments under the heading of franchises and royalties should be assumed to be service payments for the use of produced intellectual property products.

4.7 Structural Business Survey

These surveys collect information on the costs of inputs as well as the revenue from outputs of businesses. Where R&D is carried out within the normal arrangements of the production process, rather than in a unit identified as an R&D unit, the costs of R&D will be included in the general costs of

production. Tracker questions can be introduced to determine where such R&D is carried out, and the panel of R&D units covered by the Frascati Manual Business survey (BERD) checked to ensure that the resulting R&D capital formation is captured through that survey.

4.8 Capital expenditure inquiries, annual and quarterly

The coverage of these inquiries should include the acquisition and disposal of Intellectual Property Products, including those produced as the result of the performance of R&D. There is scope for inconsistencies here, as recognition of the creation of capital assets through the performance of R&D and scored in the business accounts may not be the same value as that arrived at through the BERD survey. Clear guidance is needed for companies as to which collection vehicle should be used for the registering of the creation of IPPs, and which should be used for the acquisition and disposal of existing IPPs, through trade in the associated copyrights and licences.

4.9 Taxes and subsidies data e.g. tax credit systems for R&D

A tax credit system used to encourage the performance of R&D across industry is a potentially valuable source of information on R&D. Where there is a comprehensive system of tax credits and subsidies operated in a country and the statistical office can access the underlying administrative information, these systems can provide sufficient information for reliable estimates. This is the situation in Australia. The situation in Europe has proven to be less favourable, either for lack of such a uniform tax system or the inability for the national statistical office to access detailed administrative information in the tax system.

4.10 Records held by patent offices

Information on patents can give useful information on the length of economic life of R&D, classified by industry. However, the issue of partial coverage is a major problem. R&D can be performed without the final product being patented, and the value preserved through secrecy rather than legal protection.

4.11 In general, compilers should collect data from as many data sources as possible. As different data sources may allow for different thresholds, concepts or other factors their results have to be reconciled.

Section 5: Compilation guide

5.1 The main sources used in Europe for R&D satellite accounts have been the surveys following the principles of the Frascati Manual (FM). The aim of the Frascati Manual is to generate information about the extent and role of R&D, to identify the industry sectors where this occurs, and to identify the source of funds. Much of the information collected through the surveys of the Frascati Manual can be used in estimating R&D as capital formation in the national accounts, but changes are needed to make them consistent with national accounts concepts.

5.2 Table 5.1 shows the template used in successive trials in Europe of how to move from Frascati Manual headings and measure output of the performance of R&D at sector and whole economy level.

Table 5.1: Output of R&D

		S11		S12		S13		S14		S15		TOTAL	
		+	–	+	–	+	–	+	–	+	–	+	–
1	Frascati Manual Intramural expenditures on R&D												
2	Subtract payments for licences to use intellectual products (principally R&D assets, such as patents) that should be recorded as GFCF												
3	Subtract expenditure on own-account production of software												
4	Add payments to postgraduate students not included in FM data												
5	Subtract capital expenditures												
6	Add other taxes on production not included in FM data												
7	Subtract other subsidies on production												
8	Add extramural purchases of R&D that should be recorded as intermediate consumption. Applies only to R&D industry												
9	Sub-Total (1 to 8): current expenditures												
10	Add estimate of consumption of fixed capital plus a return to capital (for non- market producers only consumption of fixed capital):												
11	— Option 1: As percentage of current expenditures (line 9) or compensation of employees												
12	— Option 2: As cost of capital services measured with a PIM												
13	Adjustment for exhaustiveness												
14	Other adjustments												
15	Total: Output of R&D												

The headings used in this table (TF Table 2) will now be described in more detail.

Row 1: FM intramural expenditures for R&D

5.3 The FM definition of R&D has been accepted as consistent with the concepts underlying national accounts.

Intramural expenditures are defined as follows in FM:

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

FM intramural expenditures consist of current and capital expenditures. A full description of intramural expenditure is given in chapter 6 of the Frascati Manual. Current costs are split down into two components: labour costs and other current costs.

5.4 Labour costs are described in detail in FM paragraph 361 and satisfy to a great extent the national accounts concept of compensation of employees.

5.5 Current non-labour costs are consistent with the national accounts definition of intermediate consumption apart from one component: expenditures on licences to use qualifying as GFCF may have been reported under this heading. These have to be deducted and this is carried out in the next row in the table.

Row 2: Subtract payments for licences that should be recorded as GFCF

5.6 These payments are for the acquisition of the outright ownership of R&D products, and not simply for the use of R&D products which remain owned by another entity. Current general guidance for Intellectual Property Products is that if a licence fee is paid annually or more frequently, then the payments are likely to be for the use of the original intellectual property. If the payments cover a longer period than a year, then it is more likely that the payment reflects acquisition of a free-standing capital asset. Ideally, R&D surveys should separately identify these expenditures. However, at the moment no explicit reference is made to licences in the Frascati Manual.

5.7 However, usually the bought-in R&D will be incorporated as a component in the final R&D produced on own account, and so these payments will be recorded as intermediate consumption, to ensure that there is no double-counting of GFCF. So in practice, this row will usually be zero.

Row 3: Subtract expenditure on own-account software used in the performance of R&D

5.8 As own-account R&D and own-account software development activities are often performed by the same people it's important to avoid double counting of these activities. This holds for all industries where IPPs are produced on own-account. Hence, units should be asked to separately estimate the cost of each IPP in the current period. Payments recorded will either be service payments for the use of own-account software, or for own-account software to be embedded in the final R&D product. In both cases they should remain as intermediate consumption. So in practice, this row will usually be zero. Only software custom-built for continuing use in the performance of R&D should be scored as a capital asset acquisition, and so subtracted along with other capital expenditure in row 2 of the implementation table 5.1.

Row 4: Add payments to postgraduate students not included in FM data

5.9 Where such figures can be obtained, typically through the FM surveys going to higher education (HERD), they should be included as labour costs.

Row 5: Subtract capital expenditures

5.10 These items are consistent with national account definitions, apart from land. Land value is not likely to be a significant component of the estimate.

Row 6: Add other taxes on production not included in FM data

5.11 Survey responses and data from the national accounts taxes and subsidies unit should be reconciled.

Row 7: Subtract other subsidies on production

5.12 Survey responses and data from the national accounts taxes and subsidies unit should be reconciled in order to arrive at best results.

Row 8: Add extramural purchases of R&D that should be recorded as intermediate consumption.

5.13 The Task Force provided the general recommendation to record extramural purchases of R&D by the R&D industry as intermediate consumption. However, all such extramural purchases should be recorded as intermediate consumption, on the assumption of them being embedded in the final product. This rule applies for any unit responding to the FM survey, as the principle of not recognising R&D to be embedded in the final product as capital formation separately, applies as much to in-house units not recognised separately from the main business, as specialist R&D units classified to the R&D industry.

Row 9: Sub-total

Rows 10, 11, 12: Add estimate of consumption of fixed capital, plus a return to capital for market producers

5.14 The estimate for consumption of fixed capital should be derived using a standard Perpetual Inventory Method for the capital assets ([1]) identified as being used in the performance of R&D. Where information on back series of capital expenditure is missing, the figures should be estimated. One option is to use industry output measures to back-cast recent estimates of capital expenditures. A simple PIM using straight line depreciation and no mortality function is acceptable in these cases.

If no PIM is currently used, then more approximate methods as suggested in Table 5.1 can be used pending the introduction of a simple PIM.

5.15 The mark-up for net operating surplus can be derived from ratios identified for market producers in NACE 72, operating in the same technological field as the unit. If no such information is available, then the ratio of net operating surplus to gross output of the parent company for in-house units may be used.

Row 13: adjustment for exhaustiveness

5.16 R&D can be carried out by units too small to be recorded in the business register, and in service industries which may not be as well represented in the business register as more traditional activities. Those units which are in the business register may not be included in FM surveys.

Countries should introduce a tracker question in their regular structural business surveys. Where the response indicates that R&D takes place, the sample/panel for the Frascati Manual surveys should be expanded to include the enterprise or local kind of activity unit.

Row 14: Other adjustments

5.17 A variety of other coverage issues can arise in compiling estimates of output through a cost-approach for an industry such as R&D where the range of size, industry and location is wide. These adjustments can be entered in this row.

([1]) Further guidance on the calculation and depreciation of the capital stock can be found in the OECD manual 'Measuring Capital', second edition, 2009, Paris.

Estimation of GFCF in R&D

5.18 The table below shows how GFCF in R&D is calculated as a residual between the supply and demand for R&D products. The table shows how the rows of a supply-use system can be used for this purpose, but in this table for convenience, the rows are represented as columns. The numerical example in Annex 7 illustrates the relationship between the normal supply-use commodity flow approach and Table 5.2.

5.19 This table is presented to be consistent with the presentation used in Table 5.1, and so differs in terms of column headings and shadings from the template of the Task Force Table 3.

Table 5.2: Estimating GFCF in R&D

		S11		S12		S13		S14		S15		Total	
		+	-	+	-	+	-	+	-	+	-	+	-
1	R&D output												
2	Add Imports of R&D												
3	Add trade margins												
4	Add taxes on products												
5	Subtract subsidies on products												
6	Subtract extramural purchases of R&D that should be recorded as intermediate consumption. Applies only to R&D industry												
7	Subtract Acquisitions of R&D not expected to provide a benefit												
8	Subtract changes in inventories of finished R&D												
9	Subtract Exports of R&D												
10	Add Net purchases of R&D between domestic sectors												
11	Balance: Total GFCF of R&D												

Each of the rows will now be described.

Row 1 — R&D output

5.20 This is the gross output of R&D as calculated in row 15 of Table 5.1.

Row 2—Add imports of R&D

5.21 The imports are captured through two alternative sources. The first is the extramural expenditures of the FM surveys, which will include purchases from abroad. These imports of R&D going to R&D units are likely to be embedded in the final products of the R&D units being surveyed, and so recorded as intermediate consumption rather than free standing capital assets.

5.22 The second is a Balance of Payments Survey on International Trade in Services. The imports of R&D as products are recorded under the heading of R&D services, and represent a change of ownership of the R&D, often through the outright purchase of a patent, copyright, etc. Note that this heading is separate from the heading of royalties and licences, where the fees for the use of R&D products are specified as 'expenses incurred for the use of patents, copyrights, industrial processes, designs, produced originals and prototypes.' This heading will capture the service payments for produced R&D products.

5.23 It is recommended that a reconciliation between these two sources is established, so that the estimates of expenditures abroad in the FM surveys are reconciled with the international trade figures. As the

international trade figures will include outright purchase of R&D products by non-R&D units, as well as the payment of fees for the use of licences owned abroad, this reconciliation is important.

Row 3 —Add trade margins

5.24 Where trade margins can be identified separately they should be added. In practice the entries in this row are likely to be zero.

Row 4 — Add taxes on products

Row 5 — Subtract subsidies

5.25 Figures for rows 4 and 5 should come from the national unit responsible for the allocation of product taxes and subsidies across all products. In practice, row 4 and 5 will normally contain zero values.

Row 6 — Subtract extramural expenditures on R&D that should be recorded as intermediate consumption.

5.26 Given that extramural expenditures on R&D products will be work sub-contracted out, this item will in practice be equal to all of the extramural expenditures.

Row 7 — Subtract acquisitions of R&D not expected to provide a benefit.

5.27 This row will in practice be zero.

Row 8 — Subtract changes in inventories of R&D

5.28 In theory, output of R&D which is neither marketed nor launched in the case of own-account production, should be recorded as a change in inventories — work in progress or finished goods. In practice, these changes are difficult to identify, and the assumption is generally made that R&D output is acquired as a capital asset as it is produced. So this row will usually have zero values. If the asset is subsequently sold, the seller will show a disposal of the asset matched by an acquisition of the asset by the purchaser.

Row 9 — Subtract exports of R&D

5.29 Exports of units addressed through the FM surveys will be captured in the source of funding information. Where this is identified as abroad, then it is likely that the R&D unit will be acting on a sub-contract to supply R&D products.

5.30 As with imports, there is an alternative source of information, as these transactions should be included as ‘R&D services’ in a Balance of Payments International Trade in Services survey. Again these two sources should be reconciled.

5.31 A simple example illustrating how the two tables of this section can be used as in a commodity flow approach to estimating R&D as GFCF is given in Annex 7.

Row 10 — Add net purchases of R&D between domestic sectors

5.32 This row sums the acquisitions and disposals of existing R&D assets between sectors. This information must be collected through standard national accounts capital expenditure inquiries, expanded to cover transactions in intellectual property products.

Sector allocations of R&D based on Frascati Manual surveys

5.33 Surveys supporting the Frascati Manual will cover business, government, and non-profit units. In this mix will be higher educational institutes such as universities.

The table below shows how the Frascati Manual headings map onto ESA 2010 sectors.

Table 5.3: Linking Frascati sectors to ESA 2010 sectors

Frascati Manual heading	ESA 2010 sector
Business enterprise sector	Non-financial corporations (S.11)
	Financial corporations (S.12)
Government sector	General government (S.13)
Private Non-profit sector	Non-profit institutes serving households (S.15)
Higher education	General government (S.13)
	Non-profit institutes serving households (S.15)
	Non-financial corporations (S.11)
Foreign countries	Rest of the World (S.2)

5.34 The correspondence in higher education will depend upon the arrangements in each Member State. The FM surveys (HERD) to higher education institutes should clarify this.

5.35 The FM surveys include questions on the source of funding for the performance of R&D. The funder of the performance of R&D should be assumed to be the owner of the final product, unless there is evidence to the contrary. This ideally would come from the separate identification in funding, between items such as government grants and capital transfers to promote R&D, and contracts intended to generate R&D products to be owned by the contractor. In the large majority of cases, in-house R&D units will supply their output of R&D products to the enterprise of which they are part. This enables an industry allocation of GFCF in R&D.

Section 6: Special issues

Back-casting

6.1 Even where there are not long series of estimates of capital expenditure used in the performance of R&D, proxies can be used to back-cast the estimates that exist, and a series of more than ten years will suffice for the first rough estimates of stock levels to drop out of the model. A typical proxy would be the output of the unit or grouping of units concerned. If this is not possible, then assumptions can be made on CFC as a proportion of total current costs, or total current labour costs. Evidence from other European countries with longer series of estimates of assets used in the production of R&D products will prove useful, as proxy relationships can be used which are likely to hold for most European economies.

Prices and volume

6.2 As the cost approach is used to estimate the value of own account R&D output, it is not possible to produce volume estimates using the normal national accounts practice of the identification of typical market prices and using these to reduce nominal estimates to volume terms. Instead, the main components of the costs must be measured in volume terms — this requires a breakdown of materials and labour by type, and changes over time.

6.3 A benchmark estimate of categories of labour should be established, and then indicators of the change in labour components used to give volume estimates. The technique is the same as used for the estimation of the output of government in volume terms. As with government, the cost approach prevents the use of the resulting estimates in productivity analysis.

Payments for the use of R&D products

6.4 Where the R&D results in a product which is patented and then made available to other users without change of ownership through a system of licences, the payments are recorded as service payments. Structural business surveys and international trade in services surveys should include questions on such payments so that a picture of the use of R&D products in the economy can be obtained.

Double counting

6.5 Often the same people work on the development of R&D and software. When data from different surveys is used it may result in double-counting of their work The manual states that bought-in R&D should be scored as intermediate consumption when embedded in the final R&D product, to avoid double counting. Where custom-built software is used with the R&D product to produce a combination of R&D and software, it is most practical to consider the final product as software. So in this case, the R&D will be embedded in the final software product, and should be treated as intermediate consumption in the estimation of the software IPP.

Exhaustiveness

6.6 R&D can be carried out by units too small to be recorded in the business register, and in service industries which may not be as well represented in the business register as more traditional activities. Those units which are in the business register may not be included in surveys due to their relatively small size in terms of employment and possibly turnover. However, relatively small units may produce high values of R&D. Countries should introduce a tracker question in their regular structural business surveys. Where the response indicates that R&D takes place, the sample / panel for the Frascati Manual should be checked to include the enterprise or local kind of activity unit. Similarly, all other sources of R&D activity as detailed earlier in the manual should be examined on a regular basis to ensure that the Frascati Manual panel continues to cover all R&D activity occurring in the country. The coverage is not limited to free-standing R&D units, nor those associated with industries known for large spending on R&D such as pharmaceuticals and aerospace. In these industries there will typically be large and often separate units

devoted to R&D which will provide the ideas and patents for future production of medicines and aircraft. But there are other activities where the R&D may not be so well defined or conducted separately from the main business, and these should also be covered by the R&D survey to business.

Frequency and timely estimates

6.7 Annual and quarterly surveys into capital expenditure should cover all IPPs as well as the traditional tangible capital formation categories. This will enable timely estimates of R&D activity, obtained by projecting forward the benchmark estimates based on the biannual or annual surveys supporting the Frascati Manual. Where quarterly surveys into the complete costs of carrying out R&D are not available, employment figures and current wage rates will provide suitable indicators to enable quarterly estimates to be made in nominal and volume terms, until benchmarked by an annual survey.

Multinationals

6.8 Where the R&D carried out within a multinational is scored as R&D by the enterprise, and production, imports and exports are recorded in the appropriate business, balance of payments and Frascati Manual surveys, then the R&D activities of multinationals will be covered in the implementation steps set out in this manual. Where the R&D activities of multinationals are not patented, and not reported through Frascati Manual surveys, then the R&D activities will be essentially not capable of accurate measurement, and even where identified, estimates of final value are extremely unlikely to be possible or accurate. Such transactions should not be imputed until international agreement is reached on how best to identify and measure these elusive phenomena.

Estimates of stock levels and service life

6.9 Stock levels of R&D products are estimated using a standard Perpetual Inventory Method model (PIM). For this, price movements of the assets are needed, together with an estimate of service life. The service life of R&D products should be determined according to evidence from the activities where they are most used as capital assets. Where this evidence is not readily available in a Member State, evidence from other Member States with similar industries and R&D products may be used. Where no equivalent MS and activity can be identified, then general European practice can be followed. As a last resort, where no reliable evidence is available for the activity in which the R&D product is used, a service life of 10 years is as acceptable until further reliable information becomes available. The depreciation function can be any currently used in the standard PIM models, including straight-line depreciation, although the geometric one is recommended.

6.10 Service payments associated with the use of R&D assets outside the enterprise which produced them are represented by licence payments, and structural business inquiries should contain questions to obtain reliable estimates of the associated flows.

Funding and ownership

6.11 In the FM surveys, sources of funding are given by sector. It is a reasonable assumption that funders of the performance of R&D will be the ultimate owners of the product, although exceptions do occur. It is possible to include a question directly inquiring as to the ultimate ownership of the R&D product, so that sector allocations of the acquisition of capital assets can be made for national accounts purposes. However, performers may well not be aware of the final destination, and as with other supply-side estimates of capital expenditure in the national accounts, a reconciliation of supply-side figures and the results of the standard inquiries into capital expenditure acquisition and disposal of assets will be necessary.

Annex 1 — Definitions of Intellectual Property Products in International Standards

The introduction of IPPs into European national accounts before ESA 2010

A1.1 The 1970 European System of Integrated Economic Accounts (1970 ESA) defined gross fixed capital formation as the value of durable goods intended for non-military purposes, acquired by resident producer units and intended for use in production for more than one year. Specifically excluded were (paragraph 340 d) services of scientific research, advertising, market research etc.

A1.2 The second edition of the ESA in 1979 retained this definition of the asset boundary.

A1.3 After a gap of sixteen years, a substantially revised version of the ESA was produced in 1995, consistent with the international standard of 1993, the System of National Accounts (SNA). The definition of fixed capital formation was expanded to include intangible assets, and these were listed as:

Mineral exploration;

Computer software;

Entertainment, literary or artistic originals;

Other intangible fixed assets.

Intellectual Property Products in ESA 95

A1.4 Computer software (AN.1122)

Computer programs, program descriptions and supporting materials for both systems and applications software. Included are purchased software and software developed on own account, if the expenditure is large. Large expenditures on the purchase, development or extension of computer databases that are expected to be used for more than one year, whether marketed or not, are also included.

A1.5 Entertainment, literary or artistic originals (AN.1123)

Original films, sound recordings, manuscripts, tapes, models, etc. on which drama performances, radio and television programmes, musical performances, sporting events, literary and artistic output, etc., are recorded or embodied. Included are works produced on own account. In some cases, such as films, there may be multiple originals.

A1.6 Other intangible fixed assets (AN.1129)

New information, specialised knowledge, etc., not elsewhere classified, whose use in production is restricted to the units that have established ownership rights over them or to other units licenced by the latter.

A1.7 ESA 95 describes the category Intangible non-produced assets (AN.22) in paragraph 7.19 as follows:

Intangible non-produced assets include patented entities, transferable contracts, purchased goodwill, etc. Entities not evidenced by legal or accounting actions — that is, such actions as the granting of a patent or the conveyance of some economic benefit to a third party — are excluded.

A1.8 Patented entities (AN.221)

Inventions in categories of technical novelty that, by law or by judicial decision, can be afforded patent protection. Examples include constitutions of matter, processes, mechanisms, electrical and electronic circuits and devices, pharmaceutical formulations and new varieties of living things produced by artifice.

Intellectual Property Products in ESA 2010

A1.9 Following SNA 2008, the asset boundary in ESA 2010 was expanded to include the results of Research and Development. The term 'intangible assets' was replaced by Intellectual Property Products, and a general code was introduced. The sub-categories are described as follows:

A1.10 Intellectual Property Products (AN.117)

Fixed assets that consist of the results of research and development, mineral exploration and evaluation, computer software and databases, entertainment, literary or artistic originals and other intellectual property products, as defined below, intended to be used for more than one year.

A1.11 Research and Development (AN.1171)

Consists of the value of expenditure on creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and use of this stock of knowledge to devise new applications

The value is determined in terms of the economic benefits expected in the future. Unless the value can be reasonably estimated it is, by convention, valued as the sum of costs, including those of unsuccessful research and development. Research and development that will not provide a benefit to the owner is not classified as an asset and is instead recorded as intermediate consumption.

A1.12 Mineral exploration and evaluation (AN.1172)

The value of expenditure on exploration for petroleum and natural gas and for non-petroleum deposits and subsequent evaluation of the discoveries made. This expenditure includes pre-licence costs, licence and acquisition costs, appraisal costs and the costs of actual test drilling and boring, as well as the costs of aerial and other surveys, transportation costs, etc. incurred to make it possible to carry out the tests.

A1.13 Computer software (AN.11731)

Computer programs, program descriptions and supporting materials for both systems and applications software. Included are the initial development and subsequent extensions of software as well as acquisition of copies that are classified as AN.11731 assets.

A1.14 Databases (AN.11732)

Files of data organised to permit resource-effective access and use of the data. For databases created exclusively for own use the valuation is estimated by costs, which should exclude those for the database management system and the acquisition of the data.

A1.15 Entertainment, literary or artistic originals (AN.1174)

Original films, sound recordings, manuscripts, tapes, models, etc., on which drama performances, radio and television programmes, musical performances, sporting events, literary and artistic output, etc. are recorded or embodied. Included are works produced on own-account. In some cases, such as films, there may be multiple originals.

A1.19 Other intellectual property products (AN.1179)

New information, specialised knowledge, etc., not elsewhere classified, whose use in production is restricted to the units that have established ownership rights over them or to other units licensed by such units.

Annex 2 — Work guiding the content of the implementation manual

Research and Development — the Eurostat and OECD Task Forces

A2.1 The first Eurostat Task Force on Research and Development met five times in 2008 and 2009. The Task Force enabled discussions on this new area for national accounts between member states, and with Eurostat and OECD. A final report was produced in October 2009, and the main findings were as follows:

A2.1.1 The work of the Task Force and its conclusions are broadly consistent with the outcome of the OECD task force on R&D, as captured in the OECD publication 'Handbook on deriving capital measures of intellectual property products'.

A2.1.2 Templates for supplementary tables of R&D are set out for use by member states in testing data reliability of R&D estimates.

OECD Handbook on deriving Capital Measures of Intellectual Property Products

A2.2 This handbook was published in 2010, and presents a wide range of discussion, comment and guidance on the implementation of SNA 2008 with regard to the measurement of IPPs in the national accounts.

A2.3 The OECD handbook key recommendations concerning R&D products are given below.

General recommendations

A2.3.1 Recommendation 3

As a general rule, all expenditures on intellectual property products, either purchased or produced on own account, should be recorded as gross fixed capital formation if they are expected to provide economic benefits for the owner. Only in cases where units specializing in producing a type of intellectual property product for sale should acquisitions of that type of product be expensed, or if it is clear that they are completely embodied in another product: for example software copies purchased to be embedded in computers for sale, or other specific information exists such as the existence of a license with a duration of one year or less.

A2.3.2 Recommendation 8

When summing costs to estimate gross fixed capital formation of intellectual property products, all costs should be included, irrespective of whether the activity is eventually successful or not. Values of assets that subsequently prove unsuccessful should not be written off in the other changes in volume account. Instead they should be depreciated in the same way as similar classes of assets that prove successful.

A2.3.3 Recommendation 10

When asking units to estimate the cost of producing assets on own account, they should be asked to itemize their costs, separately identifying expenditures on other fixed assets. The latter should not be included in the sum of costs. But estimates of the user cost of capital should be (but only capital consumption for non-market producers). This can be done either by applying the perpetual inventory method to past estimates of capital expenditures or by making an imputation based on data for units specializing in the production of the particular intellectual property product.

A2.3.4 Recommendation 30

It is very important to distinguish between licences to use for more than a year, and licences to use for a year or less. Expenditures on the former, purchased by production units and not embodied and sold on with other products, are treated as GFCF, while expenditures on all other licences to use are recorded as consumption. Whatever approach is used it is vital that the accurate discrimination between the two should be central to measurement.

In principle, the terms of the license dictate the treatment of payments. If the risks and rewards of ownership are transferred to the user, then the payments are for the original and so acquisition of a capital asset is recorded. If there is no effective transfer of risks and rewards, then the payments are rentals. Regular annual or shorter period payments usually reflect no transfer of ownership rights, and payments covering a longer period of time suggest ownership transfer.

A2.4 Key specific recommendations for R&D

A2.4.1 Recommendation 16

Ownership of an asset exists when the owner has effective management and control of the R&D output in order to ensure the expected benefits are obtained by the owner. There are more ways of ensuring this than patenting the R&D, for example by publishing R&D in a scientific journal. By doing this, others are prevented from claiming ownership.

A2.4.2 Recommendation 17

As a practical solution, when the rights to benefit from the results of R&D are not clearly assigned by intellectual property protection, the owner should be deemed to be the purchaser or, in the case of own account R&D, the owner is deemed to be the producer.

A2.4.3 Recommendation 19

As a general rule, all R&D purchased or produced on own account should be treated as gross fixed capital formation by the producer, except when the original is produced for sale (in which case it should be recorded as GFCF of the acquiring unit).

A2.4.4 Recommendation 20

Unless specific information to the contrary exists, all expenditures on purchases of R&D or on R&D production by market producers in the Scientific Research and Development industry (Division 72 ISIC Rev. 4) should be recorded as intermediate consumption, or otherwise expensed, on the presumption that such units produce R&D for sale, and any purchases are incorporated in products for sale. Only when specific information is available to the contrary should acquisitions of R&D be recorded as gross fixed capital formation, such as R&D performed by start-ups that do not yet have sales or cases when a unit takes out a patent and sells licenses to use.

Eurostat Second Task Force

The outcomes of the second Eurostat Task Force form the basis of this implementation manual.

A2.5 According to the mandate agreed by the Eurostat National Accounts Working Group on 17 March 2011, two objectives were identified:

A2.5.1 Analyse the results of the supplementary tables on the capitalisation of R&D submitted by Member States — in particular, assess the reliability of the data and the main difficulties encountered in completing them;

A2.5.2 Promote the exchange of experience with regard to the capitalisation of R&D between the participants.

A2.6 The issues identified as problems in implementing capitalisation of R&D were as follows:

A2.6.1 Sub-contracting;

A2.6.2 Double-counting of R&D and own-account software;

A2.6.3 Estimation of capital consumption;

A2.6.4 Estimation of a return to capital (or mark-up) for market producers in using costs as an estimate of value of production on own account of R&D products;

A2.6.5 Exhaustiveness;

A2.6.6 Use of balance of payments data in the estimation of GFCF of R&D products;

A2.6.7 Treatment of freely available R&D;

A2.6.8 Price indices for R&D;

A2.6.9 Estimation of stock levels of R&D and the associated consumption of fixed capital;

A2.6.10 The impact of the capitalisation of R&D on GDP — are the results sufficiently reliable.

Final Report of the Second Task Force on the Capitalisation of Research and Development in National Accounts

A2.7 The following recommendations were agreed by the Task Force on R&D, and subsequently by a meeting of Directors of Macro Economic Statistics (DMES), November 2012:

(a) *Full consistency between the data in the agreed compulsory R&D tables and the national accounts should be ensured in the course of the capitalisation of R&D services;*

The Task Force agreed a compulsory set of tables that should be used as bridge between data sources and National Accounts (see Annex to this report). In particular Table 1 and Table 2 concern the calculation of output of R&D. Table 1 may be filled in for sectors for which sufficient information from sources other than Frascati surveys is available (that could most probably be the case for S13, but maybe also for other sectors). In the other cases Table 2, which is based on Frascati surveys data, should be used. The Task Force made a recommendation that full consistency between the data in the agreed compulsory R&D tables and the national accounts should be ensured in the course of the capitalisation of R&D services.

(b) *Until the R&D stocks are available, the consumption of the R&D assets used in the production of R&D services does not have to be taken into account in the estimates of the R&D output (as a part of the consumption of fixed capital);*

The calculation of the consumption of fixed capital in the production of R&D services (R&D output) by means of the PIM method requires estimation of the use of all fixed assets, including existing R&D assets used to produce new R&D. As the stocks of R&D assets are not yet available in most of the countries, the Task Force recommended that for the moment the consumption of the R&D assets used in the production of the R&D services may not be taken into account.

(c) *The input method is recommended in the calculation of R&D in volume terms;*

In view of difficulties in identifying the output unit in R&D and as no unit value indices exist, the Task Force recommended to use the input method for the volume measures of R&D.

(d) *Geometric depreciation function is recommended as a reference method in the calculation of CFC of R&D; however, countries that have developed alternative methods may continue to use them;*

The Task Force recommended that countries should use the geometric depreciation function as a reference in the calculation of consumption of fixed capital of R&D assets. However, countries that developed alternative methods may continue to use them.

(e) *The R&D services subcontracted by one R&D institutional unit to another R&D institutional unit should be recorded as intermediate consumption. However, the possibility of recording the output of R&D institutional unit net of subcontracted R&D or on a gross basis would be left open to countries that encounter problems in obtaining data needed to adjust the Frascati intramural expenditures on R&D to gross recording;*

Already the previous R&D Task Force encouraged the Member States to record the R&D services subcontracted by one R&D company to another R&D company as intermediate consumption. However, the possibility of recording the output of R&D companies net of subcontracted R&D was left open to countries that encounter problems in obtaining data needed to adjust the Frascati intramural expenditures on R&D to gross recording.

(f) *All expenditures by government on Intellectual Property Products (IPPs), including freely available R&D, should be recorded as GFCF, if they satisfy the requirement that IPPs is intended for use in the production of more than one year;*

While filling in the questionnaires some countries excluded a part of the freely available R&D from investment. The justification of such a treatment was intensively discussed. Finally the Task Force was reminded of the pragmatic decision of the ESA 95 review group to capitalise all freely available R&D which is intended for use in the production of more than one year.

(g) *The net operating surplus of market producers of R&D (as reference to return to capital) is derived as mark-up including unsuccessful R&D. The method to obtain the mark-up may be calculated as industry specific or as a single mark-up for all industries: To ensure stability of the mark-up time series, an average or a weighted moving average of several years should be used*;

Ideally, the averaging technique should be consistent with the parameters used in the calculation of CFC. In practice, however, there could be problems regarding the availability of long time series and thus a simple average of a limited time-span should also be allowed.

(h) *Service life estimates used in the calculations of R&D should be based on dedicated surveys or other relevant research information, including information of other countries with comparable market/industry characteristics. In case, where such information is not available, a single average service life of 10 years should be retained. It is also recommended that the above mentioned service life estimates should be investigated regularly, e.g. every 10 years.*

A majority of countries have neither detailed nor reliable information on service life for each component of R&D. The proposed single average of service life of 10 year is a practical solution for those countries that have no information on service life of R&D assets. There is no intention to prevent countries from using more specific information resulting from their research efforts.

Annex 3 — IPPs in BPM6

IPPs and non-produced assets in the balance of payments

A3.1 In the balance of payments, international trade is split up into trade in goods and trade in services. The principle of a transaction taking place for goods only when there is a change in ownership applies in ESA 2010 and in the balance of payments system.

A3.2 IPPs and non-produced assets do not fit easily into the balance of payments classification scheme. They are not physical goods, despite having all the other economic attributes of a good. As they are intangible and not traded across borders in physical form, they are not captured in the merchandise trade statistics reflecting goods crossing national borders. So they are classified under services (as are goods bought by tourists abroad, under the heading of travel). It is important for national accounts to distinguish between international trade in the IPPs themselves, and the associated service payments for use of the assets.

A3.3 Table 10.1 in the Balance of Payments Manual sixth edition (BPM6) gives an overview of the classification headings in the goods and services account, and IPPs occur in the entry 'Charges for the use of intellectual property'. This is the heading for service payments for the use of the IPPs, not the exchange of IPPs themselves.

Charges for the use of intellectual property are described in paragraph 10.137 as follows:

(a) Franchising fees and charges for the use of registered trademarks;

(b) Charges for the use of proprietary rights arising from research and development (such as patents, trademarks, copyrights, industrial processes and designs including trade secrets);

(c) Charges for the authorised reproduction and distribution through licencing agreements, of produced originals and related performing rights.

The key sentence in 10.138 is 'payments made by the licensee to the owner may be described as fees, commissions, or royalties, but are treated as payments of services'.

A3.4 Paragraph 10.131 states that 'In contrast to temporary rights to use results arising from research and development, outright sales of patents, copyrights, and industrial processes and designs are included under research and development services (see 10.147)'.

So a new heading for the recording of service payments for R&D product use has been introduced in BPM6, retaining a separate heading (R&D services) for recording the exchange of ownership for an R&D IPP.

A3.5 Study of the suggestions for an extended balance of payments services classification (EBOPS) in the Manual on International Trade in Services Statistics (MSITS 2010) show that the BPM6 recommendations are followed, with one extension — to show a split of the category 'charges for the use of intellectual property' into 'franchise and trademark licencing fees' and 'licences for the use of outcomes of research and development'.

However, both manuals accept that franchise and trademarks can include aspects of produced and non-produced assets which are difficult to identify separately. So the income and service elements of payments cannot be differentiated. The pragmatic guidance of both BPM6 and MSITS 2010 is to treat all payments for use of franchises and trademarks as service payments.

Annex 4 — Subsidies

A4.1 In the calculation of gross output of R&D at basic prices, it is necessary to add 'other taxes on production less subsidies' to other costs to obtain the estimate of gross output required

The definition of *other taxes* in ESA 2010 is given in paragraph 4.22:

Other taxes on production (D.29) consist of all taxes that enterprises incur as a result of engaging in production, independent of the quantity or value of the goods and services produced or sold.

So for example, *other taxes* are taxes which are administered as a result of business being carried out, rather than a charge on the amount of income of the business. A typical tax under this heading would be 'local rates' — a charge by a local authority connected to the size and location of the business premises, and not to the production scale or income of the business. In most NSIs, this tax will be calculated centrally from administrative information, and then allocated to industry and sector.

A4.2 The definition of *other subsidies on production* in ESA 2010 is given in paragraph 4.36:

Other subsidies on production (D.39) consist of subsidies except subsidies on products which resident producer units may receive as a consequence of engaging in production.

ESA 2010 then carries on to say: For their non-market output, non-market producers can receive other subsidies on production only if these payments from general government depend on general regulation applicable to market and non-market producers as well.

ESA 2010 gives examples for D.39 as payments according to the wage bill, or total work force, or employment of special categories of employees such as handicapped persons, long-term unemployed or employees on training schemes.

A4.3 Example

The following example shows two different cases. One is where a market producer has sales of a product of 50m, labour costs of 50m, and intermediate current costs (IC) of 20m It also receives 'other subsidies' linked to production, of 40m.

The production account for this unit reveals value added as 30m. This is carried forward to the generation of income account, and the other entries in this account are labour costs as a use, and 'other taxes less subsidies' as a use. To help understanding, the negative entry of other subsidies was moved on the use side (-40m) to become a positive entry (+40m) of subsidies on the resources side.

The balancing item of gross operating surplus is calculated to be 20m. This is used to replace worn away capital (CFC) and provide an operating margin for the benefit of shareholders etc. This operating margin is also known as Net Operating Surplus (NOS).

Now consider the case where the output is not sold on the market, but created as own-account production, for internal final use as capital.

Now the output is calculated as sum of costs: As it is a market producer, this internally created asset when valued as sum of costs, includes an estimate of capital depreciation (CFC) and Net Operating Surplus, or the margin expected if sold on the market. The remaining cost is net other taxes on production — this consists of other taxes on production less subsidies on production. In the example, we assume no other taxes on production, only subsidies.

Then output = 'Sales' = labour costs + IC + CFC + NoS – subsidies

= 50m + 20m + 10m + 10m – 40 m

= 50m

So if we make realistic assumptions about consumption of fixed capital (CFC) and the net operating surplus (NOS), the gross output estimate is consistent with the sales figure when the products are marketed, at 50m.

Gross output measurement with other subsidies (D.39)

Market production

Sales	50
Labour	50
IC	20
Other subsidies	40

Production account

Uses		Resources	
IC	20	Sales	50
VA	30		

Generation of income account

Uses		Resources	
Labour	50	VA	30
		Subsidies	40
Op surplus	20		

Own account production

'Sales'	50
Labour	50
IC	20
Other subsidies	40

Production account

Uses		Resources	
IC	20	'Sales'	50
VA	30		

Generation of income account

Uses		Resources	
Labour	50	VA	30
		Subsidies	40
Op surplus	20		

Annex 5 — Embedded R&D and sector estimates

A5.1 Intellectual Property Products can be incorporated with another capital asset, with no change in form. This causes no measurement problem when the measurement of GFCF is approached from the demand side. Taking a machine bought by a business as an example, the full price of the machine can include two parts — one representing the hardware of the machine, and the other part the embedded custom-built software which forms an integral part of the final product. So if the cost of building the machine without software is 200, allowing for all inputs including the use of capital assets (CFC) and a mark-up, and the software adds value of 50, the purchase price will be 250. An expenditure survey will ask the holder of the machine as an asset what his acquisition of capital is in the period concerned, and the value of 250 will reflect both the hardware and software components.

A5.2 If however the estimate of GFCF is approached from the supply side, then there is a danger of double counting. Surveys on the output of capital goods will give sales of 50 from the software industry, and 250 from the machine tool industry — a grand total of 300. The double-counting comes from the inclusion of the software both as a capital asset in its own right, and also in the value of the final product of a machine tool, the software being embedded in the machine tool.

A5.3 In this example, it is easy to see that a correction can be made by scoring the software embedded in the machine as intermediate consumption, and not as the supply of a capital asset. The capital asset value is wholly represented by the value of the final computer (250).

A5.4 Note that if the machine tool maker buys in software to control the production process creating the machines, then this software is not embedded in the final product, but is capital being used up (becoming obsolescent) in the making of the machines. So the price of the machine will reflect the CFC of the software controlling the production process. So in this case, there will be no double counting (beyond the usual national accounts one of measuring production without allowing for the using up of capital assets).

A5.5 An exactly analogous phenomenon can occur with R&D. R&D supplied to a unit performing R&D can be incorporated inside the final product as a component, and not acting as a capital asset in the production of further R&D. In fact, the second option has been taken to be an unrealistic representation of how R&D is used by R&D producing units. So we can consider an example where R&D is sold to an R&D producing unit. As in the machine example, if we approach the measurement from the expenditure side, then only the value of the final R&D will be captured as capital formation. If the R&D component supplied to the R&D industry is 50, and the final product 150, then only 150 will be captured by an expenditure survey on capital acquired for use as an asset in further production.

A5.6 There is a measurement issue if we approach measuring the creation of R&D through a costs approach. Approaching the R&D units separately, they will report 50 and 150 as the production of R&D, giving a total supply of 200. As before, we can correct the double-counting by scoring the R&D supplied to the second R&D unit as a component of the final product — i.e. as intermediate consumption, and then reducing the amount of supply going to GFCF by this amount going to intermediate consumption.

A5.7 In the area of R&D where output is calculated as the sum of costs in the absence of a marketed product with market prices available, treating the bought-in R&D as a component ensures that the sum of costs will give an estimate of the value of the final product including the value of the bought-in R&D, as desired. This is equivalent to the machine including the value of the embedded software.

A5.8 It has been suggested that an R&D product can incorporate embedded software, and if this is so, then a corresponding reduction to the GFCF of software estimated through a supply approach is necessary. However, it is usually more appropriate to consider such products as software with the R&D component being subsumed indistinguishably into the normal inputs of creating the software IPP. So if significant amounts of software are embedded in R&D, this product is better described as a software product.

Annex 6 — Moving to ESA 2010 from ESA 95 for ancillary R&D units as opposed to local KAUs

Some countries distinguished a local KAU for R&D while calculating ESA 95 figures. Other countries treated R&D as an ancillary activity. The example below sets out the difference in moving to ESA 2010.

Consider an enterprise with a main and R&D unit. The sales of the main activity are 100, compensation of employees is 30, and intermediate consumption is 30. The R&D unit has intermediate consumption of 10, and compensation of employees of 10.

Treating the R&D unit as ancillary, no gross output (turnover) is recorded for this unit and the costs are shown as part of the overall costs of the enterprise. The totals for the whole enterprise are: output = 100, IC = 30 + 10 = 40 and compensation of employees = 30 + 10 = 40.

ESA 95 treatment — R&D unit treated as ancillary

Production account

Uses		Resources	
Materials and services	40	Output	100
Intermediate consumption	40		
Value added	60		

Generation of income account

Uses		Resources	
Compensation of employees	40	*Value added*	60
CFC	0		
Operating surplus, net	20		

Capital account

Changes in assets		Changes in liabilities and net worth	
Capital formation	0	*Saving, net*	20
Net lending/borrowing	20		

Under ESA 95, when two separate units are recognised, we impute an output for the secondary activity as sum of costs (no mark-up) equal to intermediate consumption (10) and compensation of employees (10), giving 20. The output is treated as intermediate consumption for the main activity, so the IC (main) rises from 30 to 50.

ESA 95 treatment — Main activity

Production account

Uses		Resources	
Materials and services	30	Output	100
R&D output	20		
Intermediate consumption	50		
Value added	50		

Generation of income account

Uses		Resources	
Compensation of employees	30	*Value added*	50
CFC	0		
Operating surplus, net	20		

Capital account

Changes in assets		Changes in liabilities and net worth	
Capital formation	0	*Saving, net*	20
Net lending/borrowing	20		

ESA 95 treatment — Secondary activity

Production account

Uses		Resources	
Materials and services	10	Output	20
Intermediate consumption	10		
Value added	10		

Generation of income account

Uses		Resources	
Compensation of employees	10	*Value added*	10
CFC	0		
Operating surplus, net	0		

Capital account

Changes in assets		Changes in liabilities and net worth	
Capital formation	0	*Saving, net*	0
CFC	0		
Net lending/borrowing	0		

So for the two units, combined gross output is 120, combined intermediate consumption is 60. Compared to the accounts treating the R&D activity as ancillary, output and intermediate consumption have both risen by 20 - the value of the imputed output for the R&D activity. The combined value added is unchanged at 60. This is illustrated below.

ESA 95 treatment — Combined accounts for Main and R&D activities

Production account

Uses		Resources	
Materials and services	40	Output	120
R&D output	20		
Intermediate consumption	60		
Value added	60		

Generation of income account

Uses		Resources	
Compensation of employees	40	*Value added*	60
CFC	0		
Operating surplus, net	20		

Capital account

Changes in assets		Changes in liabilities and net worth	
Capital formation	0	*Saving, net*	20
Net lending/borrowing	20		

Under ESA 2010, we must treat the R&D activity as secondary, not ancillary, and recognize the output of the R&D unit as capital formation. We impute a mark-up for market bodies when calculating an output for the R&D unit. So if the mark-up is taken as 5, the output of the R&D unit is now 25 rather than 20. But this output is now recorded as capital formation for the main activity, rather than intermediate consumption as under ESA 95. The accounts are below.

ESA 2010 treatment — Main activity unit

Production account

Uses		Resources	
Materials and services	30	Output	100
Intermediate consumption	30		
Value added	70		

Generation of income account

Uses		Resources	
Compensation of employees	30	*Value added*	70
CFC	0		
Operating surplus, net	40		

Capital account

Changes in assets		Changes in liabilities and net worth	
GFCF	25	*Saving, net*	40
CFC	0		
Net lending/borrowing	15		

ESA 2010 treatment — Secondary activity

Production account

Uses		Resources	
Materials and services	10	Output	25
Intermediate consumption	10		
Value added	15		

Generation of income account

Uses		Resources	
Compensation of employees	10	*Value added*	15
CFC	0		
Operating surplus, net	5		

Capital account

Changes in assets		Changes in liabilities and net worth	
		Saving, net	5
Net lending/borrowing	5		

ESA 2010 treatment — Combined main and secondary activities

Production account

Uses		Resources	
Materials and services	40	Output	125
Intermediate consumption	40		
Value added	85		

Generation of income account

Uses		Resources	
Compensation of employees	40	*Value added*	85
CFC	0		
Operating surplus, net	45		

Capital account

Changes in assets		Changes in liabilities and net worth	
Capital formation	25	*Saving, net*	45
CFC	0		
Net lending/borrowing	20		

Changes moving to ESA 2010 over ESA 95 with R&D treated as ancillary, comparing ESA 2010 combined accounts over ESA 95 account

Production account

Uses		Resources	
Materials and services		Output	+ 25
Intermediate consumption			
Value added	+ 25		

Generation of income account

Uses		Resources	
Compensation of employees		*Value added*	+ 25
CFC			
Operating surplus, net	+ 25		

Capital account

Changes in assets		Changes in liabilities and net worth	
Capital formation	+ 25	*Saving, net*	+ 25
CFC			
Net lending/borrowing			

Changes moving to ESA 2010 over ESA 95 with R&D treated as separate unit, comparing combined accounts for ESA 2010 over ESA 95

Production account

Uses		Resources	
Materials and services		Output	+ 5
R&D output	– 20		
Intermediate consumption	– 20		
Value added	+ 25		

Generation of income account

Uses		Resources	
Compensation of employees		*Value added*	+ 25
CFC			
Operating surplus, net	+ 25		

Capital account

Changes in assets		Changes in liabilities and net worth	
Capital formation	+ 25	*Saving, net*	+ 25
CFC			
Net lending/borrowing			

Annex 7 — Practical example using Frascati Manual survey results

A7.1 This is an example of using simple Frascati Manual survey results to estimate capitalisation of R&D. Consider an economy with the following units:

(a) A manufacturer;

(b) An in-house R&D unit where the R&D is recognised as secondary production in the manufacturing enterprise of (a);

(c) Government;

(d) A Non-Profit Institution, serving government and the public;

(e) A commercial R&D unit, working on contract;

(f) Interactions with the Rest of the World also occur.

A7.2 The manufacturing company does not receive an FM survey. However, they may include the costs of the R&D unit in the overall costs reported under business surveys, and may report own account capital formation as a result of the activities of the R&D unit. It is important that the separate estimation of output and capitalisation of R&D through the Frascati Manual surveys is reconciled with the returns to the business surveys. For this example, it is assumed that the activities of the unit are accounted for separately, and the main business response does not include any of the performance of R&D, except for the acquisition of R&D own account output as capital formation in the carrying out of the main production.

The business survey returns show output of 60m, and intermediate consumption of 30m. Labour costs are 15m and so gross operating surplus is 15m. Capital expenditure is 5m (including in-house capital formation), and depreciation is recorded as 5m giving a net operating surplus of 10m.

A7.3 In-house R&D unit. This is big enough to require that separate accounting records are held for the secondary production of R&D, and the R&D that is eventually used in production is recorded as capital assets in the company accounts. The unit will receive an FM survey, and in the simple form, are taken to respond as follows:

Intramural expenditures: 16m

Of which:	labour costs	5m
	Other current costs	10m
	Capital expenditure	1m

A7.4 It is necessary to estimate the contribution of existing capital assets to the performance of R&D. Ideally this is carried out by identifying those capital assets purchased in the past for the performance of R&D, and using a Perpetual Inventory Method (PIM) to derive estimates of current Consumption of Fixed Capital. If no such time series exists, one can be estimated using an indicator such as employment or costs over the past to proxy the behaviour over time of capital expenditure. In this simple example, we assume that new capital expenditure is roughly equivalent to the Consumption of Fixed Capital from previous GFCF — in other words the unit is acting on a replacement policy to maintain current levels of capital used for the performance of R&D. So in this example we take CFC as 1m.

A7.5 In extramural expenditures, money paid by the unit to a commercial unit on a sub-contract for part of the performance of R&D, is observed, at a value of 4m. As this supply of R&D is embedded in the work of the in-house unit, rather than acting as a capital asset providing a service over time in the conduct of further R&D, the payments are scored as IC by the in-house unit.

A7.6 Then output of R&D for this unit is estimated by FM intramural expenditure less capital expenditures plus the payments for the sub-contracted work, plus CFC, plus a mark-up typical of a similar R&D unit acting in the market. As we do not have this information in this example, we will assume that the net operating surplus of the company can be used, and this is approximately 15 % in this case.

So output = 16m less 1m plus 1m plus 4m plus mark-up of 2.5m = 22.5m

A7.7 In terms of the rows in the whole economy template, we have

Table A7.1: Output of R&D, million EUR

1	FM intramural expenditures on R&D	16
2	Subtract payments for licenses to use IPPs which are capital	– 0
3	Subtract expenditure on own account production of software	– 0
4	Add payments to postgraduate students not included	+ 0
5	Subtract capital expenditures	– 1
6	Add other taxes on production not in FM	– 0
7	Subtract other subsidies on production	– 0
8	Add extramural purchases of R&D to be recorded as costs	+ 4
9	Sub-total	19
10	Add CFC + Mark-up for market producers	3.5
11	Alternative option 1 estimate	0
12	Alternative option 2 estimates	0
13	Add adjustment for exhaustiveness	0
14	Add other adjustments	0
15	Total: output of R&D	22.5

Government

A7.8 This is taken to be government as a whole, not a particular R&D unit within government. Output and final consumption is taken to be 100m.

NPISH performing R&D

A7.9 The method of calculating output is as follows. The Frascati Manual intramural expenditures are taken to be 1.5m, with capital expenditure for performance of R&D 0.1m., and a corresponding estimate of CFC is made of 0.1m. There is no mark-up reflecting net operating surplus. The sum of costs approach to measuring output gives:

Output of R&D = FM intramural expenditures – capital expenditure + estimate of CFC = 1.5m

Commercial R&D unit, working on contract

A7.10 This unit undertakes the performance of R&D on behalf of others, funded through contract arrangements. In this case we would have market price measure of output from the extramural data; and countries may reconcile the information; sum of cost plus mark-up versus purchased price, usually payment for specific time periods reflecting costs plus mark-up.

A7.11 The assumption is that this unit does not do any work on own-account, such as creating R&D to be recorded as capital formation. This would require a costs approach to measure the output of this R&D, whereas the rest of the output would be measured through receipts.

A7.12 So assuming no in-house performance of R&D, output is simply the revenue received through contracts with the customers over the period being measured. This output can either be delivered to the manufacturing company for incorporation in new production — a stand-alone capital asset — or to the R&D in-house unit of the manufacturing company, to be embedded in the overall R&D output of the unit.

A7.13 So for the commercial R&D unit in this example, we will assume earnings of 5m euros, of which 4m is on contract to the manufacturing R&D unit, and 1m will be recorded as capital formation acquired by the manufacturing unit through the acquisition of a patent.

A7.14 This information is available through the breakdown of FM funding information for the commercial R&D unit, which typically will record the following headings:

(a) Self-financed (own account);

(b) Financed by government;

(c) From abroad;

(d) Business (non R&D);

(e) Other R&D units.

A7.15 For this example, the values are as shown in Table A7.2.

Table A7.2: External funding for commercial R&D unit

a.	Self-financed (S.11 NACE 72)	0
b.	Government (S.13)	0
c.	Abroad (S.2)	0
d.	Non R&D business (S.11 and S.12)	1
e.	Other R&D units	4

A7.16 Notice that the sub-contract payments can come from two sources — the payments by the in-house unit, or the funding of the R&D unit by source. Where there is a choice of source, they should be reconciled by balancing the supply-use picture shown in Table A7.3.

Supply — use picture for whole economy

A7.17 Taking the above transactions as a complete picture of the performance of R&D in the economy, we can build the following supply-use table, showing GFCF by sector.

Table A7.3: Supply use table

Output	Inputs					Total Int. demand	Final Cons	GFCF by sector						Total demand
	Business	O-A R&D	Comm. R&D	NPISH	Gov't			Business	O-A R&D	Comm. R&D	Gov't	NPISH	Total final demand	
Business	30	10	1	0.4	5	46.4	3.5	5			5	0.1	13.6	60.0
Own accunt R&D									22.5				22.5	22.5
Comm. R&D		4				4		1					1	5.0
NPISH R&D												1.5	1.5	1.5
Gov't							100						100	100.0
Total IC	30	14	1	0.4	5	50.4								
Comp Emp	15	5	3	1.0	90	114.0								
CFC	5	1		0.1	5	11.1								
NOS	10	2.5	1			13.5								
Output	60	22.5	5	1.5	100	189.0								

A7.18 The supply use balance in Table A7.3 ties in with the Eurostat Task Force table 3 in the following manner.

Table A7.4: Tie-in of supply-use balance with Table 5.2 (TF Table 3)

		Business (S.11)	R&D business (S.11) O-A	R&D business NACE 72	NPISH	Gov't	Total
1	R&D output		22.5	5	1.5		29
2	Add imports of R&D						
3	Add trade margins						
4	Add taxes on products						
5	Subtract subsidies on products						
6	Subtract extramural purchases of R&D			4			
7	Subtract acquisitions of RD with no benefit						
8	Subtract changes in inventories of finished R&D						
9	Subtract exports of R&D						
10	Add net purchases of R&D between domestic sectors						
11	Sub-total						
12	Balance: GFCF of R&D by producer		22.5	1	1.5		25
13	Add/subtract capital transfers of R&D between sectors in capital account						

A7.19 The three rows of the supply-use table showing the supply and use of R&D products is matched by the three columns of TF Table 3.

Introducing imports and exports

A7.20 There are two potential sources for import and export data on R&D products

(a) The extramural expenditures (imports) and funding sources (exports) of the FM surveys, and

(b) The system of balance of payments / national accounts surveys which collect information on trade in services.

A7.21 In the example chosen, the in-house R&D unit is shown as importing R&D from abroad, and the commercial unit is shown as exporting some of its production. This is assumed to be from the FM source.

A7.22 So let the in-house unit sub-contract out the performance of R&D abroad instead of the domestic commercial unit, to a value of 2m. And let the commercial R&D unit do work on contract for a foreign buyer, to a value of 3m.

Table A7.5: Supply use for example including imports and exports

Domestic Output	Imps	Inputs					Total Int. dem	Final Cons	Exps	GFCF by sector						Total demand
		Business	O-A R&D	Comm. R&D	NPISH	Gov't				Business	O-A R&D	Comm. R&D	Gov't	NPISH	Total final demand	
Business		30	10	1	0.4	5	46.4	3.5		5			5	0.1	13.6	60.0
O-A R&D											22.5				22.5	22.5
Comm. R&D	2		4						3	1					4.0	6.0
NPISH R&D														1.5	1.5	1.5
Gov't								100							100	100.0
Total IC		30	14	1	0.4	5	50.4									
Comp Emp		15	5	3	1.0	90	114.0									
CFC		5	1		0.1	5	11.1									
NOS		10	2.5	2			14.5									
Output		60	22.5	6	1.5	100	190.0									

Table A7.6: Example of Table 5.2 (Task Force Table 3) including imports and exports

		Business (S.11)	R&D business (S.11) O-A	R&D business NACE 72	NPISH	Gov't	Total
1	R&D output		22.5	6	1.5		29
2	Add imports of R&D			2			
3	Add trade margins						
4	Add taxes on products						
5	Subtract subsidies on products						
6	Subtract extramural purchases of R&D			4			
7	Subtract acquisitions of R&D with no benefit						
8	Subtract changes in inventories of finished R&D						
9	Subtract exports of R&D			3			
10	Add net purchases of R&D between domestic sectors						
11	Sub-total						
12	Balance: GFCF of R&D by producer		22.5	1	1.5		25
13	Add/subtract capital transfers of R&D between sectors in capital account						

These imports and exports of 'R&D services' are not payments for the short-term use of R&D assets, but transactions in output of R&D. They should be reconciled with the corresponding estimates of R&D services measured through a balance of payments survey into international transactions, such as an International Trade in Services (ITIS) survey. The categories used in the balance of payments system are described in more detail in Annex 3 of this manual.

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