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HANDBOOK ON DERIVING CAPITAL MEASURES OF INTELLECTUAL PROPERTY PRODUCTS

DRAFT

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HANDBOOK ON DERIVING CAPITAL MEASURES OF INTELLECTUAL PROPERTY PRODUCTS

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1.1 Introduction

1. The 2008 SNA describes five categories of intellectual property assets:

   a. research and development;

   b. mineral exploration and evaluation;

   c. computer software and databases;

   d. entertainment, literary and artistic originals; and

   e. other intellectual property products.

2. It recommends that category (c) should be decomposed into two sub-categories: *computer software* and *databases*. Category (e), *other intellectual property products*, includes any such products that constitute fixed assets but are not captured in one of the specific items. As it does not comprise any defined items, it is ignored in this handbook. The remaining four categories are quite different in nature and the data available to estimate them vary considerably, too. Nevertheless, the same general principles apply for estimating their gross fixed capital formation (GFCF).

1.2 Intellectual property assets and gross fixed capital formation

3. The definition of an asset is given in paragraph 3.30 of the 2008 SNA as follows:

> An asset is a store of value representing a benefit or series of benefits accruing to the economic owner by holding or using the entity over a period of time. It is a means of transferring value from one accounting period to another.

4. This definition has a number of important implications for the measurement of intellectual property assets. First, the value of an intellectual property asset is determined by the benefits accruing to its economic owner. This implies that any benefits accruing to other units are not included in the value of the asset. Second, the definition refers to economic owner and not legal owner. In most cases the two are the same, but it is quite common for the legal owners of intellectual property assets to give up their economic ownership by issuing licences (or leases). Third, assets are a means of transferring value from one accounting period to another. This is interpreted to mean that the product is expected to produce benefits for more than a year, and largely determines whether expenditures on intellectual property products should be recorded as gross fixed capital formation (GFCF) or intermediate consumption (IC).

5. Fixed assets are produced assets that are used by their final users in production. It follows from the definition of an asset, given above, that fixed assets are to be used in production for more than a year. There are two exclusions. The first is the exclusion of products, with the exception of dwellings, acquired by a household to provide services to the household, because the production of household services is outside the production boundary. Thus, intellectual property products, such as computer software, acquired by a household for the provision of services for itself is not regarded as GFCF. The second exclusion is a pragmatic one rather than a conceptual one, and concerns small tools. Paragraph 10.35 of the 2008 SNA describes the exclusion as such

> 10.35 The second exclusion is pragmatic rather than conceptual and concerns small tools. Some goods may be used repeatedly, or continuously, in production over many years but may nevertheless be small, inexpensive and used to perform relatively simple operations. Hand tools such as saws, spades, knives, axes, hammers, screwdrivers and spanners or wrenches are examples. If expenditures on such tools take place at a

> fairly steady rate and if their value is small compared with expenditures on more complex machinery and equipment, it may be appropriate to treat the tools as materials or supplies used for intermediate consumption. Some flexibility is needed, however, depending on the relative importance of such tools. In countries in which they account for a significant part of the value of the total stock of an industry's durable producers' goods, they may be treated as fixed assets and their acquisition and disposal by producers recorded under gross fixed capital formation.

6. In concept, it is clearly preferable to record all expenditures on products that qualify as fixed assets as GFCF, irrespective of their size, and small expenditures should only be excluded when there good practical reasons for doing so. Given the ways estimates of GFCF of intellectual products are derived in practice, there appears to be little or no occasion to make this exclusion.

Recommendation 1.1: Small expenditures should only be excluded from estimates of intellectual property products GFCF if there are good practical reasons.

7. One of the difficulties to be overcome in measuring GFCF of intellectual products is distinguishing between expenditures of a capital nature and intermediate consumption. There are three particular cases that cause most of the difficulties: maintenance and repairs; licences to use; and licences to reproduce.

1.2.1 Maintenance and repairs

8. The SNA defines ordinary, regular, maintenance and repairs as intermediate consumption, and major renovations, taken at any point in time not dictated by the condition of the asset, that increase the performance or expected service life of the asset as GFCF. Intellectual property products are not subject to wear and tear, or any other form of physical deterioration[1]. However, they can be amended or augmented. In principle, any amendments or augmentations that improve the performance of the asset or extend its expected service life should be recorded as GFCF, but for things such things as minor changes to computer systems that enable them to continue working due to changes in the computing environment, it is not so clear cut. Paragraphs 10.45-10.47 of the 2008 SNA make it clear that it is not so straightforward to discriminate between IC and GFCF. Factors such as the magnitude of an improvement and whether it is has been planned need to be taken into account. Substantial, planned improvements should be recorded as GFCF, while minor, unplanned improvements are better recorded as IC.

Recommendation 1.2: Intellectual property products are not subject to wear and tear, but they can be subject to amendment and augmentation. Substantial, planned improvements should be recorded as GFCF, while minor, unplanned improvements are better recorded as IC.

1.2.2 Licences to use and reproduce

9. Under what circumstances expenditures on licences to use and reproduce should be recorded as GFCF is discussed in paragraphs 10.99 and 10.100 of the 2008 SNA, and they are reproduced here.

> 10.99 Some intellectual property products are used solely by the unit responsible for their development or by a single unit to whom the product is transferred. Mineral exploration and evaluation is an example. Other products, such as computer software and artistic originals, are used in two forms. The first is the original or "master copy". This is frequently controlled by a single unit but exceptions exist as explained below. The original is used to make copies that are in turn supplied to other units. The copies may be sold outright or made available under a licence.

[1] They are subject to obsolescence and sometimes control over the asset which lead to their consumption of fixed capital (*i.e.* depreciation) and reduced value.

10.100 A copy sold outright may be treated as a fixed asset if it satisfies the necessary conditions, that is, it will be used in production for a period in excess of one year. A copy made available under a licence to use may also be treated as a fixed asset if it meets the necessary conditions, that is, it is expected to be used in production for more than one year and the licensee assumes all the risks and rewards of ownership. A good, but not necessary, indication is if the licence to use is purchased with a single payment for use over a multi-year period. If the acquisition of a copy with a licence to use is purchased with regular payments over a multi-year contract and the licensee is judged to have acquired economic ownership of the copy, then it should be regarded as the acquisition of an asset. If regular payments are made for a licence to use without a long-term contract, then the payments are treated as payments for a service. If there is a large initial payment followed by a series of smaller payments in succeeding years, the initial payment is recorded as gross fixed capital formation and the succeeding payments as payments for a service. If the licence allows the licensee to reproduce the original and subsequently assume responsibility for the distribution, support and maintenance of these copies, then this is described as a licence to reproduce and should be regarded as the sale of part or whole of the original to the unit holding the licence to reproduce.

The importance of licences to use and reproduce varies a lot between the different types of intellectual property product and the application of the above recommendations is not straightforward. Therefore, it is best to consider them asset by asset.

1.3 Estimating GFCF of intellectual property products

1.3.1 Purchased assets

10. Fixed assets can be acquired either by purchasing them or producing them on own account. If they are purchased, estimates of gross fixed capital formation (GFCF) can be obtained either by surveying businesses and government to ask for details of their expenditures (demand-side approach), or they can be obtained by estimating the supply of capital products (as output less exports plus imports less intermediate and final consumption less changes in inventories) and allocating it to different users (supply-side approach). The principal advantages of the demand-side approach are that it is a direct measure and provides estimates by sector or industry of activity. Its principal disadvantage is that it often leads to underestimates because respondents do not identify all their expenditures on intellectual property products of a capital nature that correspond to the scope of the SNA. The principal advantage of the supply-side approach is that the major components of supply (output and imports less exports) are comparatively well measured at a detailed level of product, although there is considerable room for improvement[2]. The principal disadvantages are that it is valued at basic prices, not purchasers' prices, and it does not provide estimates by type of user. Given this situation, it is recommended that the two sets of estimates be confronted and reconciled using supply and use tables in such a way as to take account of their relative strengths and weaknesses. Even if one approach is considered to be markedly superior to the other for a particular type of asset, such a confrontation can still be informative if they differ and re-assuring if they are similar.

Recommendation 1.3: Whenever possible, estimates of purchased fixed assets should be derived using both the demand and supply-side approaches and confronted with each other.

1.3.2 Assets produced on own account

11. The 2008 SNA recommends (paragraph 6.124) that output for own use should be valued at the basic prices at which the goods and services could be sold if offered for sale on the market. In order to

[2] It is expected that the updated *Manual on Statistics of International Trade in Services* and the *Extended Balance of Payments Classification*, scheduled for release in 2010, will improve matters regarding the measurement of exports and imports of intellectual property products.

value them in this way, goods or services of the same kind must actually be bought and sold in sufficient quantities on the market to enable reliable market prices to be calculated for use for valuation purposes. The expression "on the market" means the price that would prevail between a willing buyer and willing seller at the time and place that the goods and services are produced. When reliable market prices cannot be obtained, a second best procedure must be used in which the value of the output of the goods or services produced for own use is deemed to be equal to the sum of their costs of production.

12. Intellectual property products are generally unique and so they fail the condition of being sold in sufficient quantities to enable reliable market prices to be determined. However, some intellectual property products derive their value from sales of copies or licences to use them, such as most entertainment, literary and artistic originals and packaged software, and this raises the possibility of estimating the value of the original as the net present value of the expected future sales. In practice, of course, only past sales may be known – not future ones – and so certain assumptions have to be made to use this method. In some cases, such as original books and music, royalty data are often available but data relating to the cost of production are not, and so this method may offer the only viable way of making reasonable estimates. In most cases, however, estimates of own account GFCF of intellectual property products are estimated by summing costs.

13. When summing the costs of production to estimate own account GFCF, the demand-side and supply-side approaches coincide, as they both entail surveying businesses and government to obtain their estimates of the costs of producing their fixed assets.

14. Another way of getting estimates of own-account capital formation of intellectual property products is to identify the number of people in those occupations that produce these products and how much time they spend doing so, and then multiply the quantum of labour input by wage rates and other costs (non-wage labour and overheads) per unit of labour input. This gives an estimate of the total output of intellectual capital products from which an estimate of those produced for sale must be deducted. This "macro" approach is commonly used to estimate own-account software GFCF.

15. As for purchased estimates, it is best if two independent estimates of own-account GFCF can be derived and compared. Only in this case, it is a matter of confronting estimates from surveys, i.e. the "micro" approach with estimates derived using the "macro" approach.

Recommendation 1.4: Whenever possible, estimates of own-account GFCF should be derived using both micro and macro approaches and confronted with each other.

1.3.3 Using business records

16. For some asset types, such as computer software, business and national accounting standards are quite similar, but for others, such as research and development, they differ substantially. Businesses do not record any research expenditures as GFCF and less expenditure on experimental development than recommended by the SNA. In any case, businesses have a strong general tendency to minimise their recording of capital expenditures on intellectual property products, particularly those produced on own account, to such an extent their estimates are useless for national accounts purposes. This is due to a number of factors, including a desire to be prudent and cautious as well as a desire to minimise tax payments by depreciating assets as quickly as possible. Hence, the use of business records to estimate the GFCF of intellectual products is not recommended.

Recommendation 1.5: Business records of asset acquisitions should not be used to derive estimates of GFCF of intellectual property products.

1.3.4 Degree of product detail

17. Estimates of the GFCF of intellectual property products need to be published for at least the first four broad category headings listed above. However, at least for some of the categories a more detailed compilation is desirable. Two things need to be taken into account: first, the needs of users and second, the needs of estimation. Regarding the latter, consideration needs to be given as to what level of detail best supports not only the estimation of GFCF in current prices, but also estimation in volume terms. If the price and volume elements of different components are growing at different rates then prima facie there is a need to have either price indexes that take account of these changes (i.e. a Paasche price index to derive Laspeyres volume measures) or the volume estimation needs to be conducted at a sufficiently detailed level to allow satisfactory aggregate volume estimates to be derived (*i.e.* using Laspeyres price indexes). Likewise, if components are growing at different rates and they have different service lives then there is good reason to derive the capital measures[3] at a sufficiently detailed level.

18. As already noted, the 2008 SNA has separate sub-categories for software and databases, but it is highly recommended that software be decomposed into packaged software, customized software and own-account software, at least for estimation purposes, because different deflators and service lives apply. The components of entertainment, literary or artistic originals are quite heterogeneous and lend themselves to separate estimation.

Recommendation 1.6: In deriving estimates of GFCF, the degree of product detail should be determined by the needs of users, data availability and the heterogeneity of the products, including the rate of price change and variation in service lives.

1.3.5 Time of recording

19. As explained in the 2008 SNA (paragraphs 10.53-10.55), the general principle for the time of recording of acquisitions and disposals of fixed assets is when the ownership is transferred to the institutional unit that intends to use them in production. Until then assets under production are generally recorded in inventories as work-in-progress, and when completed they are re-classified as inventories of finished goods. Assets produced for own use should be recorded as GFCF as they are produced.

1.3.6 Unsuccessful developments

20. There are two different ways of dealing with unsuccessful developments. The general approach is to record the value of the asset either as work-in-progress or GFCF in the usual way whilst the development is going on, and then write it off when the project is abandoned (in the other changes in the volume of assets account, paragraph 12.55, 2008 SNA). This is consistent with business accounting procedures.

21. The general approach is inappropriate at the macro level when the production of a type of asset is inherently high risk and the values of the assets created are measured by summing costs. Mineral exploration and R&D are high risk activities, and those that undertake them expect that the benefits obtained from the few successes will more than compensate for the many failures. If only the costs of successful activities were used to value the assets produced, there would be a great understatement of GFCF and the value of assets on the balance sheet. While the risk of complete failure with software development is less than it is for either mineral exploration or R&D, there are well known cases of it happening. Furthermore, software developments are notorious for cost overruns and failure to meet all specifications. It seems reasonable to assume that units take these risks into account when they embark on

[3] Capital stock, consumption of fixed capital and capital services

software development, and, accordingly, their expectations of the benefits that the software will provide must exceed not only the anticipated costs but also an allowance for failures and cost overruns by a substantial margin. In these circumstances, it appears unlikely that total own-account GFCF of intellectual products would be overestimated by summing costs of both successful and unsuccessful development projects.

Recommendation 1.7: When summing costs to estimate GFCF of intellectual property products, all costs, irrespective of whether the activity is successful or not, should be included.

1.3.7 Spillovers

22. As already noted, the value of an asset is determined by the benefits accruing to its economic owner. Benefits that accrue to other units are known as spillovers and they are not included in the value of the asset that produces them. Furthermore, the flows of spillovers are not recorded as transactions. Paragraph 10.101 of the 2008 SNA has this to say on the matter.

> When copies are distributed by the owner free of charge then no flows between the owner and recipients are recorded in the System. If, despite making copies freely available, the owner still expects to obtain benefits then the present value of those benefits should be recorded in its balance sheet. It may be that when the information distributed freely it was incomplete and the owner intends to make more detailed information available at a price later. Software distributed freely at the beta test stage is one example. Alternatively, the owner justifies the expenditure on the basis of the benefits to its own production and may make copies available for marketing purposes, generating goodwill or in cases it considers deserving.

Recommendation 1.8: The value of a fixed is not directly influenced by spillovers.

1.4 Demand-side approach

23. Because of the quite different nature of the different categories of intellectual property products it is not sensible to prescribe a generic survey form with a list of questions that could be asked of enterprises to obtain the various estimates of GFCF. Nevertheless, it is possible to identify some general principles that can be used to develop specific surveys. In what follows, the term "survey" is used to cover all forms of data collection, including censuses and administrative sources.

24. The scope of a survey should be all the units – private and public enterprises, government and NPISHs – undertaking the GFCF of the particular category of intellectual property product. For software this should be the whole economy, but for other types of intellectual property products the scope could be much narrower. For example, the scope of a mineral exploration survey may be restricted to units classified to mining or units providing relevant supporting services to mining. If the collection of intellectual property product GFCF is part of an economy-wide survey then the questions should be tailored to particular industries to reflect the various scopes of different intellectual property products.

25. The survey should distinguish between purchases of intellectual property products for own final use and the unit's estimates of the costs of producing intellectual property products for its own final use. It is imperative that clear and comprehensive guidelines be given as to how each of these two types of expenditures should be estimated. It will almost certainly require the intensive and iterative use of pilot surveys to hone the questionnaire, supporting material and edits to achieve good results. Given the substantial possibilities for error due to understatement and to a lesser extent double counting, it is recommended that the questionnaire should lead the respondent through all the items that are required to obtain estimates of purchased assets and assets produced on own account, and ask for intermediate estimates along the way.

1.4.1 Purchases of intellectual property products

26. Units should be requested to include all their purchases of intellectual property products intended for own final use, including complete products, such as pieces of software, and services. They should be categorised by each type of expenditure. This varies according to the type of intellectual property product, but should cover the following where appropriate:

a. Outright purchases of complete products, such as a piece of software or a patent, for own use;

b. Payments for services that constitute fixed assets, such as the development of customized software or aerial and satellite imaging services to locate mineral deposits;

c. Payments for licences to use (*e.g*. software, the output of R&D and to exhibit movies) that satisfy the asset criteria; and

d. Payments for licences to reproduce (*e.g*. software and artistic originals) that satisfy the asset criteria.

1.4.2 Own-account production of intellectual property products

1.4.2.1 Valuation concepts

27. As described earlier, own-account GFCF should be valued at the basic prices at which the goods and services could be sold if offered for sale on the market. If this is not possible, which is nearly always the case, then the basic price should be estimated as either the net present value of future royalties, or more commonly, by summing the costs of production, including the user cost of fixed assets.

1.4.3 Costs to be included when summing costs to estimate own-account GFCF

28. Paragraph 6.125 of the 2008 SNA defines how estimates should be obtained when reliable market prices are unavailable.

> When reliable market prices cannot be obtained, a second best procedure must be used in which the value of the output of the goods or services produced for own use is deemed to be equal to the sum of their costs of production: that is, as the sum of:
>
> i. Intermediate consumption;
>
> ii. Compensation of employees;
>
> iii. Consumption of fixed capital;
>
> iv. A net return to fixed capital; and
>
> v. Other taxes (less subsidies) on production
>
> By convention, no net return to capital is included when own-account production is undertaken by non-market producers.

29. When a producer hires a fixed asset (such as a building or a piece of equipment) to use in production the rental is included in intermediate consumption, but when the producer owns the fixed asset it is necessary to impute the rental. In some instances, it may be possible to do this by observing market rentals, but in practice it is usually estimated by summing the costs of owning the asset, *i.e*. the *user cost.* The user cost has two principal components: consumption of fixed capital and a return to capital. The second component comprises two sub-components: the interest cost of owning the capital (the cost of financing the asset or the opportunity cost of the financial capital tied up in owning the asset) and the

expected holding gains and losses of owning this type of asset. In addition, government taxes, such as the tax deductibility of interest or accelerated depreciation allowances also influence the user cost of capital. For a full discussion as to how it can be estimated, refer to the OECD's revised *Measuring Capital*.

30. Note that a net return to fixed capital, item (iv), is only included when summing the costs of market producers.

31. Costs of developing in-house intellectual property products whether for internal use or for which the unit intends to sell licences-to-use or reproduce should be included. It requires the calculation of total labour costs and other costs as follows:

Total labour costs:

a. The number of in-house staff involved in the development of the intellectual property asset;

b. Estimates of average percentage of time spent by in-house staff on intellectual property asset development, excluding maintenance and commercial tasks, but including time spent on R&D;

c. Average compensation of staff engaged in asset development, including wages, salaries, bonuses, employer social contributions and other special benefits.

Other costs:

d. Overheads associated with employing the staff engaged on asset development*, includes management costs, training, personnel management, office requisites, electricity, rent, etc. and the use of fixed assets owned by the enterprise;

e. Any other intermediate consumption associated with producing the asset;

f. Taxes associated with the cost of producing the asset, such as payroll taxes*;

* In proportion to that spent on asset development.

32. In principle, the cost of the capital services provided by assets (*i.e*. the user cost of capital) used in any own-account production process should be included in the value of own-account production, but the cost of the assets themselves should not be. Unfortunately, the boundary between "intermediate" and "asset" characteristics is sometimes blurred. The general principles are that the purchased product should be recorded as:

(i) intermediate consumption if it is expected to be used up in less than a year;

(ii) intermediate consumption if is expected to be completely, or almost completely, embodied in the own-account production of a specific intellectual property product; and

(iii) as the acquisition of a fixed asset if it is expected to provide capital services for over a year in the production of a number of different products.

33. In case (ii), the acquired product in effect becomes a part of the new original being produced on own-account. For example, if a piece of software is acquired for the sole purpose of creating an enhanced, own-account software original then, in principle, its acquisition should be recorded as intermediate consumption. Recording its acquisition as GFCF would lead to double counting if the cost of capital services provided by it were included in the measurement of GFCF of the own-account software original.

34. The same argument applies to products produced on own account that are subsequently embodied in a single new product. For example, suppose in the staged production of own-account software there is an additional R&D stage. If the R&D output is to be used exclusively, or almost exclusively, in the production of a single, software original then the costs of undertaking the R&D should, in principle, be included in the costs of producing the software original, and there should be no GFCF of an R&D asset. If, however, the R&D output is expected to be used in the development of other software originals for a year or more, then it should be recorded as a fixed asset and the value of the capital services it provides should be allocated to the costs of creating the various software originals.

35. Making such distinctions in practice is difficult to do. Moreover, it is probably uncommon for purchased or own-account intellectual property products, such as software and R&D, to be completely used up in a year or completely embodied in another product. Therefore, it is recommended that as general rule all expenditures on intellectual property products purchased or produced on own account should be recorded as GFCF. It follows that the cost of the capital services provided by these fixed assets should be included (when summing costs) if they contribute to subsequent own account GFCF. Only in cases where units specialise in producing an 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.

Recommendation 1.9: As a general rule, all expenditures on intellectual property products either purchased or produced on own account should be recorded as GFCF. Only in cases where units specialise 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.

36. Returning to the detailed list of costs identified in paragraph 31. It is evident that the same expenditures on developing R&D and software are likely to be double counted in the estimates of own-account GFCF of R&D and software or the own-account GFCF of some other product. In principle, the business undertaking the own account GFCF should include the cost of the capital services provided by previously developed R&D and software assets rather than the whole cost undertaken in the current period. Clearly, it is unrealistic to expect businesses to do the former. In any case, taken across all businesses and over a number of periods, the difference between the conceptually correct approach and the practical one is likely to be insignificant. Therefore, it is recommended that when asking units to estimate the costs of producing assets on own account they should be asked to include the full costs incurred in undertaking R&D and software development to produce the asset in the current period.

Recommendation 1.10: When asking units to estimate the costs of producing assets on own account they should be asked to include the full costs of undertaking R&D and software development in the current period to produce the asset.

37. Survey respondents should be asked to itemise their expenditures, including purchases of R&D and software and other fixed assets needed to produce the asset. There are several advantages in doing so. First, it encourages and supports the respondent in costing all the required items. Second, data pertaining to purchases of fixed assets can be used to estimate the value of the capital services they provide. Third, it supports editing of the response by survey statisticians that could lead to substantially better estimates. For instance, there could be an edit that compares the reported staff hours spent on asset development with other costs. If one or more of these relationships were to fall outside certain bounds then follow-up action could be taken. For major respondents it may justify a query with the respondent, but for minor respondents it may initiate replacement of the reported values with imputed values.

38. R&D surveys conducted as per the Frascati Manual are an example of surveys designed to measure the total in-house costs of developing an intellectual property asset. Although not entirely consistent with national accounts requirements they provide a useful guide as to how to conduct surveys of this type. For many countries these surveys have been conducted over a long period of time and the experience gained could be exploited in developing surveys to obtain data for other types of intellectual property products.

39. The Frascati Manual recommends that capital costs should be measured by expenditures on capital products (including land). Whereas for national accounting purposes, capital costs should be measured as the rental payable for the use of fixed assets. When own assets are used these have to be imputed by estimating the cost of capital services (*i.e*. the consumption of fixed capital plus a return to capital). It is unrealistic to expect respondents to provide reasonable estimates of the user cost of capital, and so it is recommended that this component of the costs of own account GFCF should be imputed by the NSO. There are several ways of making this imputation.

a. If it is known what the past expenditures have been on fixed assets to be used exclusively for the production of the intellectual property product then the perpetual inventory method (PIM) can be used to estimate the cost of capital services. This is a possibility for R&D.

b. If sufficiently accurate and detailed data are available for units specialising in the production of the intellectual property product then the ratio of the cost of capital services to labour input can be calculated for this activity and used to make the imputation. Another possibility is to use the ratio of gross operating surplus to labour input.

40. Collecting detailed cost data for own-account GFCF of widespread intellectual property products, such as software, imposes a considerable respondent burden and substantial costs for the NSO. One way to reduce the costs is to collect the full set of cost data from only a sub-sample of units, collect only labour costs for the remaining units in the sample and impute the total costs using a regression model, or by some other means.

Recommendation 1.11: When asking units to estimate the costs of producing assets on own account they should be asked to itemize their costs, separately identifying purchases of fixed assets. The latter should be excluded from the sum of costs and be replaced with estimates of the user cost of capital.

1.5 Supply-side approach

1.5.1 Purchases of intellectual property products

41. The underlying principle for estimating GFCF using the supply-side approach is simple. GFCF is calculated as:

Domestic supply + imports

minus

Exports, households' expenditure and exclusions to avoid double counting

42. Production on own account needs to be excluded from domestic supply to avoid double counting. Both it and imports are valued at basic prices, and so transport costs, wholesale and retail margins and taxes less subsidies on products need to be added to obtain values at purchasers' prices.

1.5.2 Own-account production of intellectual property products

43. As already discussed, the demand and supply approaches for own account production of assets cannot be distinguished but there is a macro approach to estimating supply. It entails identifying the number of people in those occupations that produce the target intellectual property products and how much time they spend doing so, and then multiplying the quantum of labour input by wage rates and other labour costs, and the cost of all the overheads in undertaking such production. Naturally, the types of costs to be included are exactly the same as at the micro level.

Total number of employees working on own-account production

x

Average remuneration

x

Proportion of time spent on own-account production

+

Other intermediate costs used in own-account production

+

Notional operating surplus related to own-account production

44. For harmonisation and measurement purposes, it is sensible to restrict the employee categories included in the calculations to those that make a significant contribution. Where this information is not separately collected, estimates based on the relevant categories as per the International Standard Classification of Occupations 88 (ISCO) should be used.

45. Average remuneration, or compensation of employees, should include wages and salaries, social contributions (including imputed social contributions) and any related compensations-in-kind.

46. Not all of the time of each employee within the identified categories will be spent on own-account production of the target asset. Some of their time will be spent working on other tasks. The time spent on training by employees in the identified categories should be included proportionately. The same applies to managerial, supervisory, training, administrative and any other "overheads". The proportions may be obtained by referring to information gleaned from survey data, or failing that using rules of thumb based on international experience.

47. There are several ways of estimating non-labour intermediate input costs. One is to refer to data from demand-side surveys and another is to refer to the activity data of units specialising in the production of the target asset.

48. The same kinds of choices apply to estimating the operating surplus. That is, by assuming that the ratio of operating surplus to compensation of employees is the same as that obtained from the demand-side surveys or from the activity data of units specialising in the production of the target asset. The first option is probably the best in the case of R&D, while the second is the probably the best for software.

49. Care needs to be taken to avoid double counting. Production of the target asset for outright sale has to be excluded. How this is to be achieved varies from asset to asset. For example, in the case of software it is desirable to include the own-account production of software originals that are to be held by their developers and leased to users, but it is desirable to exclude the production of custom-made software.

1.6 Prices and volumes

1.6.1 General methodology when price data are available

50. The principles of compiling price indexes when products are sold on the market and price data are available are well understood. An overview is given section B of chapter 15 of the 2008 SNA and more thorough explanations are given in the Producer Price Index Manual[4] and the OECD's *Handbook on Hedonic Indexes and Quality Adjustments in Price Indexes* by Jack Triplett. Section C of chapter 15 addresses volume measurement and in paragraphs 15.141 to 15.147 it addresses the volume measurement of software GFCF.

51. Here we give a brief introduction to the two prevailing methods used in measuring price changes: matched-model and hedonic pricing. Hedonic pricing is based on regression techniques and used for a wide range of products, but they are most widely used in the area of computers and peripheral equipment. The standard approach in matched-model methods is to choose a fixed reference period and to match prices of products in subsequent periods with prices of the same products in the reference period. However, this is difficult to establish in a fast changing market where old products disappear or new products are introduced with high frequency, which is typically the case for software.

1.6.2 Matched-model method

52. In a typical matched-model, the price of a product in the base period is compared with the price of the product with the identical attribute or characteristic in the comparison period. In this way the price difference is the pure price change not due to any quality improvement. In cases where an existing product disappears or is replaced by a new product with different characteristics, it has to be deleted from the sample and the new product must be included in the sample to be matched in the next period.

53. After matching the products in two adjacent periods, the Laspeyres price index, P_L, the Paasche price index, P_P, and the Fisher Ideal index, P_F, can be calculated as follows:

$$(1)\quad P_L = \frac{\sum_i p_i^2 q_i^1}{\sum_i p_i^1 q_i^1},$$

$$(2)\quad P_P = \frac{\sum_i p_i^2 q_i^2}{\sum_i p_i^1 q_i^2},$$

$$(3)\quad P_F = \sqrt{P_L P_P},$$

[4] *Producer Price Index Manual: Theory and Practice* (Washington: International Monetary Fund). See also *the* OECD's *Methodological Guide For Developing Producer Price Indices For Services http://www.oecd.org/dataoecd/44/40/36274111.pdf* . A further manual on export and import price indices is in draft (as of mid-2008) http://www.imf.org/external/np/sta/tegeipi/index.htm).

where p_i^t and q_i^t are the price and quantity of product *i* sold in period *t*, *t = 1,2*.

54. In the Laspeyres price index the first period quantities q_i^1 are used as weights for the prices in both periods, implying that the buyers do not adapt their purchasing patterns to price changes. Since this assumption does not match reality, the Laspeyres price index is generally biased upwards, *i.e*. true price changes are overstated. On the other hand, the Paasche index is downward biased as it is based on the second period purchases. The Fisher index, which is the geometric mean of P_L and P_P, is a good approximation of the "true" price change because it accommodates the substitution effect.

55. Problems with matched-model price indexes arise when old products disappear or new products are introduced with high frequency. An index based only on overlapping products in a few periods and ignoring new products means that products actually sold are not sufficiently represented in the index. A way to get around this problem is to calculate a chained index with frequent re-sampling and re-weighting.

1.6.3 Hedonic pricing

56. The technique of hedonic pricing assumes, in principle, that each product is made up of a multitude of definable characteristics, that for each characteristic a price can be estimated and that quality changes in a product can be viewed as adding a new characteristic to the product. The resulting price change can then be divided between the change resulting from adding the better quality characteristic and from a more general price increase (or decrease). As such, a quality-adjusted or "pure" price can be calculated (Hollanders 2001).

57. In general, the following functional relation between the price of a product and its quality characteristics is assumed:

(1) $p_{it} = f_t(x_{1it}, x_{2it}, ..., x_{kit}, u_{it}), t \in [0, T]$,

where p_{it} is the price of variety *i* of a product at time *t*, x_{jit} the quality *j* of variety *i* at time *t* where there are *k* different product characteristics and u_{it} a disturbance term measuring all random factors.

58. There are several possible functional forms for this relation, *e.g*. semi-logarithmic, linear and linear in logarithms. Assuming the empirically most convenient semi-logarithmic functional form gives:

(2) $\log p_{it} = a_o + a_1 x_{1it} + a_2 x_{2it} + ... + a_k x_{kit} + u_{it}$,

where the a_j coefficient can now be interpreted as an estimate of the percentage increase in price due to a one-unit change in quality *j*.

59. Adding a time-dummy for each year except the base year, *i.e*. the dummy variable D_t takes the value one in year *t* and zero otherwise, gives:

(3) $\log p_{it} = a_o + a_1 x_{1it} + a_2 x_{2it} + ... + a_k x_{kit} + \sum_{t=1}^{T} a_{dt} D_t + u_{it}$,

where the coefficient a_{dt} provides with an estimate of the average percentage increase in price between year *t* and the previous year *t-1*, keeping the various qualities *j* constant.

60. The accumulation of these quality-adjusted price changes results in an estimate of the quality-adjusted price change between the base year and year *T* for any individual product.

61. A hedonic regression of equation (3) results in estimates for the a_k coefficients. Between period *t* and *t-1*, the quality change can then be calculated as:

$$(4)\ g_{i,t-1}^{t} = \frac{\hat{p}_{it}}{\hat{p}_{i,t-1}},$$

where $\hat{p}_{it} = f_t(x_{1it}, x_{2it}, ..., x_{kit}, u_{it})$ and $\hat{p}_{i,t-1} = f_{t-1}(x_{1i,t-1}, x_{2i,t-1}, ..., x_{ki,t-1}, u_{i,t-1})$ are the predicted prices for each period based on the estimates for the a_k coefficients.

62. The observed price index between years *t* and *t-1* can then be adjusted for this quality change as follows:

$$\text{true price index} = \frac{\text{observed price index}}{\text{quality change index}} = \frac{p_t / p_{t-1}}{\hat{p}_t / \hat{p}_{t-1}} = \frac{p_t / \hat{p}_t}{p_{t-1} / \hat{p}_{t-1}},$$

where p_t is the price index for year *t* compiled out of the individual p_{it}'*s*.

63. Hedonic pricing requires a big and detailed data set, since details of characteristics for each product are needed. Moreover, some product knowledge is necessary so that a certain amount of research effort is required. These requirements make the compilation of a hedonic price index very resource consuming.

64. A comparison of price index studies in packaged computer software shows that hedonic price indexes generally decline more rapidly than their matched-model counterparts. For example, a study (Hardoff 1997) of database prices in Germany show for the period 1986-1994 an annual average price decline of 7.4 per cent using hedonic pricing and of 4.4 per cent using the matched-model method.

Recommendation 1.12: For products where price data are available and there is evidence of rapid quality change, as is the case for packaged software, then the hedonic method should be used to derive price indices.

1.6.4 General method for products when price data are unavailable

65. A feature of intellectual property products is that they are commonly produced on own account, and no price data are observable. For non-market output, the 2008 SNA provides advice in paragraph 15.112. Some of this advice is often also applicable to the output of market producers not sold on the market.

> 15.112 In practice, there are three possible methods of compiling volume estimates of the output of non-market goods and services. The first is to derive a pseudo output price index such that when it is compared to the aggregate input price index the difference reflects the productivity growth thought to be occurring in the production process. Pseudo output price indices can be derived in various ways, such as by adjusting the input price index according to the observed productivity growth of a related production process or by basing

the growth of the pseudo output price index on the observed output price indices of similar products. However, such data are rarely available for the goods and services produced by government and NPISHs.

66. The other two methods referred to in the paragraph 15.112 apply to the production of individual and collective services by non-market producers, and do not generally apply to the production of intellectual property products.

67. The possibilities for deriving pseudo output price indices depend on whether suitable data are available for similar products or comparable production processes. When no such data are available there is little option but to compile input price indexes.

Recommendation 1.13: For products where price data are unavailable, pseudo output price indices should be derived if practicable, otherwise input price indices must be used.

1.7 Capital measures

68. The capital measures referred to in the 2008 SNA comprise gross fixed capital formation, capital services, net capital stock and consumption of fixed capital. Their definitions and the roles they play are all described in chapter 19. Methods for estimating GFCF are discussed elsewhere in this handbook and methods for estimating the other three measures is the subject of a new edition of the OECD manual *Measuring Capital*.

69. Nearly all countries derive their estimates of capital services, net capital stock and consumption of fixed capital using the perpetual inventory method (PIM). As its name suggests, the PIM involves aggregating GFCF over time, but allowing for declines in efficiency and value until assets reach the end of their service lives and are retired. The PIM is applied to groups of assets, generally at the most detailed level at which GFCF data are available.

70. Intellectual property products are not subject to wear and tear like most other fixed assets, such as motor vehicles and buildings, but they are subject to obsolescence. R&D products either become out of date due to the products they are used to produce going out of fashion or they are subsumed in some other R&D products. While some products of R&D may have an infinite life, such as the wheel, they eventually become available to all, have no owner and cease to be recognized as assets in the System.

71. The key parameters in the PIM are the expected service life of a group of assets of a similar type, the rate at which its productive capacity, or efficiency, is expected to decline as it ages and the rate at which its value is expected to decline as it ages. The last two are interdependent and their relationship hinges on a discount rate. Not all assets within a group can be expected to have exactly the same service life, and so a probability distribution function is usually specified. The most important PIM parameter is the service life. Specifying a service life of 10 years rather than 5 years would make a huge difference to the estimates of the capital measures. Net capital stock would be approximately double, and with a typical scenario of strong growth, consumption of fixed capital would be appreciably smaller. It therefore deserves a good deal of attention. There are several ways of obtaining estimates of service lives, they include: surveying users, surveying suppliers and consulting experts.

72. The age-efficiency function is usually unobservable, but the age-price function is observable for some fixed assets, such as motor vehicles or buildings, and the corresponding age-efficiency can be determined. It is likely that this will need to be adjusted to be plausible and so an iterative procedure can be undertaken until a plausible age-efficiency is obtained, such that the corresponding age-price function reasonably approximates the observed data. But an age-price function for intellectual property products is not readily observable. There are two reasons: most intellectual property products are produced on own

account and aged intellectual property products are not commonly traded. In the absence of information of the functional forms of either the age-efficiency or the age-price function then we can only hypothesise as to what appears to be plausible.

73. It can be shown that no matter what the functional form of the age-efficiency function of individual assets is, once they are considered as a group with individual service lives subject to a probability distribution then the functional forms of both the age-efficiency and age-price functions of the group will at least roughly approximate a geometric function with the same rate of decline, δ. Hence, the specification of a geometric function for the age-price and age-efficiency functions for a group of assets is attractive, particularly for assets, such as intellectual property products, for which the age-price function of an individual asset or a cohort of assets is unobservable. The geometric function also has the advantage that it is much easier to apply than any other functional form.

74. Another factor to consider in choosing a functional form for intellectual property products is what functional forms are used for other asset types when applying the PIM. It may be judged impracticable to use geometric for intellectual property products and some other functional form for other asset types.

75. In practice, δ is rarely observable for fixed assets and it has to be imputed by some means. One approach is to ask the owners of assets what their expectations are or to ask experts familiar with a particular type of asset for their views. Such respondents usually find it easier to report what they think the service life of an asset will be rather than the rate of decline in its efficiency or value. Given the service life it is possible to determine a corresponding δ using the following formula:

$$\delta = X/N,$$

where X is the declining balance rate and N is the expected mean service life of the group of assets.

Recommendation 1.14: When using the PIM, it is important to have reasonably accurate service lives. The geometric model has a number of advantages and should be used unless there are strong conceptual or practical objections.

2. Research and experimental development

2.1 Introduction

76. One of the major changes in the 2008 SNA is the recognition of expenditures on research and experimental development (R&D) as capital formation. The following was agreed by the United Nations Statistical Commission in 2007:

a. Research and development should be treated as gross fixed capital formation in the SNA. It should be defined as in the *Frascati Manual*[5], namely "research and experimental development comprises creative work undertaken on a systematic basis in order to increase the stock of knowledge, including the knowledge of man, culture and society and use of this stock of knowledge to devise new applications." This definition should not be interpreted as including human capital as capital formation within the SNA.

b. By convention, since much R&D is carried out on own account, it should be valued at cost. In practice, the information collected in accordance with the *Frascati Manual* will provide estimates of R&D expenditure; discussion is ongoing to make adjustments to this Manual to meet the needs of the SNA more closely. It is recognised that a detailed guide to implementation will be desirable to assist implementation of this recommendation.

c. All R&D expenditure that is sold or is expected to bring a benefit in the future to its owner (including for the provision of public services in the case of R&D undertaken by government) is included within the asset boundary. Only R&D that brings no economic benefit discernable at the time of its completion is excluded.

d. With the inclusion of R&D in the (fixed) asset boundary, patented entities will no longer be separately identified as such in the system, but they will be subsumed into R&D assets.

While there is strong support by countries for adopting these recommendations in the SNA, there is also considerable concern that it is premature to do so because of technical difficulties that have yet to be overcome. In conclusion, R&D expenditure should be recognized, in principle, as part of capital formation. However, recognising the difficulties to be overcome before this objective can be reached, satellite accounts will provide a useful way of working towards solutions that give the appropriate level of confidence in the resulting measures and practical guidance on implementation will help to ensure international comparability. Therefore, the 2008 SNA will describe the objective and its conceptual underpinnings, note the difficulties and provide links to work underway to overcome them and recognize that for many countries implementation will take some time. The ISWGNA will report periodically to the UNSC on progress and signal when widely accepted implementation guidelines are available.

77. The need to address the concerns raised in the last paragraph provided the impetus to create OECD and Eurostat task forces to develop recommendations and guidelines for compiling capital measures of R&D, and hence this handbook. A considerable amount of work was undertaken during the update of the 1993 SNA by members of the Canberra II Group on the Measurement of Non-Financial Assets, including the compilation of R&D satellite accounts. This provided the springboard for the work of OECD Task Force on R&D and Other Intellectual Property Products that has culminated in the guidelines and recommendations presented here. These represent the views of the Task Force based on the current state of knowledge. It is likely that as further work is undertaken, some of the guidelines and recommendations will need to be refined and expanded. For example, in the case of international trade in R&D, where the handbook discusses further work that could be undertaken.

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5 OECD *Frascati Manual 2002: Proposed Standard Practice for Surveys on Research and Experimental Development*

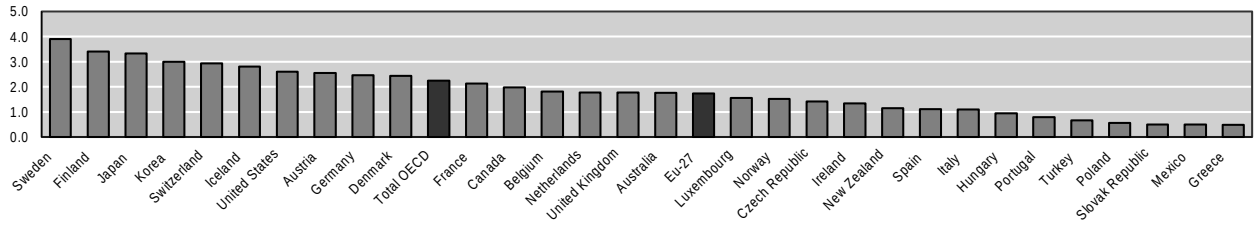
78. In the course of the work of the OECD task force, it became evident that more information was needed about various aspects of R&D, such as service lives and information about international trade. This led the task force to develop a standard set of questions that could be addressed in surveys of R&D performers. This was presented to the OECD's Working Party of National Experts on Science and Technology Indicators in June 2008, and is reproduced here in Annex 2.1.

2.2 Quantitative impact

79. The impact on GDP of the capitalisation of R&D depends on the relative size of R&D production to GDP, if and when implemented. An approximate indicator of what this is likely to be is the ratio of gross domestic expenditures on research and development[6] (GERD) to GDP. This ratio varies considerably between OECD countries. Figure 1 presents the value of this ratio for OECD Member countries in 2006, or the latest year. The ratio varies from about 0.5% for Greece to a little under 4% for Sweden – with the OECD average being 2.3%. The ratios do not change very quickly over time, which suggests that the capitalisation of GDP will have little impact on GDP growth rates.

80. A word of caution is needed because the GERD to GDP ratio is only an approximate indicator of the impact of the capitalisation of R&D on GDP for three reasons. First, there are conceptual differences between GERD and the national accounts measure of R&D production. Second, expenditures on R&D are already included in the output of non-market producers because output is measured by summing costs. However, R&D assets will incur consumption of fixed capital (depreciation) and so the gross value added, but not the net value added, of non-market producers will be boosted by the consumption of past R&D capital formation. In a growing economy the consumption of past R&D capital formation will be generally less than current expenditures on R&D and so the impact on GDP can be expected to be a little less than the GERD to GDP ratio suggests. Third, it is likely that some expenditure on R&D by government and non-profit institutions will not be recorded as capital formation.

Figure 1. Gross Domestic Expenditure on R&D as a percentage of GDP, 2006[1]



a) Source: OECD, Main Science and Technology Indicators, May 2007

1. 2006 or latest year.

2.3 Definition and scope of R&D in the 2008 SNA

81. The criteria for determining whether an expenditure on R&D is GFCF are just the same as they are for any other product. The definition and scope of R&D GFCF read as follows in the 2008 SNA:

> 10.103 Intellectual property products include the results of research and development (R&D). ***Research and [experimental] development consists of the value of expenditures 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. This does not extend to including human capital as assets within the System.*** The value of R&D should be determined in terms

6 One of the principal aggregates obtained from R&D surveys conducted as per the *Frascati Manual*.

> of the economic benefits it is expected to provide in the future. This includes the provision of public services in the case of R&D acquired by government. In principle, R&D that does not provide an economic benefit to its owner does not constitute a fixed asset and should be treated as intermediate consumption. Unless the market value of the R&D is observed directly, it may, by convention be valued at the sum of costs, including the cost of unsuccessful R&D.
>
> 10.105 With the inclusion of R&D expenditure as capital formation, patented entities no longer feature as assets in the System. The patent agreement is to be seen instead as the legal agreement concerning the terms on which access to the R&D is granted.

82. While in most respects R&D assets are no different from any other fixed assets, they do have certain characteristics that differ from most other fixed assets. One of the most important is that R&D assets can provide benefits to units other than their owner without compensation – a characteristic they share to varying degrees with other intellectual property products. When the knowledge gained from R&D is sold by its legal owner to other units, such as via a licence or the sale of a patent, the sale is recorded like that for any other product. But it is in the nature of R&D that the knowledge gained often becomes available to units other than the legal owner[7] by means other than a transaction. This can happen because the owner knowingly makes the knowledge available to others by putting it in the public domain, such as by patenting the knowledge or by making the knowledge freely available. The knowledge also can be spread by the simple act of the legal owner, or a licensee, using the knowledge in their production and it being observed by others.

83. Once the knowledge has been leaked it can become valuable to other units in a number of ways. First, there is considerable variation between countries in the extent that they recognise and uphold the rights of units with patents; knowledge that is well protected by a patent in one country may not be so well protected in another. Second, most new knowledge is gained by extending or synthesising existing knowledge, and if a pharmaceutical company introduces a new type of important drug, for example, other pharmaceutical companies often endeavour to build on this knowledge and develop related, but more effective varieties. Third, when a patent expires other units are free to use the patented knowledge and produce products that compete with those of the owner of the R&D, and this is also a common occurrence in the pharmaceutical industry.

84. The benefits that accrue to units other than the R&D owner without compensation are commonly referred to as spillovers, and it is common for the owner to obtain only a portion of the total economic benefits provided by the knowledge gained from its R&D, but it is only that portion that is recorded as an asset in the System. Spillovers are not attributed to any asset in the System.

85. It is common for the owners of R&D knowledge, particularly the output of basic research, to make it freely available to others. This may be due to a desire to benefit society, a common objective for government and non-profit institutions, or it may be that the owner expects to benefit as a result. The owner may expect benefits from being the first to publish, thereby enhancing their reputation, or from the activity that is stimulated by making the knowledge available to others, or it may be that researchers have simply found that if they do not share their knowledge other researchers will not either, and so it is in their best interests to collaborate. In any case, making knowledge freely available does not exclude the knowledge from being an asset provided the expected benefits for the owner are not diminished. What matters is the effective management and control of the knowledge asset in order to ensure the expected benefits are obtained. Knowledge is not recognised as an asset in the System if it is made freely available and leaves the owner with no expected economic benefits. Hence, if government undertakes or funds R&D (*e.g.* medical research) with the intention of using the knowledge it hopes to gain in its own production (*e.g.* the production of hospital or medical services) then it is acquiring an R&D asset equal to the expected

[7] Or the economic owner if a licence agreement has the appearance of a sale of the R&D

economic benefits reflected in its future production. If, however, it undertakes or funds the R&D with no intention of using the knowledge in its own production then it is not an asset.

86. The following recommendations are made:

Recommendation 2.1: Ownership of an asset exists when the owner has effective management and control of the knowledge asset in order to ensure the expected benefits are obtained. 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. The expected benefits can therefore be obtained.

Recommendation 2.2: As a practical solution, when the rights to benefit from the results of R&D are not clearly assigned by intellectual property protection, but the R&D output nevertheless has the characteristics of a produced asset, 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.

Recommendation 2.3: When ownership is deemed to exist, the only relevant question for determining whether R&D should be capitalized is whether it produces economic benefits for its owner. When it produces direct or indirect economic benefits, it should be capitalized. When it does not produce economic benefits (including the case where it only produces non-economic benefits), R&D should not be capitalized.

In practice, the following is recommended:

Recommendation 2.4: As a general rule, all R&D purchased or produced on own account by market producers should be treated as GFCF. Only when the R&D is produced for sale or when explicit information is available of non-market production should it be treated as consumption.

87. There are two ways of determining how much of the expenditures on R&D by non-market producers should be recorded as GFCF. One way is to ask units questions in a survey to determine whether they expect to receive economic benefits from the expenditures. Another way is to use existing data from R&D surveys, such as classifications of R&D expenditures by socio-economic objective (SEO), or by type (basic research, applied research and experimental development) and to allocate those categories to GFCF that appear to satisfy the asset criteria. Evidently, the quality of estimates obtained from this second approach rests on the veracity of the assumptions made: are they 100% true, 80% true, etc. Therefore, in concept the first approach is preferred, but practicality may dictate use of the second. The SEO categories are as follows:

1. Exploration and exploitation of the Earth
2. Infrastructure and general planning of land use
3. Control and care of the environment
4. Protection and improvement of human health
5. Production, distribution and rational utilisation of energy
6. Agricultural production and technology
7. Industrial production and technology
8. Social structures and relationships
9. Exploration and exploitation of space
10. Non-oriented research
11. Other civil research
12. Defence

88. Investigations have revealed that type of R&D is not very useful for determining whether R&D satisfies the criteria for being a fixed asset: some basic research, applied research and experimental development meet the criteria and some do not. The best prospect for using available data to determine which R&D owned by non-market producers should be recorded as GFCF is to identify those SEO categories that appear likely to provide future benefits for the owner and those that do not. The SOE categories to be excluded from GFCF comprise: agricultural and industrial production and technology; exploration and exploitation of space; and non-oriented research. But this last hinges on it being akin to pure basic research.

89. The FM describes two sources of SEO data. The first is from surveys of R&D performers and the second is from government budget appropriations or outlays for R&D by socio-economic objective (GBAORD) – see the FM for details: paragraphs 277-288 for the first and chapter 8 for the second. SEO data obtained from R&D perfomers are regarded by the FM as being of higher quality than SEO data from GBAORD and there are separate data for higher education units and other general government units. Investigations have revealed that SEO data from GBAORD require "purification" before they can be used. GBAORD data, however, have the advantage of being much more commonly available in countries. Moreover, they are on a funder basis rather than a performer basis.

The use of these data is still under consideration by the OECD TF and it is too soon to make any recommendations.

2.4 Features of the FM data

90. The principal aims of FM-based surveys are to estimate how much is being spent on undertaking R&D by resident units, *i.e*. the amount spent on the inputs to R&D, which are referred to as intramural expenditures, and to identify the sources of the funds used. There are several dimensions to the data collected. First, three different kinds of R&D activity are identified: basic research, applied research and experimental development. Second, there are expenditures by socio-economic objective. Third, expenditures are classified by type: current and capital. Fourth, there is a sectoral dimension: business enterprise, government, private non-profit, higher education and abroad[8]. The data are compiled as a single vector in each dimension, with no three dimensional matrix. In addition, the FM prescribes the identification of supplementary extramural R&D expenditures[9].

2.4.1 Intramural expenditures

91. Paragraphs 358 and 359 of the FM define intramural expenditures as:

a) All expenditures for R&D performed within a statistical unit or sector of the economy during a specific period, whatever the source of funds.

b) Expenditures made outside the statistical unit or sector but in support of intramural R&D (*e.g*. purchase of supplies for R&D are included. Both current and capital expenditures are included.

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8 There is a fourth dimension – product field - recommended for the business enterprise sector, which focuses on the actual industrial orientation of the R&D carried out.

9 Some countries compile all, or nearly all, the data recommended by the FM. Some countries compile less detail and some countries collect extra detail.

92. The composition of intramural expenditures is described in paragraphs 361 to 388 of the FM. Current costs have two sub-categories:

a) *The labour costs of R&D personnel*, which comprises all persons employed directly on R&D including those providing direct services such R&D managers, administrators and clerical staff.

b) *Other current costs*, which includes intermediate expenditures to support R&D, administrative overheads and on-site consultants.

93. Capital expenditures have three sub-categories:

a) *Land and buildings*, which comprises the share of these assets used for R&D. Land includes that under buildings and any other land used for R&D, such as testing sites;

b) Instruments and equipment, which includes embodied software; and

c) Computer software, which includes purchases as well as annual licence fees.

2.4.2 Sources of funds

94. Sources of funds are described in paragraphs 389 to 407 of the FM. The aim is to identify all direct transfers of resources both intended and used for the performance of R&D, and to attribute them to their ultimate source. "Transfers" has a much broader meaning in the FM than it does in the SNA and comprises two categories:

a) Those that are specifically for the procurement of R&D, *i.e*. the results of the R&D belong to the recipient of the output or product of the R&D, which is not necessarily the funder of the R&D; and

b) Those that are provided to the performers of R&D in the form of grants or other financial incentives, with the results of the R&D becoming the property of the R&D performers.

95. The FM recommends that, where possible, both categories of transfer of government R&D funds should be identified in the R&D data of the business enterprise sector. It also suggests that, if possible, a similar breakdown should be made for government funds to the higher education sector. Because transfers (the national accounts meaning) are treated quite differently from purchases in the national accounts it is highly desirable that they be distinguished. Some countries do distinguish between purchases and grants. Until other countries make the split, then probably their best option is to assume that non-government R&D performers mainly make outlays to acquire R&D, while government R&D performers make almost none.

96. The FM recommends that, as far as possible, the following breakdown of sources of funds should be obtained from R&D performers:

- Business enterprise sector:
  - Own enterprise
  - Other enterprise in the same group
  - Other enterprise
- Government sector:
  - Central or federal government (excluding general university funds)
  - Provincial or state government (excluding general university funds)

- ❖ Public general university funds
- ➢ Private non-profit sector
- ➢ Higher education sector
- ➢ Abroad:
  - ❖ Business enterprise:
    - Enterprises within the same group
    - Other enterprises
  - ❖ Other national governments
  - ❖ Private non-profit
  - ❖ Higher education
  - ❖ EU
  - ❖ International organisations

2.4.3 Extramural expenditures

97. Extramural expenditures are defined in paragraph 408 of the FM as:

> the sums a unit, organisation or sector reports having paid or committed themselves to pay to another unit, organisation or sector for the performance of R&D during a specific period. This includes acquisition of R&D performed by other units and grants given to others for performing R&D.

98. It is recommended in the FM that the following breakdown of extramural expenditure be obtained:

- ➢ Business enterprise sector:
  - ❖ Other enterprise in the same group
  - ❖ Other enterprise
- ➢ Government sector
- ➢ Private non-profit sector
- ➢ Higher education sector
- ➢ Abroad:
  - ❖ Business enterprise:
    - Enterprises within the same group
    - Other enterprises
  - ❖ Other national governments
  - ❖ Private non-profit
  - ❖ Higher education
  - ❖ International organisations

99. In principle, the estimated total of R&D expenditure within a country based on performers' reports of their sources of funds should equal the total based on the reported extramural expenditures of those providing funding. In practice, this does not normally occur due to such factors as sampling error and

different interpretations of what constitutes R&D. Most importantly, the scope of R&D surveys is confined to R&D performers and excludes R&D non-performers who may purchase R&D. Given this and that it is the performers who are actually undertaking the R&D, greater confidence should be put in their reports of expenditures on R&D than those who are providing the funding. However, given that performers may not always accurately identify the ultimate source of their funds the extramural expenditure data may provide a useful check on the distribution of the source of funds.

100. Note that extramural expenditures comprise grants and purchases of R&D, but the FM makes no recommendation to distinguish between them. For national accounts purposes this needs to be remedied. In addition, as with intramural expenditures, there is the problem of different sectoring, particularly in respect of higher education. These and other shortcomings are addressed in the Appendix.

101. The expenditures on the inputs used to undertake R&D reported by performers provide much of the data required to estimate the output of R&D in a country by summing costs. Combining an estimate of R&D output with imports gives an estimate of the total supply of R&D that can then be allocated to the using categories, including GFCF, using the commodity flow approach. To accomplish all of this requires three kinds of bridges between the FM and SNA data:

- Between FM sectors and SNA sectors
- Between FM's expenditures on R&D and SNA output
- Between FM's classifications of expenditures and funding and the SNA supply and use tables.

Annex 3 of the FM describes the differences and similarities in the SNA and FM treatments of R&D. This includes a discussion of the differences in sectoring and the differences between SNA output and total intramural R&D.

2.5 The bridge between FM and SNA sectors

102. Table 1 depicts the relationship between FM and SNA sectors. As can be seen from the table, there are several instances where FM sectors correspond to more than one SNA sector. The most important case concerns the higher education sector. This difference may be overcome by making a subdivision of the FM data for the higher education sector between:

a. Corporations and quasi corporations (including NPIs serving them)

b. General government units (including NPIs controlled and mainly financed by government)

c. NPISHs

103. In fact the FM already recommends a step in this direction in paragraphs 227 and 228: *"For some countries, it may be helpful, for the purposes of international comparison, to know the breakdown between public and private universities"*. Since data in R&D surveys are mostly collected for each institution, it seems feasible to make the necessary sub-classification for most countries. For those countries with sector codes recorded in their business register it may be relatively straightforward to produce this breakdown. For other countries some other means will be needed.

Table 2.1: Linking FM and SNA Sectors

OECD Frascati Manual	SNA
Business enterprise sector	Non-financial corporations
	Financial corporations
Government sector	General government
Private non-profit sector	NPISH
	Households[10]
Higher education sector	Corporations and quasi corporations
	General government
	NPISH
Abroad	Rest of world

2.6 The bridge between FM's intramural expenditures on R&D and SNA output

2.6.1 Duplication and omission with respect to other fixed assets

104. In a sense, all capital formation involves a form of double (or multiple) counting in the national accounts. The production of an asset is recorded in gross value added and GDP. In subsequent periods it can provide capital services which contribute to the production of goods and services, including other assets. Hence, over time there is a multiple counting. This is why the inclusion of R&D in the asset boundary will raise the level of GDP and why estimates net of consumption of fixed capital are preferred.

105. From a national accounts perspective, acquisitions of R&D performed by another unit should be recorded as either GFCF or intermediate consumption (IC) depending on the circumstances:

a. IC if it is expected to be used up in less than a year;

b. IC if it is expected to be completely, or almost completely, incorporated in the production of another single product; and

c. GFCF if it is expected to provide capital services for over a year in the production of a number of different products.

106. The same applies to R&D produced on own account, only in this case those expenditures not recorded as GFCF would be expensed according to their type.

107. As discussed in paragraphs 32 to 35 and summarised in recommendation 1.9, it is recommended that in general all acquisitions of intellectual property products should be recorded as GFCF on the presumption that all, or nearly all, of them are expected to have multiple uses for an extended period. An

[10] Expenditures on R&D by the household sector are considered to be nil as there is no real survey coverage.

important exception occurs when R&D is acquired – either by purchase or undertaken on own account – with the intention of future sale. This is most likely to occur in respect of units classified to the Scientific R&D industry (ISIC 67). Only when specific information is available to the contrary should acquisitions of R&D be recorded as GFCF by units in this industry, such as cases when a unit takes out a patent and sells licences to use. The other exception is R&D acquired by non-market producers that does not satisfy the asset criteria.

Recommendation 2.5: All R&D purchased or undertaken on own account by the Scientific R&D industry (ISIC 67) should be recorded as IC, 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 GFCF, such as cases when a unit takes out a patent and sells licences to use.

108. A separate issue concerns what to do about double counting costs incurred in producing two or more types of asset when summing costs to estimate GFCF. This can easily happen when software is developed in-house to undertake R&D and vice versa. The issue is addressed in paragraph 36, and recommendation 1.10 is to ignore the problem on the grounds that the double count is only shifting costs between periods and is unlikely to have a significant effect.

2.6.2 Licences to use

109. Payments for a licence to use an R&D asset that satisfy the criteria of an asset should be recorded as R&D GFCF of the licensee according to the 2008 SNA. But data to compile estimates are not currently available from FM surveys because payments for licences to use are included in neither R&D intramural nor R&D extramural expenditures and the receipts from such payments are not included in FM funding data. One way of getting such data would be to ask R&D performers for details of the licences they sell to determine whether they satisfy the SNA requirements for GFCF by the licensee, and to obtain the income received for such licences. While such data could be expected to give reasonable estimates of total GFCF on licences to use R&D from domestic sources (assuming foreign sales could be excluded) it would exclude GFCF of foreign-sourced licences and there would be no industry (and possibly sector) breakdown. Another way would be to obtain details of expenditures in economy-wide surveys, as for software. It would be best to use both approaches. However, before embarking on them it would be sensible to get some idea of the magnitude of GFCF by licensees by obtaining information from major R&D performers.

2.6.3 Licences to reproduce

110. The 2008 SNA recommends that if a licence allows the licensee to reproduce the original and subsequently assume responsibility for the distribution, support and maintenance of the copies, then this is described as a licence to reproduce and should be regarded as the sale of part or whole of the original to the unit holding the licence to reproduce. However, if the licensee simply reproduces and distributes copies without taking responsibility for support and maintenance then there is no change of ownership and the payments the licensee makes to the licensor should be recorded as IC rather than GFCF.

111. The FM does not cover payments and receipts for licences to reproduce, and the solutions suggested for licences to use could be applied to licenses to reproduce. However, before embarking on them, as for licences to use, it would be sensible to get some idea of the magnitude of GFCF by contacting major R&D performers.

2.6.4 Deriving estimates of R&D output

112. The SNA recommends that own-account capital formation should be estimated at market prices if possible, and when it is not, which is generally the case, its basic price should be estimated by summing costs. When summing costs to measure output by market producers, the 2008 SNA identifies five principal components to be included (paragraph 6.125):

a) Intermediate consumption;

b) Compensation of employees;

c) Consumption of fixed capital;

d) A net return to fixed capital

e) Other taxes (less subsidies) on production

113. For non-market producers, item (d), a net return to fixed capital, is omitted.

114. The FM-based R&D surveys provide most of the data required to compile estimates for each of these components. In some cases the data need little, if any, adjustment. In other cases there is quite a bit of work to do. But the first step is to identify the expenditures on R&D reported in the surveys that should be excluded to avoid double counting.

2.6.5 Intermediate consumption of goods and services

115. The scope of intermediate consumption and the FM's *other current costs* are quite similar, but the accounting principles differ. When measuring output by summing costs, the SNA recommends summing the costs of the inputs actually used in the period. By contrast, the FM recommends the measurement of all the expenditures made in the period. Thus, in principle, an adjustment is required to the FM data for the changes in inventories of inputs. In practice, it is very likely to be insignificant and can be ignored.

116. The *other current costs* category should include payments for licences to use intellectual property other than software (licence fees for software are included in capital expenditures), but the FM does not make a recommendation to separately identify this item. Payments for a licence to use an R&D asset that satisfy the criteria of an asset should be recorded as R&D GFCF of the licensee according to the 2008 SNA. These R&D assets could be acquired either to produce R&D output, such as research tools for performing pharmaceutical R&D, or to produce other products, such as a licence to produce pharmaceuticals for sale in a particular country or region. Ideally, R&D surveys should be amended to separately identify these expenditures and collect information that would enable the determination of whether they should be treated as GFCF, and if so what kind. However, before embarking on such a change it would be worthwhile conducting a pilot survey to determine how significant the estimates of GFCF are likely to be.

117. *Other current costs* include intermediate inputs as well as the labour costs provided by staff providing indirect services, such as security and canteen staff. For national accounts purposes these costs should be included in compensation employees and value added. But where they are included in the sum of costs has no bearing on the measurement of output and GFCF.

118. The FM data include payment of gross taxes on products other than VAT, including when it is not refunded.

2.6.6 Acquisition of R&D services for use in R&D production

119. The FM excludes transactions in R&D between producers to avoid double counting. Gross expenditures on R&D (GERD) are estimated by adding the intramural expenditures of all resident producers; consequently the R&D performed by one resident unit should not be included in the intramural expenditure of another resident unit (*e.g.* the outsourcing of part of an R&D contract that is a component of the R&D project to be performed). For the same reason, imported R&D used as an input by an R&D producer should be excluded from GERD. Acquisitions of R&D are registered by the FM as extramural expenditures, which provide a financing source for the costs of the R&D produced by the seller.

120. From a national accounts perspective, acquisitions of R&D performed by another unit should be recorded as GFCF, except acquisitions by the Scientific R&D industry – see recommendation 2.5.

2.6.7 Compensation of employees

121. Included in those directly employed on R&D are postgraduate students who are either on the payroll of R&D units and/or receive external funds (such as research scholarships). Although the external funding component is not included in the SNA measure of compensation of employees, the 2008 SNA (paragraph 10.63) prescribes that even labour provided free should be included at what it would have cost if it had been paid for when summing costs to measure own-account GFCF and output. Therefore, the payments made to postgraduate students, whether by pay or external funding, should be included when summing costs to measure output and GFCF on the assumption that they are indicative of the students' contribution to R&D output.

2.6.8 Capital services, consumption of fixed capital and return to capital

122. The user cost of capital (*i.e.* the value of capital services provided by fixed assets) is approximately equal to the consumption of fixed capital and a return to capital. As noted, above, the 2008 SNA recommends that when summing costs to measure the output of market producers the value of capital services should be included, but when measuring the output of non-market producers the return to capital is set to zero, and the value of capital services is equal to the consumption of fixed capital.

123. In measuring GERD, the FM includes capital expenditures both on fixed assets and land. Neither of these should be included when summing costs to measure output. But one way of estimating the value of capital services is to apply the perpetual inventory method (PIM) to the estimates of GFCF for previous periods as reported by FM surveys. In addition, any R&D assets that have been specifically identified as contributing to the production of R&D should also be included (see paragraph 44). In order to do this a breakdown below the level that is recommended by the FM is needed - one sufficient to distinguish between major components that have different long-term price changes and service lives. At a minimum the following breakdown is suggested:

- Land and buildings
    - Land
    - Buildings
- Instruments and equipment
    - Transport equipment
    - Office machinery and equipment

- Radio, TV and communication
- Other machinery and equipment

- Software

Breakdowns of past capital expenditures would need to be imputed.

124. Other ways of estimating the value of capital services are by making an imputation using the ratio of the estimated value of capital services or gross operating surplus of an industry specialising in R&D (*i.e*. Scientific Research and Development, Division 72, ISIC Rev. 4) to labour input or output. Alternatively, a hybrid measure could be used, with consumption of fixed capital derived using data for the R&D performer and net capital services or net operating surplus imputed from an industry specialising in R&D.

125. Factors to consider in choosing between the various methods include:

a. The capital intensity of Division 72 might be quite different to that of other R&D performers and so the ratio of capital services or GOS to output or labour costs for Division 72 might be quite inappropriate.

b. The ratio of operating surplus to labour or output could vary a good deal from year to year and, in any case, might not be indicative of R&D activity undertaken by other industries.

c. R&D is a high risk activity, and one would expect those engaging in it would demand a high rate of return. This implies that if the first method is to be used a relatively high interest rate should be used in determining the return to capital for market producers.

126. On balance it would seem that using the PIM on GFCF data collected via FM surveys is to be preferred, providing a sufficiently detailed breakdown of GFCF can be obtained.

127. There is another issue regarding the FM capital expenditure data: sales of fixed capital and land are ignored. There is reason to believe this is insignificant, but it should be taken account of if possible.

128. Do R&D assets contribute to the development of future R&D assets? In principle, past R&D can contribute to future R&D, but in practice it is generally difficult to measure. Therefore, by convention, it is acceptable to ignore it unless specific information is available.

2.6.9 Other taxes less subsidies on production

129. The FM does not show the flows of taxes explicitly, but some taxes are included in current expenditures. For example, payroll taxes are included in labour costs. On the other hand, other subsidies on production are not deducted from expenditure, but are shown as a financing source. Furthermore, payable tax credits (see chapter 22 of the 2008 SNA) should also be recorded as subsidies. Subsidies on R&D production may be quite substantial, and it is important to take them into account.

130. Details on government funding of R&D performance in other sectors are already recommended in the FM for government budget appropriations or outlays for R&D by socio-economic objectives (GBOARD) (see chapter 8 of the FM), and include the data necessary for bridging between the two systems. In the short term, if such data are unavailable then national accounts data on subsidies may be used to estimate these flows.

2.7 The bridge between FM's classifications of expenditures and funding and the SNA supply and use tables

2.7.1 Supply of R&D

131. Supply and use tables provide the means to estimate the GFCF of R&D using the commodity flow approach. However, for most countries a more realistic portrayal of the estimation process is that of making adjustments to the R&D survey estimates of intramural expenditures on R&D, because they usually dwarf the other components of supply and use. Detailed FM data on expenditure and funding provide the major part of the data needed for supply and use tables for R&D.

Box 2.1. Defining and Measuring International R&D Trade

"R&D exports and imports" can be defined as transactions of R&D services between resident and non-resident institutional units, where R&D is defined as per the 2008 SNA and the Frascati Manual, as noted elsewhere in the Handbook. Transactions between resident and non-resident units of a compiling economy may be delivered in as many as four modes as defined by the Manual of Statistics of International Trade in Services (MSITS).

MSITS defines transactions "as an economic flow that reflects the creation, transformation, exchange, transfer or extinction of economic value and involves changes in ownership of goods and/or financial assets, the provision of services or the provision of labour or capital" (MSITS 2.31). For its part, residency requires both having a centre of interest (*i.e.*, participation in economic activities) and residing in the country for one year or more. This "concept of residence… is identical to that used in BPM5 and the 2008 SNA [and]…it is not based on nationality or legal criteria…" (MSITS 3.3).[11]

The two modes most relevant for R&D services are mode 1, "cross border supply [which] takes place when the consumer remains in [the] home territory while the service crosses national borders" (MSITS 2.16) and mode 3, commercial presence, associated with foreign direct investment (FDI) (2.18, 2.59). Mode 1 is captured by conventional cross-border trade statistics, whereas mode 3 is captured by FATS (foreign affiliates trade in services) (1.21, 1.24, 2.64) or FDI statistics (1.20, 2.46, 2.59).

For the purpose of estimating gross fixed capital formation, however, the interest is in adjusting R&D investment flows by adding imports and subtracting exports. In turn, imports and exports are captured most appropriately by mode 1 (cross-border flow) statistics. For example, just because an organization or parent enterprise funds R&D in another country or owns a unit acquiring R&D in another country does not mean that the R&D is intended for use back in the home country – this may be the case but funding or FDI data by themselves do not suffice to reach such a conclusion. Notably, cross-border R&D grants (cash transfers) from a public organization or a parent company should not be included in R&D trade, as discussed in the main text. Separately, once cross-border flows of R&D services are identified they may be disaggregated in terms of affiliated and unaffiliated trade. The latter raises measurement issues associated with transfer prices and related reporting issues, as discussed elsewhere in this Handbook.

For their part, statistics on transactions of international services associated with intellectual property products are difficult to separate from other activities, especially for intra-group services. Indeed, "intra-group arrangements for rendering services are sometimes linked to arrangements for transferring goods or intangible property (or the licensing thereof). In some cases, such as know-how contracts containing a service element, it may be very difficult to determine where the exact border lies between the transfer or licensing of property and the transfer of services" (OECD 2001: 1.42-1.44, 7.3). See the main text for a discussion of identifying and using appropriate data.

132. Total supply of R&D is obtained by summing output and imports – see Box 2.1 for a definition of R&D imports and exports. R&D output for the business sector[12] can be classified in three different categories consistent with both FM and SNA-based terminology and data collection (Moris 2008). The three types are own account, custom, and speculative production. Own account R&D is produced ('performed' in FM terminology) and used internally, regardless of funding source (internal or external).

[11] See "The rest of the world account (external transactions account)", in the 2008 SNA, especially paragraphs 26.XX to 26.XX.

[12] Material on government & NPs R&D trade remains to be developed.

Custom R&D is produced on behalf of an outside customer, often under contract. Speculative R&D[13] refers to self-funded production not intended for internal use and with no advanced, secured buyer.[14] [15]This is exemplified by commercial R&D service providers (the latter, of course, also perform custom R&D under contract). Speculative R&D may result in an increase in inventories (finished or in-progress R&D), sales, or transfers. Own account R&D, likely the largest output component across OECD countries, must be derived from FM-based R&D survey data. Custom R&D may be obtained from R&D, economic, and international transactions surveys (*e.g.*, sales or exports by commercial R&D providers). Speculative R&D may be included, but not separately identified, in R&D survey data and may be treated similar to own account R&D for valuation purposes (*i.e.*, based on production costs).

133. In principle, imports may be classified as cross-border purchases of custom and speculative R&D and inbound cross-border R&D transfers. However, imports of custom and speculative R&D are likely to be included as a whole in international transactions surveys that include a dedicated category for R&D services. Inbound transfers are not available from either R&D or trade surveys. FM-based surveys can provide estimates of imported R&D by R&D performers (especially custom R&D based on extramural expenditures tied to overseas R&D suppliers), but imports of R&D by non-R&D performers must be obtained from trade surveys. Another source of data that could possibly also provide information on R&D transactions of producers that are not themselves performing any R&D are innovation surveys.

2.7.1.1 Grants, transfers, and R&D trade

134. Both funding grants (cash transfers) and asset transfers (capital transfers) are one-way or unrequited flows.[16] At the same time, grants and assets transfers are exact opposites in the sense that grants reflect flow of funds with no associated asset flow whereas transfers are asset flows with no associated money flows. For the purposes of measuring R&D imports (and exports), R&D grants must be discounted when using funding data from R&D surveys whereas the estimated value of cross-border transfers of (completed or in-process) R&D should be added if the data allow it.

2.7.2 Uses of R&D

135. Uses of a product typically comprise final consumption, intermediate consumption, exports, GFCF and changes in inventories. Final consumption of R&D is likely to be trivial and can be ignored. In order to derive GFCF as a residual by sector, all purchases of R&D output between domestic sectors need to be recorded, too. Any capital transfers of R&D output should be recorded subsequently in the capital account.

2.7.2.1 Intermediate consumption of R&D services used in R&D production

136. This has already been dealt with above.

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13 The label is consistent with the term used for construction of dwellings and other buildings and structures in the SNA.

14 The 2008 SNA recognizes speculative production of assets (see for example paragraph 10.55). Mohr and Murphy (2002: 5) consider speculative IP production in the context of product classification systems.

15 R&D contracts where the buyer does not receive payments until the client successfully commercializes resulting knowledge could be classified as speculative R&D as defined here.

16 See 2008 SNA paragraphs 8.34-8.40. Also called transactions without a quid pro quo (3.54).

Table 2.2 R&D supply/use, by supply source

	Total Use			
Total Supply	**Intermediate consumption**	**GFCF**	**Changes in inventories**	**Exports**
Output				
A-own account	X	X		
B-speculative production	X	X	X	X (sales/transfers)
C-custom R&D services	X	X	X	X (sales)
Imports	X	X		
D-purchases				
imports of speculative production				
imports of custom R&D services				
E-inbound transfers				

2.7.2.2 R&D acquisitions that do not meet the criteria for being an asset

137. Acquisitions of R&D output (purchased or produced on own account) that are not expected to provide benefits for their owner should be recorded as intermediate consumption. This applies to R&D non-market producers, *i.e*. the government and NPISH sectors.

2.7.2.3 Net purchases of R&D between domestic sectors

138. The net purchases of R&D output between domestic sectors that constitute R&D GFCF need to be recorded. If a split of the funding data is unavailable, then probably the best option is to assume that non-government R&D performers mainly make outlays to acquire R&D, while government R&D performers make almost none.

2.7.2.4 Inventories of finished R&D and work in progress

139. Since production of R&D mostly takes longer than one year, whether own account, custom, or speculative, there will also be work in progress until the R&D is finished. If the R&D is produced on own account, then the 2008 SNA recommends that the production of assets on **own account** should be recorded as GFCF as it occurs. If there is significant production of R&D for sale (as is the case for exporting countries such as Israel), then it should be recorded in inventories of work in progress. This is particularly important for the R&D produced by affiliates of multinational firms, which may be ultimately be exported.

Exports of R&D

140. Exports may be classified as cross-border sales of custom and speculative R&D and outbound R&D transfers (Moris 2008). However, similar to the case for imports, exports of custom and speculative R&D are likely to be included as a whole in international transactions surveys that provide details for R&D services, whereas outbound transfers are not available from either R&D or trade surveys.

141. Alternatively, some export data may be obtained from R&D surveys. As described above, the FM recommends that R&D performers should be asked to provide details of their sources of funds. Unfortunately, these funds include both payments for purchases and **funding grants** (**cash** transfers in the national accounts sense) and at best only a partial decomposition may be available. But detailed data of funding from R&D surveys with appropriate sub-classifications by domestic and foreign sectors of origin

(similar to the classification outlined above for extramural expenditure), and by economic kind (*sales, transfers and subsidies*) could provide a reliable source for estimating exports – see annex 2.2 *Additional Data Requirements*. (The NESTI group is currently reviewing the issue of internationalization of R&D performance, and a task force has undertaken work to improve measures of international transactions of R&D.) Until such data are available from R&D surveys, in the short run it should be possible to prepare reasonable estimates of uses of R&D by subdividing data on funding of business R&D using balance of payments data on exports of R&D. Such a subdivision can be made under the assumption that funding from the business sector to the business sector is only received to make a purchase (that there are not any transfers – *i.e*. with no quid pro quo - between business enterprises) and that exports of R&D by producers that do not engage in R&D may be ignored.

2.7.2.5 Gross fixed capital formation in R&D

142. GFCF is derived as the residual between supply and the above uses. While it is possible to derive estimates of R&D GFCF using data collected as per the FM, the quality of the estimates could be significantly improved with the collection of additional data. In 2005, the Canberra II Group composed a list of additional data required from R&D surveys to better meet national accounts requirements and sent to the OECD's NESTI Group, which is responsible for the FM. This is presented in annex 2.2. The most important improvements are to obtain funding and extramural expenditures that are sufficiently classified, as described in the annex.

143. The FM does not provide all the required data to estimate imports and alternative data sources need to be used, such as trade surveys or specialized business surveys, including innovation surveys. Further guidance on the estimation of exports and imports using commonly available current data sources is provided in annex 2.4. Pointers for the future development of trade data sources are described in annex 2.5.

144. Table 2.3 summarises the steps involved to derive an estimate of R&D output and table 2.4 gives a numerical example. Table 2.5 summarises the remaining steps to derive GFCF of R&D and table 2.6 continues the numerical example.

Table 2.3 Summary of steps to derive output of R&D

Starting point: FM Intramural expenditures on R&D for each sector	
1. Intermediate consumption of goods and services other than R&D	Subtract payments for licences to use intellectual products (principally R&D assets, such as patents) that should be recorded as GFCF. See item 4 below and item 7 of table 2.5.
2. Intermediate consumption of R&D services used to produce R&D	Add extramural purchases of R&D that should be recorded as intermediate consumption, but not those that should be recorded as GFCF. Applies only to Scientific R&D industry.
3. Compensation of employees	Add payments to postgraduate students not included in FM data.
4. Cost of capital services	Subtract capital expenditures Add cost of capital services (only CFC for non-market producers), including R&D assets specifically identified as contributing to R&D output.
5. Other taxes less subsidies on production	Add taxes not included in FM data Subtract subsidies
	Equals Output of R&D for each sector

Table 2.4 Summary steps to derive output – numerical example

	Corporations	General government	NPISH	Total economy
FM intramural expenditures	12, 816	6,170	1,411	20,397
1. Intermediate consumption of goods and services other than R&D	0	0	0	0
2. Intermediate consumption of R&D services used to produce R&D	72	39	2	113
3. Compensation of employees	0	0	0	0
4. Cost of capital services	1,316	-36	-89	1,191
5. Other taxes less subsidies on production	-717	0	0	-717
6. R&D output at purchasers' prices	13,487	6,173	1,324	20,984

Table 2.5 Summary steps to derive total supply, total use and GFCF of R&D

Starting point: R&D output for each sector	
1. Add Imports of R&D	
2. Equals Total supply of R&D for each sector	
3. Equals Total use of R&D for each sector	
4. Subtract Intermediate consumption of R&D	Same as item 2 from table 2.3
5. Subtract Acquisitions of R&D not expected to provide a benefit	Mainly applies to R&D acquired by non-market producers for which there are no expected benefits.
6. Subtract Exports of R&D	
7. Add Net purchases of R&D between domestic sectors	Net purchases that are R&D GFCF. As per funding data between domestic sectors, excluding data for items 4, 5, transfers and subsidies. Include payments to acquire a licence to use R&D output that qualifies as GFCF.
8. Subtract Changes in inventories of finished R&D and work in progress	
Equals Total GFCF of R&D for each sector	
Add/subtract capital transfers of R&D assets between sectors in capital account	

Table 2.6 Summary steps to derive total supply, total use and GFCF of R&D – numerical example

	Corporations	General government	NPISH	Total economy
R&D output at purchasers' prices	13,487	6,173	1,324	20,984
Imports of R&D	1,421	583	0	2,004
Total supply of R&D = Total use	14,358	6,756	1,324	22,438
Intermediate consumption of R&D	72	39	2	113
Acquisitions of R&D not expected to provide a benefit	0	3,000	500	3,500
Exports of R&D	2,981	240	300	3,521
Net purchases of R&D between domestic sectors	-100	300	-240	-40
Changes in inventories of finished R&D and work in progress	0	0	0	0
Total GFCF of R&D	11,755	3,777	282	15,814

2.8 Impact on the accounts

145. Estimates of output derived as per the 1993 SNA include estimates of R&D output sold on the market, while the estimates derived as per the 2008 SNA include all R&D output. Therefore, one might expect the impact on output to arise only from the inclusion in output of R&D undertaken on own account. However, in practice the impact on output might be somewhat different. This is because different data sources are being used: FM-based R&D survey data are replacing other data sources.

146. The value of output of non-market producers is derived as the sum of costs, including the costs of performing R&D. With the inclusion of R&D in the fixed asset boundary these costs also include the consumption of R&D fixed assets, and to this extent the output and value added of non-market producers are increased.

2.9 More on international trade

2.9.1 Data sources

2.9.1.1 R&D surveys

147. Data from R&D surveys are described at length earlier in the Handbook. For the purposes of R&D trade, funding from abroad and extramural expenditures represent the starting point. More specifically, the necessary data for exports/imports for the for-profit sector are funding for business enterprise R&D [FABE] *from overseas* businesses and extramural expenditures sent from domestic businesses *to overseas* businesses.

148. Data on funding from abroad or extramural expenditures at a higher level of aggregation may still be appropriate if, for example, the business sector fund and perform most R&D and are therefore likely to represent the bulk of cross-border transactions.

2.9.1.2 Services trade surveys

149. Statistics on international transactions in services for balance of payments (BOP) purposes are collected using surveys, international transactions reporting systems [ITRS], or a combination thereof. "An ITRS measures (a) individual balance of payments cash transactions passing through domestic banks and foreign bank accounts of enterprises, (b) non-cash transactions, and (c) stock positions. Statistics are compiled from forms submitted by domestic banks and from forms submitted by enterprises to compilers." (IMF/OECD 2000: paragraph 20; see also IMF 1995, chapter 2).

150. The extent that different methodologies in surveys and bank reporting systems impact R&D services statistics remains to be determined. Further, in principle, units that import - but do not export - R&D services are more difficult to identify and survey compared with R&D performers/exporters.

151. Historical survey data on R&D services transactions, where available, follows BPM5, the 5th edition of the Balance of Payments Manual released in 1993, along with the MSITS first edition released in 2002. Both of these manuals are under revision as of mid-2008. See OECD (2006**)** for an overview of metadata from this source. R&D services transactions are classified in EBOPS[17] code 279 and are part of miscellaneous business, professional, and technical services within the trade component of the current account. MSITS also provides guidance on the use of the Central Product Classification (CPC v. 1.0) system, an international classification system of products within economic activities (2.35), "providing greater detail and a necessary, although partial, statistical link between domestic production and trade in services"(2.63). R&D services activities are associated with 12 service product codes (MSITS Table A.III.1, pages 108-109). CPC codes for R&D services are essentially groupings of major field of science

[17] Extended Balance of Payments Services classification. The classification extends BPM5 codes with additional detail for services (MSITS 1.5, 3.24).

categories (physical sciences, chemistry/biology, engineering/technology, etc) plus a category for interdisciplinary R&D. CPC does not provide a separate code for commercial non-R&D testing services and thus the latter may be included within overall R&D and testing services in actual data collection.

152. MSITS requires transactions to be reported on an accrual basis, valued at market prices. According to the SNA93 (3.97-3.98) an accrual basis for exchanges and transfers of non-financial assets, implies that these transactions are recorded "at the moment when the legal ownership of those assets passes." Further, "when change of ownership is not obvious, the moment of entering in the books of the transaction partners may be a good indication…These subsidiary rules apply in particular to internal transactions." In short, "imports and exports of goods are recorded when change of ownership occurs."[18]

2.9.1.3 Other sources

153. Surveys not specifically designed for R&D purposes may provide useful indicators. For example, industry-specific surveys with data for Scientific R&D services ISIC 72 rev.4 (or NAICS 5417 for North America) may provide data on global or export revenues. However, data from this source are a lower bound since they do not include R&D exports/imports by companies or establishments whose primary activity is not R&D. (In contrast, services trade surveys cover all services, including R&D services, as an activity for all companies regardless of company classification.) Innovation surveys are also as a potential source. The further development of data sources for international trade is discussed in annex 2.4.

2.9.2 Data adjustments

154. R&D trade data for capitalization purposes should be consistent with both BPM and the FM. First, the former requires transactions on an accrual basis, valued at market prices prevailing at the time of change of ownership. The latter requires, at a minimum, consistency with R&D definition in the 2008 SNA. Second, the ideal scenario would have top figures on R&D exports and imports from trade surveys properly adjusted to track similar data from R&D surveys with additional details from the latter source. Adjusted BOP-based data would then be consistent not only with trade in other intellectual property products, such as computer/software services, but also with FM-based surveys.

155. One implication of the above observations is that countries should leverage and further develop both types of sources (SNA-based and FM-based). On a short-term basis, this calls for effective use of within country statistics and cross-country comparisons.

156. In light of current shortcomings from known sources on R&D trade, countries may leverage existing data from different sources by cross-survey comparative or benchmarking studies (Schellings, 2004) and microdata-linking exercises. Bilateral statistical studies represent another tool already exploited for comparisons of overall exports and imports across countries. Data quality studies on exports and imports of intellectual property products may be included in such bilateral projects or be designed as stand-alone exercises, at least on a one-off basis.

[18] The BOP Compilation Guide (paragraph 20) summarizes these pointers as follows: "The BOP accounting system requires that both entries for a transaction be recorded at uniform values and in the same time period. To satisfy this requirement, transactions are recorded at market value, and the time of recording is typically the point at which a change of ownership occurs. In practice, it may be difficult to achieve these theoretical ideals. Different data sources may be used to measure the two entries in a transaction, and these data sources may not reflect uniform valuations and times of recording. In addition, coverage of transactions by data sources may be incomplete, a factor that may lead to omissions in the BOP accounts."

2.9.3 Scope of R&D

157. While the Frascati Manual is not explicitly cited in BPM5 and the 2002 MSITS (the source of historical data on R&D services exports and imports from service trade surveys), the definition of R&D services in both is generally consistent with it. Although the scope of BPM5 includes development and testing activities, which go beyond R&D the scope of the R&D defined in the 2008 SNA. Thus, in principle, transactions data obtained from services surveys should be adjusted down to correct for non-R&D components. In practice, this may not be possible since R&D and non-R&D components are not separated out in source data.[19]

2.9.4 Grants and transfers

158. Government grants funding may be easier to identify from budget or R&D survey data. For example, intra-EU R&D funding grants represent unilateral money flows. On the other hand, within-company grants, for example from the parent companies of multi-national corporations (MNC) to their overseas affiliates, may be more difficult to identify. Lastly, transfers of R&D are currently not collected in standard R&D or trade surveys.

2.10 Quarterly estimates of R&D

159. Until now R&D surveys have been conducted annually, or less frequently, and there is a need to both interpolate existing annual data and to extend the latest annual data one or more years ahead to meet the needs of quarterly national accounts.

160. This type of problem is commonplace for national accounts compilers and the usual practice is to derive a quarterly indicator that is then benchmarked to the annual estimates[20]. Ideally, the quarterly indicator should be highly correlated with the annual data to minimise revisions, and it is best to have quarterly data from the same source as the annual data. This is generally not possible and so national accountants have to use quarterly indicators that are generally, but not always, inferior to their annual counterparts. In the case of R&D, there appear to be five options:

a. A quarterly R&D survey on a smaller scale than its annual counterpart
b. Annual intention data
c. Proxy indicators
d. An econometric or mathematical model
e. Administrative

2.10.1 A quarterly R&D survey on a smaller scale than its annual counterpart

161. It may be feasible to conduct a quarterly R&D survey that collects less detailed data and from a smaller sample than its annual counterpart. A substantial part of the sample may be common with the annual survey, but probably not completely because of the births and deaths of units since the latest annual sample was taken. The most important data item is probably expenditure on wages and salaries. Intermediate inputs are probably minor and highly correlated with labour input, while capital services will

[19] A proposal has been submitted by the OECD IPP TF that the updated MSITS should recommend that R&D as identified in the SNA 2008 should be separately measured.

[20] See *Quarterly National Accounts Manual* IMF 2001

be dominated by capital goods acquired in previous periods. Data to support the estimation of international trade in R&D may also be a high priority.

162. If this option is taken the quarterly survey should be started as soon as possible in order to provide as long a time series as possible at the time the new treatment of R&D is introduced. The time taken for a new survey to settle down and the need for sufficient data for seasonal adjustment purposes should be taken into account.

2.10.2 Annual intention data

163. Some countries ask R&D performers in their FM surveys what their R&D expenditure intentions are for the coming year. The actual annual data and the intention data for the latest year can then be interpolated by employment data relating to categories prevalent in R&D. Canadian data reveals a high correlation between the intention data and actual ex post data reported by respondents.

2.10.3 Proxy indicators

164. A third option could be along the lines of the macro approach for estimating own account capital formation of software recommended by the OECD task force on software[21]. This involves summing costs, as in the first approach, but with the labour cost component being derived from quarterly employment data multiplied by a suitable average compensation rate. This approach requires reasonable quality quarterly employment data for a sufficiently fine level of employment categories. If these data are available it may be possible to construct a long time series of quarterly estimates of R&D expenditures quickly. This would allow an assessment of how good an indicator it is and permit seasonal adjustment. Data for estimating international trade in R&D would have to come from quarterly trade in services surveys.

2.10.4 Administrative data

165. Some countries may have administrative sources that provide indicators of R&D activity.

2.10.5 An econometric or mathematical model

166. The fifth approach is to either use some indicators that have a relationship to expenditure on R&D or to simply use a mathematical procedure to interpolate and extrapolate the annual estimates. Clearly, this is an undesirable option.

2.10.6 Conclusion

167. It is important to develop quarterly indicators for R&D GFCF to both interpolate and extrapolate annual estimates. Potentially at least, the best estimates will probably come from a quarterly R&D survey. If it is intended to adopt this approach and implement the proposed new treatment for R&D in the next ten years then there is no time to waste.

168. If there is an existing source of sufficiently detailed employment data then a satisfactory solution may be to use a macro approach akin to the one recommended for software. This could be implemented

21 OECD Software Task Force (2002), Report of the OECD Task Force on Software Measurement in the National Accounts, paper presented to the OECD Meeting of National Accounts Experts, Paris, October, 2002.

more quickly and produce a long time series, which amongst other things would allow an evaluation of its performance in the past.

169. Collecting estimates of expenditure intentions from R&D performers and interpolating with a suitable employment indicator is low cost and, based on the Canadian experience, produces good results. This could well be the most cost-effective solution.

2.11 Prices and volumes

170. Two features of R&D make it difficult to compile output price indexes. First, it is very heterogeneous and second, most of it is produced on own account. Consequently, either proxy price indexes, such as the GDP IPD, or input-cost price indexes have been used to deflate current price estimates of R&D flows. Experience has shown that the GDP IPD is not a good proxy price index, particularly at the industry or sector level. Therefore, the FM recommends that input-cost price indexes should be compiled and it provides detailed advice on how it should be done.

171. Nevertheless, it is widely recognised that input-cost price indexes make unsatisfactory deflators because the resulting volume estimates show no growth in productivity. This could be a very serious deficiency for R&D, because there is reason to believe that there is actually significant growth in productivity occurring.

The OECD IPP TF is yet to decide what to recommend about a pseudo output price index. Whatever it decides, it is proposed that the Handbook should describe best practice in deriving input-cost price indices and note their limitations.

2.12 Capital measures

172. Researchers have derived estimates of the capital stock of R&D using econometric methods as well as the perpetual inventory method (PIM). The PIM is the method most commonly used to derive capital stock estimates of fixed assets for national accounts purposes, and it therefore has the advantages of being well understood and having computer systems in place to employ it. Hence, it is recommended that the PIM should be used for deriving capital measures for R&D.

173. In equilibrium, the value of an asset is equal to the net present value of expected future benefits it is expected to provide. Hence, the value of an asset declines over time unless the values of the benefits do not decline, such as can be the case for natural assets like land. Like other intellectual property assets, R&D is not subject to wear and tear but future benefits can decline due to obsolescence and if the level of protection (*e.g.* afforded by patents) falls or becomes more costly to maintain.

174. Researchers have employed two different approaches to estimating depreciation rates and asset service lives for R&D output: the patent renewal method and econometric methods. While both approaches have serious shortcomings[22], they generally indicate that service lives lie between 10 and 20 years, but vary considerably between industries.

175. At the joint meeting of Canberra II and NESTI in 2006 it was proposed to approach major R&D performers in various industries to test whether they were able to provide expectations of the service lives of R&D that could be used with the PIM. The Central Bureau of Statistics in Israel undertook a pilot

[22] Econometric studies commonly make unrealistic assumptions, such as attributing all multifactor productivity growth to R&D. The major drawback with the patent-renewal approach is that much, probably most, of R&D output (by value) is not patented.

survey in 2007-2008, which is described below. The results of this survey were promising, and consequently Germany, UK and other countries started pilot surveys in 2008, using various frameworks for the collection of data. Preliminary impressions from these efforts are also described below. The upshot is that results of various studies are expected to be available soon.

2.12.1 Japanese and Korean surveys

176. Two earlier instances of data collection on service lives were also found. Although the data collected were not exactly on R&D, these examples show that it is possible to obtain data on service lives of intangibles that are close to R&D in surveys:

- A survey on "life span" was conducted in the past by the Japanese Science and Technology Agency. This survey concerned only patents and had a questionnaire with questions on length of time that a patent generated royalty revenues, or the average length of time the products that embodied patented technologies generated profits (the survey is mentioned in *Goto and Suzuki, 1989*).
- Questions on service lives have also been included in Korean innovation surveys for manufacturing and for service industries. The questions concerned service lives of knowledge accumulated during innovation activities, and a distinction between product innovation and process innovation was made. The questions in the 2005 version of the survey for manufacturing were as follows:
    - "For your innovation activities, how many years is the knowledge accumulated from your product innovation during the period 2002-2004 valid, on average?"
    - "How many years is the knowledge accumulated from your process innovation during the period 2002-2004 valid, on average?"

  Since the concept of innovation is wider than the definition of R&D, the results from the survey cannot be applied to the estimation of R&D service lives, unless R&D accounts for a large portion of innovation expenditures. The number of responses in the survey – for example the 2005 survey for manufacturing had a 61% response rate out of a large sample (from the results the sample seems to be over 10,000 enterprises) - demonstrates that it is feasible to collect data on service lives of intangibles in full-scale regular surveys.

2.12.2 The pilot survey conducted by ICBS

177. The pilot survey conducted by ICBS (Israeli Central Bureau of Statistics) covered a small number of enterprises, representing the important industries engaging in R&D in the country – software, pharmaceuticals, semiconductors, monitoring equipment, chemicals. Experts on R&D such as representatives of venture capital funds were also interviewed. Respondents were asked about the length of service life, and also about their views on ways to collect data, the relevant contact persons, etc. In almost all cases the respondents were able to give firm estimates of the average length of service lives of R&D, and when data for more than one enterprise in a certain industry were collected, the length reported was similar for R&D of a similar kind. But in almost all cases the respondents explained that they used more than one kind of R&D, each kind with its own special service life. The enterprises distinguished mainly between R&D that involves major innovation and R&D that involves minor innovation, and they reported significant differences between the two kinds. This meant that it was important to collect data on the composition of R&D in some industries and after a few interviews were conducted a shorter questionnaire was developed that included questions about length of service lives by kind of R&D for the three relevant stages: the gestation lag, the application lag and the length of time used in production (see below). Some of the major findings are as follows:

- Some respondents also explained that the length of service lives has changed in recent years, and for some industries they have become shorter. This implies that data on length of service lives need to be collected at least every few years.
- The length of service lives appeared partly to be connected to the duration and difficulty of R&D projects. Data on the duration of R&D projects were easy to obtain – the enterprises had structured working programs for R&D projects.
- The length of the application lag was quite short in many cases. The enterprises reported that they work simultaneously on the R&D and on the designs for use of the R&D in production, so that the implementation can take place as quickly as possible.
- The respondents reported that they had detailed work programs for a number of years ahead, and were well able to respond on questions on the length of the three stages in the "life" of R&D required.

178. Some complementary information was also collected during the pilot survey:

- Inclusion of unsuccessful R&D: Respondents were aware of the rates of success, and the fact that part of the R&D is unsuccessful was taken into account in the work programs. There are time schedules for the decisions - milestones when unsuccessful projects were to be abandoned. On the other hand, the respondents said that the revenues from successful R&D covered all R&D, including that which proved to be unsuccessful.
- The reason for ceasing to use an R&D asset: Respondents explained that the reason was the use of new R&D, which replaced and improved upon the former R&D. They explained that in most cases the old R&D asset is entirely abandoned, once a replacement is introduced, but in some cases it was used in production on a minor scale to reap some remaining benefits from it.
- Factors that may lengthen the use of the R&D: lack of competition (niches) or cases, where R&D is embedded in large-scale expensive equipment that is renewed infrequently.
- Framework for collection of data: Respondents thought that service lives were similar for specific types of R&D, so that collection of information on service lives from experts could be sufficient.
- Contact persons within an enterprise: The preferred respondents to the questionnaire are managers of R&D - the Vice President of R&D and the CTO (Chief Technical Officer), or if it is an R&D enterprise, the Product Manager. Representatives for marketing or financial managers mostly will not provide the relevant information, but it was a good combination to have both a R&D manager and a financial manager during a personal interview. The service lives reported in the first stages of the pilot survey are given in the table below. Details of the questionnaire follow.

Table 2. Average service lives reported by enterprises in selected industries in the pilot survey*

Industry	Type of R&D	Length of gestation lag in years	Length of application lag in years	Length of use in production in years	Total length in years
Pharmaceuticals	Major improvement - unique, original medicine	15	1	5	21
	Generic medicine	2	1	10	13
Chemicals	Major development	9	1	50	60
	Development on existing product	1	1	10	12
Semiconductors	For use in communication - appliances	2	0 to 1	3	5
	For use in communication - equipment for infrastructure	2	0 to 1	6	8
	For use in transportation equipment	2	1	10	13
Monitoring equipment	Original product	4	1	15	20
	Development on existing product	2	1	10	13
Software	Major improvement	3	Up to a year	5	9
	Minor improvement	2	Up to a year	2 to 3	5
Fabricated metal products, except machinery and equipment	Major development	2	1	15	18
	Development on existing product	Less than a year	1	10	12

* **Since only a few enterprises in each industry were covered in the pilot survey, the length may not be representative, although the responses within industries were similar**

Israeli CBS Questionnaire

Recently the important international statistics organizations approved the registration of research and development (R&D) as fixed assets in the national accounts.

In order to register R&D as a fixed asset we need information on the length of life of the R&D. The Central Bureau of Statistics is making preparations for a survey on "the Length of Life of Research and Development". To help us with these preparations we ask you to provide us with information on typical R&D projects in your company by filling out the following tables:

R&D projects for own use

No.	Description/name of the type of project describe also in what way such R&D projects are innovative.	Details on stages in the "life" of R&D			Comments
		Stage	Information needed	Time in years	
1		Development	Average time of development		
		Transition from development to production/operation	Average timegap between end of development to start of use of R&D in production/operation		
		Use in production/operation	Average length of time from start of use of the R&D developed until end of use		
2		Development	Average time of development		
		Transition from development to production/operation	Average timegap between end of development to start of use of R&D in production/operation		
		Use in production/operation	Average length of time from start of use of the R&D developed until end of use		
3		Development	Average time of development		
		Transition from development to production/operation	Average timegap between end of development to start of use of R&D in production/operation		
		Use in production/operation	Average length of time from start of use of the R&D developed until end of use		

R&D purchased from others

No.	Description/name of the type projects describe also in what way such R&D projects are innovative.	Details on stages in the "life" of R&D			Comments
		Stage	Information needed	Time in years	
1		Use in production/operation	Average length of time from start of use of the R&D purchased until end of use		
2		Use in production/operation	Average length of time from start of use of the R&D purchased until end of use		
3		Use in production/operation	Average length of time from start of use of the R&D purchased until end of use		

2.12.3 Pilot survey conducted in Germany

179. The Federal Statistical Office of Germany has distributed a questionnaire to a number of industry associations and enterprises with the help of the umbrella organization of German Industry (BDI) in Germany. The questionnaire distributed was identical to the first part of the questionnaire concerning service lives as described in annex 2.1. In addition, it asked for information on the share of R&D patented, and on the shares of different types of R&D with significant different service lives in total R&D. Results from all 12 respondents showed that it is possible to obtain answers to questions on length of service lives. Most also gave information about different types of R&D and some separated product development and process development. Those who differentiated between several types of R&D were mostly able to estimate also the shares of these types in total R&D. From this experience Germany proposes to include the question about shares of the several types of projects in all R&D expenditure in the questionnaire because this information is needed to be able to deal with the different service lives within an industry. The reported shares of patenting of R&D results ranged between 1.5 and 90 per cent – which are very big differences. This should be taken into account if patent data are used to estimate service lives of R&D.

ANNEX 2.1 CONSOLIDATED SET OF QUESTIONS FOR R&D PERFORMERS[23]

Introduction

This document is a supplement to the progress report on the development of the OECD Handbook on Deriving Capital Measures of Intellectual Property Products prepared by the OECD Secretariat.

At various times in the meeting of the OECD Task Force on R&D and Other Intellectual Property Products (TFIPP) in April 2008, the matter of approaching major R&D and software performers for information was raised. As a result, it was agreed that it would be highly desirable for countries represented on the Task Force to consult major R&D and software performers using a standard set of questions, and the development of these questions should be given a high priority.

Many of the questions are exploratory in nature. They are intended to help the TFIPP better understand how R&D performers do things and it is proposed that only major R&D performers be approached. They are not intended to be asked recurrently. Using a standard set of questions would facilitate country comparisons and if the questions are sufficiently exhaustive there will be no need to contact a performer more than once to obtain the information required by the Task Force.

There are some questions that would be recurrent and are intended to be incorporated in either a main stream R&D questionnaire or an auxiliary questionnaire. However, pilot surveys would be needed to develop these questions and these could be combined with the one-off questions.

Each sub-group of the TFIPP was asked to identify questions pertinent to its objectives. They are intended to determine the following:

I. R&D output service lives (recurrent)

II. Which R&D output should be recorded as gross fixed capital formation (GFCF) and which should not (one-off)

III. Data availability and data for international trade in R&D services and R&D output produced in the past (such as patents) between (i) affiliated enterprises and (ii) non-affiliated enterprises (recurrent, unless labelled otherwise)

IV. To what extent the acquisition of software and R&D licences to use should be recorded as GFCF (one-off)

Most questions are aimed specifically at R&D performers, but there are some aimed at software performers, who are likely to be R&D performers but may not be. Some of the questions regarding international trade have been designed to be included in surveys of trade services and foreign direct investment. Questions should apply to a given reference year (especially those intended as recurrent exercises).

Beyond the specific needs of the TFIPP regarding the first Handbook draft, it is hoped that this collection of questions will also serve to stimulate discussion and long-term data development on these intangibles.

23 Supplementary paper presented by OECD Task Force on R&D and Other Intellectual Property Products Working Party of National Experts on Science and Technology Indicators, 16-19 June 2008, Paris.

I. Length of the service life of research and development

The 2008 SNA recommends that the value of the stock of a fixed asset should be recorded in the national balance sheet and also requires that estimates be derived for the consumption of fixed capital (depreciation) of these assets over time. In order to make such estimates for R&D assets, information on the service lives of the different types of R&D assets is required. The following information is required.

R&D projects for own use

No.	Type of R&D project	Details on stages in the "life" of R&D			Comments
		Stage	**Information needed**	**Time in years**	
1		Development	Average time of development		
		Transition from development to production/operation	Average length of time between end of development to start of use of the R&D asset in production/operation		
		Use in production/operation	Average length of time from start of use of the R&D asset in production until end of use		
2		Development	Average length time of development		
		Transition from development to production/operation	Average length of time between end of development to start of use of the R&D asset in production/operation		
		Use in production/operation	Average length of time from start of use of the R&D asset until end of use		

R&D purchased from others

No.	Type of R&D	Details on stages in the "life" of R&D			Comments
		Stage	**Information needed**	**Time in years**	
1		Use in production/operation	Average length of time from start of use of the R&D asset purchased until end of use		
2		Use in production/operation	Average length of time from start of use of the R&D asset purchased until end of use		

II. Which R&D output should be recorded as GFCF and which should not

1. Questions for non-market performers of R&D

Objectives

To determine to what extent non-market performers of R&D expect to obtain economic benefits from undertaking R&D. These benefits can take several forms:

a) The NMP is paid to undertake R&D for another unit

b) The R&D output is sold outright

c) Licences to use the R&D output are sold

d) The NMP enters into a partnership or some other contract with a market producer, whereby the NMP gets some share of the profits

e) The R&D output is used by the NMP, or an affiliate, in its production

f) In cases (c), (d) and (e) the NMP is undertaking GFCF

Questions

A. In the survey form you completed for year xxxx, you indicated that you received yyyy funding from different sources. How much of these amounts were grants and how much were from sales?

B. the money you received for sales, how much of it was from

   a. R&D undertaken under contract or outright sale

   b. from licence fees or royalties

   c. share of profits from a business partner

C. Of the R&D you have undertaken paid for by grants, what proportion of the R&D do you expect to be used by your organisation, or an affiliated organisation, in its own production (other than in the production of other R&D)? This includes receiving payments for licensing R&D to others.

D. Of the R&D you have undertaken paid for by grants, what proportion of the R&D do you expect to be used *repeatedly* by your organisation, or an affiliated organisation, in the production of other R&D?

E. Could you answer these questions separately for basic research, applied research and experimental development?

2. Questions for non-market purchasers of R&D (outside the R&D industry)

Objective

To determine to what extent non-market units expect to obtain economic benefits from their purchases of R&D output

The task force has agreed that all R&D purchased by the scientific R&D industry should be recorded as IC, unless specific information says otherwise. Information on purchases by the R&D industry is, in my opinion, therefore of less importance.

These questions should be asked of non-market purchasers or funders, whether they are R&D producers as well or not.

Questions

A. Do you (expect to) use all purchased R&D in a production process (other than in the production of other R&D)?

B. If not, what other reasons do you have for purchasing R&D?

C. If not, could you quantify which part of purchased R&D is used in a production process?

D. For R&D performed by others that you fund by a grant rather than make an outright purchase, do you expect to receive any R&D output that you could use in your own future production, *i.e.* of defense services, health services, policy development? If so, can you specify?

The following shaded questions are redundant, given recommendations 1.9 and 1.10

3. Questions for all R&D performers (except those units in the Software publishing industry)

Objectives

To avoid double counting the same expenditures as software and R&D GFCF. Need to determine what proportion of R&D expenditures is on software, and what part of this is to be used up in one R&D project. For trade in R&D services vs. trade in software services see 'Questions for international services trade respondents' in section III.

Questions

A. What part of your expenditure on R&D is expenditure on software development?

B. Is this software usually used in a single R&D project or is it used in several R&D projects?

C. Could you quantify what part of the software is used in several R&D projects?

D. If you sell licences to use, for what period of time are the licences for: a year or more than a year?

E. If you sell licences to reproduce, under what terms are they sold and for what period of time? Is the licensee responsible for the distribution, support or any maintenance required?

4. Questions for units in the Software publishing industry

Objective

To avoid double counting the same expenditures as software and R&D GFCF. Need to determine what proportion of R&D expenditures is to be used up in producing one software original.

Questions

A. Are the results of the R&D you undertake usually used in a single software original or is it used in several software originals?

B. Could you quantify which part of the R&D is used in several software originals?

C. If you sell licences to use, for what period of time are the licences for: a year or more than a year?

D. If you sell licences to reproduce, under what terms are they sold and for what period of time? Is the licensee responsible for the distribution, support or any maintenance required?

III. International trade in R&D services and R&D output produced in the past (such as patents) between (i) affiliated enterprises and (ii) non-affiliated enterprises (recurrent)

Questions for R&D survey respondents

1. *International R&D transactions within your company*

   A. Would your company be able to report payments for R&D performed for you by others within your company but located outside this country?

      i. transactions involving your foreign parent company

      ii. transactions involving other foreign members of your company

   B. Would your company be able to report revenues for R&D performed by you for others within your company but located outside this country?

      i. transactions involving your foreign parent company

      ii. transactions involving other foreign members of your company

2. B. *International R&D transactions with others outside your company*

   A. Would your company be able to report payments for R&D performed for you by others outside your company and also located outside this country?

   B. Would your company be able to report revenues for R&D performed by you for others outside your company and also located outside this country?

   C. Can you separate out R&D grants from contracts for R&D services?

3. *International transfers of R&D or patents (inflow)*

   A. Have you received free transfers of R&D or patents from the following sources?

      i. Your foreign parent company? (if applicable)

      ii. Other foreign members of your company (if applicable)

      iii. A foreign university or research institute?

      iv. A foreign government unit or international organization?

   B. Would you be able to estimate the production cost or value of these transfers?

4. *International transfers of R&D or patents (outflow)*

   A. Have you donated R&D or patents to the following recipients?

      i. Your foreign parent company? (if applicable)

      ii. Other foreign members of your company (if applicable)

      iii. A foreign university or research institute?

      iv. A foreign government unit or international organization?

   B. Would you be able to estimate the production cost or value of these transfers?

Questions for international services trade respondents

1. R&D services vs. other business and technical services - (one-off)

   A. Have you reported R&D services exports/imports to include transactions in the following services? (this question assumes R&D services is a survey category in your survey,

   B. otherwise skip)

      i. commercial testing services

      ii. software development services

      iii. engineering services

      iv. design services

      v. customer services (post-sales)

      vi. royalties and license fees

   C. Would you be able to separate out R&D services exports/imports from transactions involving the following services?

      i. commercial testing services

      ii. software development services

      iii. engineering services

      iv. design services

      v. customer services (post-sales)

      vi. royalties and license fees

2. *International R&D transactions within your company*

   A. Would your company be able to report payments for R&D performed for you by others within your company but located outside this country?

      i. transactions involving your foreign parent company

      ii. transactions involving other foreign members of your company

   B. Would your company be able to report revenues for R&D performed by you for others within your company but located outside this country?

      i. transactions involving your foreign parent company

      ii. transactions involving other foreign members of your company

3. *International R&D transactions with others outside your company*

   A. Would your company be able to report payments for R&D performed for you by others outside your company and also located outside this country?

   B. Would your company be able to report revenues for R&D performed by you for others outside your company and also located outside this country?

4. *International royalties, license fees for the use or sale of intangible property*

Note: For the purposes of this question intangible property includes patents, trademarks, copyrights, and trade secrets.

A. Total royalties, license fees, and other fees for the use of intangible property (IP), EXCLUDING cross-licensing:

Payments

Receipts

of which:

Industrial processes and products (except software licensing)

Payments

Receipts

Software licensing

Payments

Receipts

B. Total royalties, license fees, and other fees for the use of intangible property (IP), in a CROSS-LICENSING arrangement:

Payments

Receipts

of which:

Industrial processes and products (except software licensing)

Payments

Receipts

Software licensing

Payments

Receipts

Are these cross-licensing measures net or gross transactions with respect to cross-licensing? If net, could you estimate the gross value of these transactions?

C. Total fees paid or received for the sale or purchase of intangible property (IP):

Payments

Receipts

of which: industrial processes and products (except software)

Payments

Receipts

Questions for FDI survey respondents: new investments

These questions should be directed to either –

a) a local business enterprise when a foreign parent company establishes or acquires directly, or indirectly through an existing affiliate, a 10 percent or more voting interest in that enterprise, or

b) existing affiliates of foreign parents when they acquire, or merge with, a local business enterprise, or a business segment or operating unit in the compiling country.

Have you or your foreign parent company engaged in the following investments in this country?

- Created a new legal entity, either incorporated or unincorporated, including a branch, which is organized and operating as a new business enterprise.

- Bought or secured a voting equity interest in a previously existing, separate legal entity that was already organized and operating as a business enterprise and it continued to operate as a separate legal entity, either incorporated or unincorporated, including a branch.

- Bought or secured a voting equity interest in a business segment or operating unit of an existing business enterprise, which is organized as a new separate legal entity, either incorporated or unincorporated, including a branch.

- Bought and merged another local business enterprise, or business segment or operating unit of a business enterprise, into your own operations rather than continuing or organizing it as a separate legal entity.

For M&As of existing businesses, would you be able to report the magnitude of the following items (where applicable) at the time of the M/A?

- employment

- R&D expenditures

- stock of patents issued

- stock of patent applications

For newly established businesses, would you be able to report: (one-off)

- if the new business is intended for R&D performance?

- if you plan to sell or license R&D to the new business?

- if you plan to sell or license patents to the new business?

- if you plan to transfer (for free) R&D or patents to the new business?

IV. Nature of software and R&D licences

Questions relate to licences to use and reproduce software copies sold by large units in the Software publishing industry and licences to use sold by major R&D performers

Objective

1. To determine what proportion of expenditures on licences to use software and R&D output qualify as GFCF. To do so the licences must be for a multi-year period and the licencee must assume all the risks and rewards of ownership.

2. To determine the extent to which acquisitions of part, or the whole, of licences to reproduce software qualify as GFCF. To do so the licensee must assume the risks and rewards of ownership, which is evidenced by taking responsibity for the distribution, support and maintenance required for more than a year.

Questions

1. If you sell licences to use,

    a. what proportion of sales to business are for a period of:

        i. a year or less?

        ii. more than a year?

    b. what proportions of sales to government are for a period of:

        i. a year or less?

        ii. more than a year?

    c. for R&D licences to use ONLY

        i. do the payments give unlimited use?

        ii. are payments linked to use, *e.g.* a royalty per unit of product produced using the licence?

2. If you sell licences to reproduce software, under what terms are they sold and for what period of time? If for more than a year, is the licensee responsible for the distribution, support and maintenance required? If so, please indicate the value in each of the last three years of:

    a. domestic sales

    • foreign sales

ANNEX 2.2 ADDITIONAL DATA REQUIREMENTS

List sent by the Canberra II Group and sent to the OECD's NESTI Group, which is responsible for the Frascati Manual.

Items to be estimated by using data from R&D surveys

1. R&D procured from other performers: Data on extramural expenditure from R&D surveys to be classified into R&D purchases from domestic performers, R&D imported from abroad and donations and other transfers. Such a classification would enable the addition of R&D acquired by domestic performers (assumed to be intermediate consumption) to be added to their intramural expenditures on R&D in order to arrive at a gross measure of domestic output of R&D. Total supply of R&D would equal domestic output of R&D plus imports of R&D.

2. Uses of R&D: A segregation of data on funding received between R&D sales to domestic producers and to other countries (R&D exports), and transfers received, would enable the measurement of uses of R&D output as required for a supply and use table. Such a classification already exists in R&D surveys for the government sector's funding of the higher education and business sectors.

3. Harmonisation of sectors: A breakdown of expenditure by the higher education sector is needed to get the institutional sector breakdown used in the national accounts. Hence the need for a classification of data for the higher education sector by sub-sector:

   a. Corporations and quasi-corporations (including non-profit institutions serving them)

   b. General Government units (including non-profit institutions controlled and mainly financed by government), and

   c. Private Non-profit Institutions serving households

Items to be estimated by combining R&D statistics with national accounts data

1. Other taxes on production less other subsidies on production: The SNA defines the other taxes on production as part of the taxes on production, "consisting mainly of taxes on the ownership or use of land, building or other assets used in production or on the labour employed, or compensation of employees paid". Other subsidies on production include mainly subsidies in payroll or workforce. The FM does not show the flow of other taxes on production explicitly, but the flows are included, at least partially, in the current expenditures, *e.g.* payroll taxes are part of the labour costs. However, the flow of other subsidies on production is not accounted for in intramural expenditures, but as a financing source of them. In the interim, until data become available from R&D surveys, national accounts data on subsidies may be used to estimate these flows.

2. Cost of capital services provided by own fixed assets: These estimates would best be obtained by applying the PIM to past GFCF. The FM breakdown of capital expenditures requires more detail to distinguish between asset types that have significantly different price growth and different service lives.

Items demanding data collection outside R&D surveys

Producer units other than R&D performers may also have external sales and purchases of R&D. In countries where such transactions are of importance, they will have to be covered through other types of sources – for example in economic surveys or in surveys of international trade in services and foreign direct investment. Another source of data that could possibly also provide information on R&D transactions of producers that are not themselves performing any R&D, are innovation surveys.

ANNEX 2.3 POINTERS ON DATA DEVELOPMENT FOR INTERNATIONAL TRANSACTIONS IN R&D

A. International transactions between affiliated enterprises

For the purposes of this Handbook, issues on transfer prices arise for cross-border trade involving R&D, software, and other intellectual property products. International transaction surveys collected for BOP purposes already cover both affiliated and unaffiliated transactions. National accountants, tax authorities, and researchers are aware of distortions, whatever the underlying causes, implied by transfer prices for fiscal matters (Hines 1996), national and international economic accounts (Landefeld et al. 2008), and more recently, measures of intangibles production and exploitation (Lipsey 2008).

The *IMF's BOP Compilation Guide* (IMF 1995) provides guidance on this issue from the perspective of international transactions (paragraphs 487-491). In particular, it recognizes misreporting issues (over- or under-reporting of quantities or values) for intra-company transactions and describes transfer prices for transactions "between enterprises in a direct investment relationship" as prices "significantly distorted from market values". Further, "an enterprise may sell goods to a related enterprise for prices unrelated to the cost of production or the acquisition cost of the goods. Such a sale might be made, for example, to transfer profits from one country to another for tax reasons or because the country of the direct investment enterprise imposes restrictions on the repatriation of income." The *OECD Transfer Prices Guidelines* (OECD 2001) recommends that internal transactions (prepared for tax administration purposes) should be reported as if they were performed by independent parties at arm's-length market prices. In particular, the arm's length principle seeks "to adjust profits by reference to the conditions which would have obtained between independent enterprises in comparable transactions and comparable circumstances, [thus] ….treating the members of an MNE group as [if] operating as separate entities…".

The IMF BOP Guide goes on with suggestions on adjustments to reported data but also cautions that "such adjustments should be made only when significant distortions are encountered" (paragraphs 487-491). Notably, adjustments recommended by either OECD or IMF guidelines are intended for tax authorities with access to taxpayer records. Some of this material *may* be applicable for surveys work (*e.g*., microdata editing/processing, imputation, and further survey development). Alternatively, adjustments to aggregate data would have to be performed by national accountants. At the moment, however, generic guidance on possible transfer price adjustments to R&D export and import totals is hindered by data and metadata limitations. Further, given the relatively small share of intellectual property products in aggregate FDI and transactions data, new or improved data on transactions between affiliated enterprises should be designed and develop collaboratively by intangibles, trade, national accounts, and globalization experts and working groups (see for example *OECD 2007*).

B. Joint production and /or ownership of R&D and IP

Joint production, both within and across companies, is recognized in the *OECD Transfer Prices Guidelines* under the label of 'cost contribution arrangements'. The latter are defined as "contractual arrangement to share costs & risks of developing, producing, or obtaining assets, services, or rights" (8.3). The Guidelines note that these arrangements are conceptually different from licensing agreements and from exchanges or transfer of existing assets. Again, the goal is to apply the arm's length principle. Further, "for the conditions of a CCA to satisfy the arm's length principle, a participant's contributions must be consistent with what

an independent enterprise would have agreed to contribute under comparable circumstances given the benefits it reasonably expects to derive from the arrangement" (8.8).

Within MNCs, joint production is entangled with joint ownership, which highlights the need to distinguish between legal vs. economic ownership and sort out implications for asset boundary issues in terms of who benefits from what and where. The Guidelines note that "…legal ownership of developed intangible property [may be] vested in only one of [the arrangement parties] but all of them have effective ownership interests." (8.4). These issues go to the core of properly defining the direction of trade flows not only for R&D (*Yorgason 2007*: 14-18) but also for other intellectual property products in the Handbook.

C. Merchanting and "fabless" production

Merchanting is the purchase of a good by a resident of the compiling economy from a non-resident and the subsequent resale of the good to another non-resident, *without* the goods entering or leaving the compiling economy (BMP5 and BMP6 draft [10.42]). Thus, with respect to the compiling economy, there is a change in ownership affecting a resident although there is no entry or exit of goods. However, "[t]he physical form of the goods may be changed during the period the goods are under merchanting, as a result of manufacturing services performed by other entities. In these cases, the enterprise that owns the goods makes contributions to the manufacturing process, such as providing planning, management, patents and other know-how, marketing, and financing, but without physically possessing the goods. Particularly for high-technology goods, these non-physical contributions may be large in relation to the value of materials and assembly." These transactions are particularly important given global and contract manufacturing, services outsourcing and subcontracting (BMP6 10.145), and within-MNCs transactions (*Connolly 2008; Takeda 2006)*, including so called fabless companies (*Peleg 2008*).

For our purposes, the relevant issue is to properly capture R&D and other intellectual property product development services provided by a compiling economy resident under merchanting. However, any recommendations for further data collection on intangibles and merchanting, if any, should be part of broader discussions within SNA, BPM, and MSITS revisions. For an overview on merchanting transactions in the context of SNA and BMP revision see *Takeda (2006)*.

D. Non-R&D testing services

As noted earlier, CPC v.1 does not provide a separate code for commercial non-R&D testing services. Such a category is contemplated in the North American Product Classification System (NAPCS) categories for NAICS 5417.[24] In addition to categories similar to the CPC code, NAPCS includes 'Testing laboratory services', defined as services "Providing various conformity assessment services such as testing, instrument calibration, product certification, management system registration and commercial inspection services, and other related services such as sale of standards information, consulting, and training."[25] Data linking exercises involving trade and R&D surveys may provide additional tools to separate out non-R&D testing.

E. R&D transfers

A possible future source for statistics on transfer of (completed or in-progress) R&D is FM-based surveys, assuming the definition of transfers in the FM and SNA are reconciled in the future. R&D surveys could ask for the cost of producing R&D that is subsequently transferred outside the performing unit (output could then be estimated by methodology similar to other R&D expenditures).

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24 Both NAICS and NAPCS support economic statistics in NAFTA countries.

25 http://www.census.gov/eos/www/napcs/napcs.htm

F. IP sales/purchases

In addition to flows of current production of R&D, a full account of R&D trade needs to incorporate sales/purchases of past R&D captured in patents and other forms of legally protected (or secret) intellectual property. These flows are separate from licensing and royalty fee statistics (for use and/or reproduction) already recognized in services trade statistics. However, information on outright sales/purchases of IP assets is very limited.

A related indicator is cross-border mergers and acquisitions (M&As) of R&D-performing or IP-holding companies. *Peleg (2008)* developed an experimental 'decision tree' to identify M&A transactions involving IP. Alternatively, surveys on new FDI investments[26] may be further developed to accommodate some of these issues.

3. Mineral Exploration and Evaluation

3.1 Introduction

180. With the development of the 1993 SNA, mineral exploration was introduced as a new category of produced asset. Essentially, mineral exploration activity is seen to lead to the formation of an intellectual property asset that, like other assets, is expected to provide economic benefits for its owner.

181. This treatment of mineral exploration has been retained in the 2008 SNA, with a number of clarifications. One of the most important clarifications is that its scope includes evaluation, hence the change of name to *Mineral Exploration and Evaluation*.

3.2 International standards and mineral exploration and evaluation as an asset

182. Before proceeding further it is useful to review what earlier international standards have had to say about mineral exploration and evaluation.

3.2.1 1968 SNA

183. Under the 1968 SNA all expenses associated with mineral exploration were treated as intermediate consumption. As mineral exploration activity takes place prior to extraction there is no production to offset these costs and therefore firms undertaking this activity on their own-account may be shown as operating at a loss. This view was not seen as meeting the economic reality of a situation in which companies undertaking mineral exploration were seen as investing in an activity in the expectation of future revenue flows.

1993 SNA

184. To more appropriately reflect the economic reality of the activity, the 1993 SNA introduced a new category of produced intangible fixed capital, called mineral exploration (AN.1121):

> "The value of expenditures on exploration for petroleum and natural gas and for non-petroleum deposits. These expenditures include 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."

[26] http://www.bea.gov/surveys/pdf/be13.pdf

185. From a macro-economic measurement perspective the capitalisation of mineral exploration can be justified on the grounds that mineral exploration adds to the stock of knowledge in the economy and that it is a necessary step in exploiting sub-soil deposits for economic purposes.

3.2.2 System of Environmental and Economic Accounting (SEEA) 2003

186. The SEEA was developed with the purpose of exploring how sets of statistical accounts can be compiled that permit the investigation and analysis of the interaction between the economy and the environment. The 2003 SEEA contains a detailed discussion of accounting for mineral exploration (paragraphs 8.46 - 8.65) which builds on the 1993 SNA treatment and provides further guidance on accounting for the activity in both the SNA and SEEA sense. The Handbook has made use of the 2003 SEEA content in a number of the issues discussed below.

3.2.3 International business accounting standards

187. The International Accounting Standards Board (IASB) released an interim guideline for the treatment of exploration and evaluation activity in 2004, "International Financial Reporting Standard (IFRS) 6". This standard reflects the divergence of accounting treatments across jurisdictions, and thus allows the treatment of costs to be considered on a case by case basis, including capitalizing costs or writing them off as an expense. When first recognised in the balance sheet, exploration and evaluation assets are measured using the cost model. Subsequently, entities can measure these assets using the cost of revaluation model. Once the feasibility of extracting a mineral resource has been demonstrated, the assets fall outside IFRS 6 and are reclassified to other IFRSs.

188. IFRS 6 is an interim standard and the IASB has formed a working group to take a more in-depth look at the issues of financial accounting in the extractive industries, including issues concerning mineral exploration.

3.2.4 Update of the 1993 SNA

189. In the update of the 1993 SNA a number of matters concerning mineral exploration were identified for clarification. The upshot is that the following recommendations were approved by the UNSC:

i. The produced asset "mineral exploration" should be described as "mineral exploration and evaluation" and the coverage should be described using the criteria of the IASB.

ii. The assets for mineral exploration and evaluation and for sub-soil deposits should continue to be recorded as separate assets, the first a produced asset and the second a non-produced asset.

iii. Mineral exploration should be valued at market prices if purchased (from specialised enterprises) or as the sum of costs if produced on own account.

iv. In the absence of a market price, the valuation of sub-soil resources should be based on the net present value of expected future receipts of resource rents. The resource rent is that part of gross operating surplus unattributable to other identified assets, specifically fixed assets including mineral exploration and evaluation.

v. Payment by the extractor to the owner of the resource should be recorded as property income (rent) regardless of the label given to the payments.

3.3 Definition and coverage of Mineral Exploration and Evaluation activity

190. As noted above, the 2008 SNA recommends using the criteria of the IASB in describing the coverage of mineral exploration and evaluation. The key criterion for recognising expenditures as mineral

exploration and evaluation assets is the degree to which the expenditure is associated with discovering mineral resources. IFRS 6 contains the following discussion on coverage:

> An entity shall determine a policy specifying which expenditures are recognised as exploration and evaluation assets and apply the policy consistently. In making this determination, an entity considers the degree to which the expenditure can be associated with finding specific mineral resources. The following are examples of expenditures that might be included in the initial measurement of exploration and evaluation assets (the list is not exhaustive):
>
> (a) acquisition of rights to explore;
>
> (b) topographical, geological, geochemical and geophysical studies;
>
> (c) exploratory drilling;
>
> (d) trenching;
>
> (e) sampling; and
>
> (f) activities in relation to evaluating the technical feasibility and commercial viability of extracting a mineral resource.

191. Regarding item (a), the costs of acquiring leases or other rights of tenure in the area of interest are included in the cost of the exploration and evaluation asset if they are acquired as part of the exploration for, and evaluation of, mineral resources.

Recommendation 3.1: The criteria for coverage recommended by the IASB and described in IFRS 6 should be used as a guide for determining the coverage of expenditures on mineral exploration and evaluation.

192. It is important to note, however, that the 2008 SNA recognizes all expenditures of the kinds just described as gross fixed capital formation, irrespective of whether the mineral exploration and evaluation leads to the identification of a sub-soil asset. If only expenditures on mineral exploration and evaluation activities that resulted in finding sub-soil assets were recorded it would lead to an understatement of the value of the knowledge gained from mineral exploration and evaluation. Mining companies expect that only some of their exploratory activities will lead to finding a sub-soil asset, but the value of a successful find more than covers the cost of all those exploratory activities that failed to do so. Moreover, exploratory activities that fail to find an economic sub-soil deposit can still lead to useful knowledge. For example, a sub-soil deposit that is not economically viable to exploit now may be so if prices rise in the future or if future technologies make it viable to exploit.

193. Expenditures recorded as capital expenditures by an enterprise in its own accounts may not coincide with those required by the SNA - either because some elements of expenditures on exploration and evaluation that should be recorded as GFCF are expensed or because some expenditures do not result in finding economic sub-soil deposits. For these reasons it is necessary to identify the total value of expenditures made by enterprises on exploration and evaluation activity.

Recommendation 3.2: All expenditures on mineral exploration and evaluation, regardless of their success or failure should be recorded as GFCF. Also, they should not be restricted to what enterprises record as capital expenditures.

3.4 Valuation

194. The preferred valuation basis, in line with SNA principles, is the market price. This market price should be observable when another enterprise is contracted to undertake the exploration and evaluation

activity. However, much of this activity is undertaken on an own-account basis, where a market price is not observable. When this occurs the activity should be valued by summing the costs of production:

a. Intermediate consumption

b. Compensation of employees

c. Consumption of fixed capital

d. A return to fixed capital

e. Other taxes (less subsidies) on production

3.5 Compiling estimates of GFCF

195. Mineral exploration and evaluation is undertaken by both enterprises specialising in this activity and on own account by enterprises whose principal activity is mineral extraction. The former either sell their services to the latter or, less commonly, undertake the activity speculatively with a view to making a sale of rights to exploit a mineral deposit to a miner later. The result is that GFCF of mineral exploration and evaluation is heavily concentrated in a relatively small number of mining enterprises.

196. The best way to obtain estimates of GFCF is to survey mining enterprises. Expenditures on exploration and evaluation are often volatile, and so a census of mining enterprises is desirable. If a sample survey is used then all the major mining enterprises need to be completely enumerated.

197. Australia is a major producer of a wide variety of minerals, and the Australian Bureau of Statistics (ABS) approach is instructive. The ABS runs two quarterly censuses of enterprises involved in exploration activity - the mineral exploration survey and the petroleum exploration survey (see Annex 1). These vehicles cover all expenditure (capitalized and non-capitalized) during the exploratory or evaluation stages in Australia and Australian waters. Expenditures include costs of exploration, determination of recoverable reserves, engineering and economic feasibility studies, procurement of finance, gaining access to reserves, construction of pilot plants and all technical and administrative overheads directly associated with these functions. Examples are costs of satellite imagery, airborne and seismic surveys, use of geophysical and other instruments, geochemical surveys and map preparation, licence fees, land access and legal costs, geologist inspections, chemical analysis and payments to employees and contractors. Cash bids for offshore petroleum exploration permits are also included.

198. On the survey forms respondents allocate exploration expenditure as either expenses or capital as they would in their financial accounts. The data definition for the items are in line with Australian accounting standards, which is in turn based on international accounting standards, and are quite straightforward for respondents to complete. Within the national accounts the two entries are combined to form the estimates for mineral exploration and evaluation GFCF. As the quarterly sources are a census, the annual estimates are simply an aggregate of the four quarters.

Recommendation 3.3: Estimates of GFCF should be obtained by surveying mining enterprises and enterprises supporting mining - a census of mining enterprises is desirable. If a sample survey is used then all the major mining enterprises need to be completely enumerated. Questions should reflect the national accounting standards and the survey statisticians should then aggregate all expenditures in scope of GFCF.

3.6 Price and volume measures

199. The preferred price index to use for deflating expenditures on mineral exploration and evaluation to obtain volume estimates is an output price index. However, given the unique nature of much mineral exploration activity, compiling such an index is not easy, and there appear to be few, if any, countries that have developed one.

200. Several years ago the ABS undertook a preliminary investigation into the feasibility of constructing an output price index for mineral exploration. The investigation included discussions with the peak industry body and with specialist mineral exploration firms. The indications were that it would be feasible to construct an output index based on a model pricing approach, but that it would be quite resource intensive to maintain given the rapidly evolving technology used in the production process. For this reason the ABS did not proceed to develop an output price index for mineral exploration.

201. The alternative is to use an input cost index consisting of the costs of production. However, the use of an input cost index means that productivity gains are not captured and it would be a reasonable assumption that productivity gains have been significant in exploration and evaluation activity arising from the introduction of new technologies, *e.g*. the introduction of remote sensing. Countries may consider adding an adjustment for productivity gains to an input cost index. For example, the index could be adjusted by a long-run estimate of productivity growth for the whole economy.

Recommendation 3.4: It is highly desirable that an output price index be used to derive volume measures of mineral exploration and evaluation. However, it appears to be relatively costly for what is in most countries a minor industry. If an input cost index is used, then an adjustment should be made for productivity growth, such as that for the total economy.

3.7 Capital measures

202. As discussed above, mineral exploration and evaluation is an economic asset because it contributes to the stock of knowledge of sub-soil resources and allows those resources to be exploited for economic purposes. It is reasonable to state that the knowledge is of value while there are still resources available to be exploited. Some discoveries are economically viable to exploit straightaway while others must wait for new technologies or higher prices and are not recognized as assets until they become economically viable. Knowledge of a deposit that can be exploited now is worth much more than knowledge of a deposit of the same size that may be exploitable sometime in the future. For this reason the expected service life of the exploration and evaluation asset can be assumed to be the same as that of the associated sub-soil assets.

203. The ABS estimates the service lives of mineral exploration and evaluation assets as follows. First, the average annual volume of production for each commodity is divided into the corresponding volume of the expected recoverable deposit of the sub-soil asset to derive the asset life for each type of commodity (*i.e*. sub-soil asset). Second, using exploration expenditure proportions for each commodity as weights, the average service life for each commodity is aggregated to form an average mineral exploration and evaluation service life for all commodities. The average service life is currently estimated to be 34 years.

Recommendation 3.5: It is reasonable to assume that the service life of mineral exploration and evaluation is similar to that of the associated sub-soil assets when using the perpetual inventory method to derive estimates of capital measures.

3.7.1 Sub-soil assets

204. Most sub-soil assets are not traded, and so there is generally no market price observable. Instead, their values are estimated as the net present value of the resource rent. The resource rent can be measured as the gross operating surplus from mining activities less the value of the capital services (or rentals) provided by the fixed assets used to extract the mineral, including exploration and evaluation assets. Failure to make this exclusion from the gross operating surplus would lead to a double count in the balance sheet.

Recommendation 3.6: Care needs to be taken to avoid double counting the stock of mineral exploration and evaluation in the stock of sub-soil assets.

3.8 Ownership

3.8.1 Mineral exploration and evaluation

205. Exploration activities are usually funded by the extractor looking to discover sub-soil assets that they can then exploit. In many countries the enterprise granted the exploration licence has an obligation to provide a given set of results/tests to the government, which then makes it part of the public record. As the funder of the exploration and evaluation activity expects to be able to exploit any sub-soil assets within a reasonably long period of time, they are deemed to be the owners of the exploration and evaluation asset, and the knowledge made public is deemed to be a spillover.

3.8.2 Sub-soil assets

206. In many countries, the government retains ownership of all sub-soil assets. Mining companies purchase licences and pay royalties for the right to access and extract these assets. While acknowledging that it is not wholly satisfactory, the 2008 SNA recommends that sub-soil assets should be recorded on the balance sheet of the legal owner, which is usually the government. Alternative treatments of ownership were proposed as part of the 1993 SNA update process, but it was decided to retain the 1993 SNA treatment and place the issue on the long-term research agenda.

ANNEX 3.1 ABS SURVEY FORMS

(To be inserted)

4. Software and databases

4.1 Introduction

207. Of the three new fixed asset categories introduced in the *System of National Accounts, 1993* (1993 SNA), by far and away the one with greatest impact on the magnitude of GDP in most countries was software (including databases). Most OECD countries had adopted the new standard by the year 2000, but it was not long after before it became apparent that country estimates of software gross fixed capital formation (GFCF) varied considerably not only in their size relative to GDP, but also in the growth rates of the volume estimates.

208. In October 2001 an OECD Task Force was set up to address the issue, and one of its first actions was to conduct a survey of member countries. The survey had several aims:

a. quantify the differences between estimates,

b. identify what the conceptual treatments were in countries and the rationale for them,

c. determine the different methods being used to quantify the various software flows (GFCF, trade in software, etc.) and what might constitute best practice, and

d. determine how countries compiled price indexes for deflating software and what might constitute best practice.

209. The OECD Task Force made a large number of recommendations covering the definition of software, the scope of software that should be recorded as GFCF, the treatment of originals and copies and how licences-to-use and licences-to-reproduce software should be dealt with, how to differentiate between GFCF and maintenance, how to estimate the value of own-account GFCF of software and the derivation of appropriate price indexes to derive volume estimates of software GFCF.

210. In the course of its work the OECD Task Force found that some of the recommendations made in the 1993 SNA either required clarification or review, and so once the UNSC had decided that a revision of the SNA should be undertaken they were brought to the attention of the newly formed Canberra II Group. The Canberra II Group subsequently proposed to the ISWGNA that two issues concerning software and databases should be included in the SNA review, namely *Originals and copies* and *Databases*. These were then formally adopted by the UNSC as issues to be considered in the SNA review: the issue descriptions are as follows:

Originals and copies

Following the 1993 SNA's introduction of computer software as capital formation, it became more evident that the SNA does not provide guidance on the treatment of originals and copies as distinct products. Should expenditures on originals and copies both be recorded as expenditure (on new goods) on the basis that originals are distinct from copies, or should originals be considered as being analogous to a 'stock' of copies, and so expenditure on a copy partly (or mostly) reflects a sale of an existing good? How should the transactions in copies be recorded?

Databases

The 1993 SNA recommends that large databases should be capitalized. Should the SNA provide a clearer definition of databases to be capitalized covering characteristics such as size and marketability of the data as well as the database itself, or should all databases be capitalized? How should the value of a database be determined?

211. The outcomes of the SNA review of these two issues is described in detail in the relevant sections of the Handbook, but a few key recommendations of the 2008 SNA deserve particular attention:

a. Originals and copies are recognised as independent fixed assets providing they meet the general definition of an asset;

b. If a licence to use a copy (*e.g*. software) is purchased with annual payments over a multi-year contract, and if the licensee assumes all the risks and rewards associated with economic ownership of the copy, this may be regarded as the acquisition of an asset under a financial lease;

c. If annual payments are made for a licence to use a copy without a long-term contract, the payments are treated as payments for a service under an operating lease;

d. If the terms under which a unit is given permission to reproduce copies resemble an operating lease, then the payments to the holder of the original are recorded as payments for a service. If the holder of the original divests itself of part or all of the responsibility to issue and service copies under licences to use, this constitutes the sale of part or all of the asset represented by the original;

e. All databases holding data with a useful life of more than one year are fixed assets;

f. In the absence of a more satisfactory alternative, the value of a database created on own account should be valued on a sum of cost basis, with the DBMS recorded separately as software. The costs of acquiring the data are not included in the value of the database; and

g. Databases for sale should be valued at their market price, which includes the value of the information content.

212. Recommendations (a) and (b) are consistent with the OECD Task Force's interpretation of the 1993 SNA, but recommendation (c) marks a change. The Task Force recommended that if the licensee has the intention to renew an annual licence-to-use then the expenditures should be recorded as GFCF, but the 2008 SNA says that the contract must be for more than a year for GFCF to occur. Recommendation (d) is a change to the SNA, because it explicitly allows for treating the sale of a licence-to-reproduce as the sale of the whole original, or part of it. While for databases, the recommendations mark a complete revamp in the 2008 SNA. With the exception of recommendation (c), all of these changes and clarifications are consistent with the recommendations made by the Canberra II Group (Ahmad 2004a, 2005 and 2004b).

213. The guidelines provided in this handbook largely reflect the recommendations made by the OECD Task Force in its report to OECD Working Party on National Accounts in 2002 (OECD 2002). Some, but not all, of the differences arise from SNA recommendations (c) to (g), above.

4.2 Software

4.2.1 Introduction

214. Software GFCF accounts for more than 1% of GDP in many OECD countries and its share is growing. It is also of special interest because investment in software and other ITC products have been found to be significant contributors to growth in output (Colecchia, 2001). This makes it very important that software GFCF and related capital measures should be measured accurately and in an internationally comparable way.

215. In its survey of OECD countries in 2001-2, the OECD Software Task Force found a considerable variation in all aspects of the measurement of software: intermediate consumption, software GFCF, volume measures, consumption of fixed capital and capital stock. This part of the Handbook focuses on the measurement of software GFCF.

216. As noted above, the guidelines presented here are largely based on the report of the OECD Software Task Force presented to the 2002 meeting of the OECD National Accounts Experts. Besides the differences arising from the revised recommendations in the 2008 SNA, there are other differences arising from the following three factors:

- The outcomes of the 2008 software survey of OECD member and accession countries
- The introduction of new industry and commodity classification systems
- New information of country practices from reports and papers

4.2.2 Definition and scope

217. In the 2008 SNA computer software and databases are recognised as two sub-categories of the category "computer software and databases", and the SNA defines computer software as follows:

> 10.110 Computer software consists of computer programs, program descriptions and supporting materials for both systems and applications software. Gross fixed capital formation in computer software includes both the initial development and subsequent extensions of software as well as acquisition of copies that are classified as assets.
>
> 10.111 The development of computer software represents the development of an intellectual property product. It is treated as an asset if it is to be used in production by its owner for more than one year. The software may be intended only for own use or may be intended for sale by means of copies. If copies of the software are sold on the market, their treatment follows the principles described in paragraph 10.101. Software purchased on the market is valued at purchasers' prices, while software developed in-house is valued at its estimated basic price, or at its costs of production if it is not possible to estimate the basic price.

218. The act of creating an original piece of software leads to the acquisition of a fixed asset if the original satisfies the conditions of an asset, *i.e.* it is expected to be a source of economic benefits to the owner over a period of years. These benefits derive from allowing other units to use the content of the original by means of issuing licences for a fee and/or the owner using the original directly.

4.2.2.1 Licences to use and reproduce

219. Licences may be issued for use by one or a specified number of users, or may be issued with permission to reproduce copies. These are referred to as “licences-to-use” and “licences-to-reproduce” respectively.

220. It is useful to distinguish between the sub-categories “original software” and reproduced software, otherwise known as “software copies”, in more detail. This should help to avoid mistakes made in the past by some national accountants in not valuing “originals” as fixed assets on the mistaken grounds that doing so resulted in double-counting.

a. Original software: Original software should be considered as machines used in the process of producing other products, and as such are considered as investment. Originals can be produced on own-account (they are then called an “own-account original software”) or can be bought (“purchased original software”). This includes games’ originals. Games software is treated in the same way as conventional software because of the similar production processes (and producers) for games and conventional software. There are two types of originals:

    i. Originals for reproduction: Original software intended to be reproduced for sale or lease, which are generally produced by specialist software companies.

    ii. Other originals: Software intended to be used in the process of production of other products, and generally produced on own-account or acquired as custom-made software from a specialist software company.

b. Software copies: Software copies are reproductions of original software. They include software giving users the rights, or licence, to use, and software that gives the rights, or licences, to reproduce:

    i. Licences-to-use: They are mostly marketed, and are referred to by a variety of names, including "packaged software" “packaged software” or "off-the-shelf software". In general, they legally provide a licence to use the software. This category includes software copies for final use and software copies for bundling in hardware, other equipment or other software. This category also covers "multiple copy" licences-to-use and software "rented" for use, for which payments often take the form of "royalties". It excludes licences that permit copies to be made for sale.

    ii. Licences-to-reproduce: Licences-to-reproduce permit companies to make further software copies for subsequent sale. These copies can be sold via licences-to-use or as part of a bundle, whether the bundled software is included separately or embedded directly onto hardware. Often, licences-to-reproduce are paid for as royalties.

221. The acquisition of a licence-to-use or a licence-to-reproduce may be recorded as either GFCF or intermediate input, depending on the circumstances – see 1.2.2. The acquisition of a licence to use is recorded as GFCF if the licence is for more than one year and the licensee assumes all the risks and rewards of ownership. A licence to reproduce is only an asset if the holder of the original divests itself of part, or all, of the asset represented by the original. This occurs usually when the holder of the original sells its rights to issue and service copies in a country or group of countries.

4.2.2.2 Bundled/embedded software

222. Bundling/embedding of software occurs when software copies are purchased or produced with the explicit intention of on-selling as part of, or within, another product – be it office machinery, other

machinery, other software, etc. Bundled/embedded software can be created in one of two ways. First, when copies are purchased from a software producer and subsequently bundled and sold on to another consumer. Second, when a licence-to-reproduce has been acquired and (the value of) the copied software is embedded in another product which is then sold on. It is recommended to treat any software (including outsourced software) purchased for bundling or embedding into products to be sold on as intermediate consumption.

223. Bundled software can be invoiced separately to the customer, in which case the purchase of software can be treated like any other purchase of software by the final-use customer. It may, however, be included in the purchaser's price of the bundle in which case the software is included within the value of the bundled product, normally computers. The value of total investment is not affected by the difference in treatment.

4.2.2.3 Maintenance and repairs

224. According to the 2008 SNA ordinary, regular maintenance and repairs of a fixed asset used in production should be recorded as intermediate consumption and major renovations taken at any point in time not dictated by the condition of the asset that increase the performance or expected service life of the asset should be recorded as GFCF. However, the SNA states also that the distinction between maintenance and repairs and gross fixed capital formation is not clear-cut (paragraph 10.45).

225. What makes the consideration of maintenance and repairs particularly problematic for software is that it is difficult to describe a software repair that is not an addition to an existing software system. For example, there are few equivalents to the replacement of a part, say, in conventional plant and machinery.

226. A repair to software systems involves a change in the configuration or code of any program, but not the replacement of a part, or repairing something that no longer works. In this way software repairs may largely be seen as improvements. Repairing "faults" introduced by bugs say, may be one example where an analogy can be made with replacements of defective parts. But other repairs or modifications, for example modifying software to provide protection from a bug, can be seen as analogous to giving a car a paint-job to protect it from unusually, but anticipated, wet weather.

227. Conventional maintenance (distinct from repairs) such as systems' checking, does not change the characteristics of the software and so is clearly intermediate consumption. Changes to software that extend its service life should be generally recorded as GFCF. For example, modifications to software to deal with the Y2K problem were an upgrade (involving changes to the code to record years using four digits rather than two), which extended the expected service lives of software. Modifications to software so that they can operate on a new operating system are part of the cost of adopting the latter and should be recorded as GFCF. However, frequent changes to the software to accommodate changes to the format of input data are more in the way of intermediate consumption. But how should such a demarcation be implemented in practice?

228. Taking account of both practical matters and conceptual principles, it is best to follow recommendation 1.2: Intellectual property products are not subject to wear and tear, but they can be subject to amendment and augmentation. Substantial, planned improvements should be recorded as GFCF, while minor, unplanned improvements are better recorded as IC.

4.2.2.4 Upgrades and outright sales of original software

229. When a software original is updated or upgraded, for example the update of Word 5 to Word 6, GFCF occurs. If possible the value of the update, or upgrade, should be determined as the present value of the expected increase in income it will provide. If it is not possible to measure this, then the GFCF of the update, or upgrade, should be measured by summing the costs incurred in updating, or upgrading, the

software original. This does not include the cost of creating the earlier software original (*e.g.* Word 5). The value of updated or upgrade software is equal to the GFCF plus the depreciated value of the software before the upgrade.

Recommendation 4.1: Own-account software updates or upgrades should not include the value of the "original" version, and instead should only reflect the increase in value. The value of the upgraded software on the balance sheet comprises the value of the upgrade plus the depreciated value of the original version.

230. When a software original is sold outright the sale is recorded at the value of the actual market transaction. Most software originals are either produced for own use or to be licensed to others to use, and unless it is possible to determine with reasonable certainty that the software original was produced with the intention of sale the transaction should be treated in the same way as sales of existing assets as specified in paragraph 10.38 of the 2008 SNA. In which case GFCF of the seller of the original is negative and that of the new owner is positive.

Recommendation 4.2: Sales of "originals" should be treated as sales of pre-existing assets as specified in paragraph 10.38 of the 2008 SNA, unless it can be determined that they were produced for sale.

4.2.3 Measurement of software GFCF

231. Software GFCF generally takes one of three forms: the acquisition of licences to use software copies, the acquisition of custom-made software from a software development enterprise and the own-account creation of software originals. Separate estimates are commonly derived for each of the three, but some countries choose to obtain an aggregate of the first two.

232. There are two ways of deriving GFCF estimates. The first is by surveying businesses and government and asking them to report their expenditures. The second is for the NSO to derive estimates at the macro-level by using the commodity flow approach for purchased software and by deriving estimates based on the number of people developing software on own account. The different approaches have their strengths and weaknesses, and recommendations 1.3 and 1.4 should be followed, *i.e.* all the approaches should be used and confronted with each other.

233. The major difference between the findings of the 2002 and 2008 and OECD software surveys was that in the earlier survey few countries reported using the demand-side approach, whereas in the later survey the majority – 15 out of the 20 countries that responded – reported using the demand-side approach. Nearly all of the 15 countries with survey data for purchases of software also derive supply-side estimates. They then go through a confrontation and balancing process. Some countries appear to rely more on the supply-side data and effectively just use the proportions from the survey estimates to allocate the supply-side aggregate to using industries and sectors, but others, such as the Netherlands, place more reliance on the demand-side data.

234. Consistent with their varying reliance on the survey estimates of software purchases, countries had different views on their quality, with some countries thinking they were of satisfactory quality and others having concerns. Six countries indicated that they also use surveys to obtain estimates of own account software GFCF. Three of them also use a macro method to derive estimates, but the others rely solely on the survey estimates. The remaining 5 of the 20 countries use the supply-side approach only for purchased software and the macro approach only for own account software.

235. A most important matter concerns the measurement of GFCF of software licences to use and the need to discriminate between those licences that meet the criteria of an asset and those that do not.

Essentially, it boils down to whether a licence to use is for more than a year (record as GFCF) or whether it is for a year or less (record as intermediate consumption). When the demand-side approach is used it is a matter of asking respondents to separately report their expenditures on licences of more than a year and those on a year or less. The supply-side approach does not by itself permit this distinction. There are two possibilities: the first is to rely on the demand-side approach to estimate the split and the second is to obtain information from software suppliers – either directly or indirectly. For many countries, much licensed software is imported, which means that the second approach would require obtaining information from software suppliers in other countries, the national statistical offices of other countries, or some other source, such as the Gartner Group.

Recommendation 4.3: It is very important to distinguish between licences to use for more than a year and licences to use for a year or less. Whatever approach is used, it is vital that the accurate discrimination between the two should be central to measurement.

4.2.3.1 Demand-side approach

236. The demand-side approach for software follows the generic demand-side approach outlined in part 1 of the Handbook. This section covers things that are peculiar to software.

237. Software is ubiquitous and so the scope of a demand-side survey is the entire economy. While nearly all units purchase software a great many of them also undertake their own-account production - both components are substantial.

4.2.3.1.1 Purchased software

238. Software purchases come in a number of different forms, but it is necessary to distinguish between packaged, or ready-made, software and customized software for a number of reasons that will become clear. Units may or may not record either type of software expenditure as capital formation, but under-reporting of capital formation – from an SNA point of view – is particularly prevalent for software services. Therefore, units should be requested to include all their expenditures made on software related services, including expenditures made on original software (on which the company retains all property rights, and from which the company may make copies to be sold) but excluding all expenditures made on software to be re-sold, whether embedded in other software or in hardware.

239. External expenditures can be categorised as follows:

a. Purchases of packaged software for own use recorded as capital expenditures by the enterprise. They should include single and multiple licences-to-use copies that meet the definition of an asset, *i.e*. they should include expenditures on software for which the licence agreement is for more than one year, but not for a year or less.

b. Payments and royalties for own use of packaged software that is expensed by the enterprise. This sub-category includes all payments, including rentals and royalties for licences-to-use, for the use of packaged software (including system software) inside the enterprise that have been expensed by the enterprise, excluding expenditures on software for which the licence agreement is for no more than one year. All payments made for licences and royalties to reproduce copies to be sold as such or embedded in hardware or a software original for which the company does not have all property rights should be excluded.

c. Payments for services related to the development of customized software for own use. They should comprise all external costs of developing customized software for own use of the enterprise,

including payments for services such as R&D, analysis, design and programming or modifications to packaged software. A software original developed with a view to selling copies is considered here as "own use". Payments for outside consultants participating in the development of in-house software are to be included whereas payments related to development of custom software on which the company will not retain exclusive property rights should be excluded. This sub-category should not contain expenditures on software to be used for less than one year.

d. Purchases of all property rights of software originals. This sub-category covers the purchase of all ownership rights of a software original from another enterprise, whether by outright purchase or by the acquisition of a licence-to-reproduce.

e. Other software related expenditures for own use. They should exclude sub-contracted maintenance costs.

4.2.3.1.2 Own-account production of software

240. This category covers the costs of developing in-house software whether for internal use or for which the company intends to sell licences-to-use or reproduce. It includes internal costs of developing a software original for which the company retains all property rights and of which the unit will sell copies or embed copies in hardware or other material.

241. Own-account software production is usually undertaken in several stages. This production process can be outlined in the following way:

1. Feasibility analysis;
2. Functional analysis;
3. Detailed analysis;
4. Programming;
5. Tests;
6. Documentation;
7. Training; and
8. Maintenance.

242. Only the costs incurred in stages 2-6 should be summed to estimate the value of the GFCF of the creation of the software. The costs of the other three stages (feasibility analysis, training and maintenance) do not contribute to the basic price of the asset, and should be expensed. Note, however, that when summing costs to measure GFCF the costs of general staff training should be included. It is only the training in the use of the particular software asset that should be excluded from its GFCF.

Recommendation 4.4: The value of own-account software GFCF should include the costs of all expenditures on stages 2-6, above.

243. The calculation of total labour costs and other costs within stages 2-6 should be derived as follows:

Total labour costs:

a. The number of in-house staff involved in the development of software;

b. Estimate of average percentage of time spent by in-house staff on software development, excluding maintenance and commercial tasks but including time spent on software R&D;

c. Average compensation of staff engaged in software development, including wages, salaries, bonuses, employer social contributions and other special benefits.

Other costs:

d. Overheads associated with employing the staff engaged on software development*, includes management costs, training, personnel management, office requisites, electricity, rent, etc. and the use of fixed assets owned by the enterprise;

e. Any other intermediate consumption associated with producing the software, including the licence fees for software or R&D not recognised fixed assets;

f. Taxes associated with the cost of producing the software, such as payroll taxes*;

*In proportion to the spent on software development.

244. As recommended in part 1 of the Handbook (recommendations 1.9 and 1.10), all the costs of software R&D should be included: either in (a) if undertaken on own account, or in (e) if purchased.

4.2.3.2 Supply-side approach

245. The main difficulty in applying the supply-side approach to software (apart from discriminating between licences of different durations) is to avoid the double-counting of some flows, including sub-contracts. The method is two-fold. For purchased software (including licences to use that qualify as assets) the commodity flow method, starting with sales statistics, is used to derive a figure for purchased GFCF as a residual. For own-account software (absent by definition from sales statistics) the method is based on a macro-estimate of the cost of inputs.

4.2.3.2.1 Purchased software

General principles

246. The recommended commodity flow method for an estimate of gross fixed capital formation in purchased software is a multi-stage approach which can be outlined as follows.

Estimated total gross fixed capital formation of purchased software
equals
Value of domestic supply of software
plus
Imports
plus
Trade margins and taxes on domestic supply and imports
minus
Software embedded by hardware industry
minus
Sub-contracting flows between software companies

minus
Software purchases that do not qualify as GFCF
minus
Household consumption of games and other packaged software
minus
Exports
minus
Maintenance expenditures

Step-by-step implementation

247. The departure point in the commodity flow method is sales. To be fully applicable, sales statistics should be available in a quite detailed classification. In a European context, a four-digit breakdown of the "2008 Statistical Classification of Products by Activity in the European Economic Community" (CPA-2008) is a minimum. If available sales data are classified by activity (main activity of the business), a preliminary step is necessary to reclassify it to obtain sales data of software products. When implementing a supply approach from industry sales data, all sales of software products should be taken into account, even if relevant businesses may produce and sell software products as a secondary activity. For example, manufacturing businesses may produce and sell software products as a secondary activity. This is more likely to be an important issue if the survey data relate to enterprises and there are establishments producing software products for sale that are included in enterprises allocated to industries other than computer services.

248. The CPA-2008 and ISIC Rev.4 classifications relating to software and concordance tables with their predecessors are presented in annex 4.2.

Step 1a: from industry (ISIC Rev.4) data to product data

249. If sales data originate from statistics based on business receipts classified by activity (main activity of the business), a preliminary step is necessary to reclassify the sales data to obtain sales data of *software products*. Indeed, the commodity flow approach is based on resources of the product, even if it is sold as a secondary activity. *Software publishing* (5820) is the principal supplier of packaged software and *Computer programming activities* (6201) is the principal supplier of customized software from within a country. There is a third domestic source in *Data processing, hosting and related activities* (6311) comprising *Application service provisioning*, which includes the provision of leased software from a centralised, hosted, and managed computing environment, some of which may be customized.

250. This step should also include another important verification for the consistency of the method: sales data should include revenues classified by businesses as *royalties*.

Step 1b: starting with CPA data

251. The CPA-2008 distinguishes between software services at a fine level of detail. Corresponding to ISIC Rev.4, *Software publishing services* (58.2) and *Computer programming services* (62.01) dominate the supply of software. *Application service provisioning* (63.11.13) is separately identified.

Recommendation 4.5: Industry sales data can only be used if they are sufficiently detailed. When implementing a supply approach from industry sales data, all sales of software products should be taken into account, even if relevant businesses are not classified under the category "computer services".

Step 2: inclusion of imports to obtain total resources

252. For many countries imports are the major source of packaged software, and it is useful at this point to consider how the importation occurs. The Australian Bureau of Statistics (ABS) identifies a three stage process (ABS 2006). The process begins with the production of an original piece of software in country A.

253. The second stage can take one of two forms:

a. the original is copied in A and exported in a 'boxed' format (*i.e*. disk(s), manuals and packaging) to country B, or

b. and becoming increasingly common, a copy is sent over the Internet or on a disk to country B. A wholesaler then makes as many copies as required.

254. The third stage involves the distribution of the software copies through licences-to-use. In the case of 2(a), this can occur directly between a distributor in country A and the final customer in country B, or it can occur indirectly through a distributor in country B. In some instances the third stage involves the export of software copies from a distributor in country B to customers in country C.

255. The case of 2(b) generally takes the form of the wholesaler in country B making payments to the software owner in country A for a licence-to-reproduce. The 2008 SNA recommends that payments such as these should be treated as intermediate consumption if the licence has the appearance of an operating lease. However, the SNA also recommends that if the holder of the original divests itself of part or all of the responsibility to issue and service copies under licences to use, then this constitutes the sale of part, or all, of the asset represented by the original. In which case, the payment(s) by the wholesaler represent GFCF.

256. Measuring international trade in software is not easy, and it is likely that Balance of Payments data will be insufficiently detailed (see below) and will have to be supplemented by data from other sources. For example, royalties and licence fees in the BOP are generally not distinguished by type of product. Statistics Canada uses its annual survey on software development and computer services to derive figures for exports of computer services and exports of royalties and licence fees. A significant amount of imported royalties and licence fees are added to goods and services data to obtain an estimate of software imports.

Table 4.1 Canada: imports and exports of software, 1998

	Imports	Exports
Merchandise trade	1003	107
Software services	314	731
Royalties and licence fees	685	1311
Total	2002	2150

Recommendation 4.6: In the supply approach, imports and exports definitions have to be consistent with definitions of domestic supply. Both should include royalty payments and licence fees.

Step 3: inclusion of trade margins and taxes

257. Sales data are valued at basic prices and imports at either their f.o.b. or c.i.f. prices. To be comparable with estimates of GFCF they need to be expressed at purchasers' prices. This is achieved by

adding trade margins and taxes *less* subsidies on products (including VAT for household consumption). Only after this adjustment can the commodity-flow method (on which the supply-side approach is based) function properly. For example, in Canada, trade margins and taxes on resources (sales and imports) account for 17% of the value of total supply of software products.

Step 4: avoiding double counting and exclusion of intermediate consumption

Exclusion of intermediate consumption

258. Refer to the concordance tables in annex 4.2 to see the exclusions of intermediate consumption.

259. As described earlier, the 2008 SNA has introduced two significant changes regarding licences to use software. First, the acquisition of a licence-to-reproduce may be GFCF, whereas before it was always intermediate consumption. Second, the acquisition of a licence-to-use a software copy can only be GFCF if the contract is for more than a year. The concordance tables in annex 4.2 reflect these changes and strategies need to be developed to take account of them.

260. There are three types of double counting to be avoided: sub-contracting, embedding of packaged software and own-account production.

Exclusion of subcontracting

261. Because the domestic supply of software is obtained using output data there is an inherent risk of double counting. For example, software product sales corresponding to the main activity of *Computer programming services* (62.01) or *activities* (6201) are to be classified as GFCF except for those corresponding to purchases by a non-final user of the software or if subsumed in an own account original (see annex 4.2). Let us assume that company U, the final user of the software, orders a software product from company A, a software consultancy company. The software will cost 100. Suppose A sub-contracts 25% of the costs of the software to company B, another software consultancy company. Then total sales of software would be equal to 125, while the value of capitalizable software is 100. The 25 subcontracted to B by A is an intermediate consumption of A, and should not be capitalized.

262. Problems also arise for *Software Publishing*. There are three cases for which sales should not be considered as GFCF: (1) when the software product is purchased by a bundler to be included into hardware or some other equipment, (2) when the software product is purchased by another software company to be embedded in another reproduced software for resale, (3) when the software is purchased by final user households or exported.

Exclusion of packaged software purchased by hardware and software bundlers

263. Packaged software is bought by the hardware computer industry to be embedded in the hardware they sell. To the extent it cannot be excluded from estimates of GFCF of computer hardware, then it must be excluded from the estimates of software GFCF. If no data are available as to what proportion of packaged software is included in hardware GFCF, the 2002 OECD Task Force suggested that it be assumed that it was 50%.

Exclusion of own-account production of software

264. Expenditures on software originals that are expected to be used repeatedly to produce copies for more than a year should be recorded as GFCF. In addition, the acquisition of software copies that meet the definition of an asset is also to be treated as GFCF. Hence, in such cases, both the own-account creation of the original and the acquisition of the copies should be recorded as GFCF. Customized software by its

nature is not generally reproduced and so only the acquisition of an original is to be recorded as GFCF. This implies that double counting can only arise with respect to customized software. Hence, double counting can be avoided by excluding customized software production from the estimates of own-account GFCF.

Recommendation 4.7: In the supply approach, double-counting of investment can be avoided by (1) excluding flows corresponding to sub-contracts, (2) excluding 50% (if no specific data) of purchased packaged software by the computer hardware industry, and (3) by excluding, in the macro-estimate of own-account production, costs of analysts and programmers corresponding to sales of custom computer programming services that have already been accounted for using the sales data.

Step 5: Maintenance

265. As explained earlier, maintenance is not GFCF. There is thus the need to exclude from sales data those sales corresponding to maintenance in order to derive GFCF.

266. Countries that have implemented the supply approach have excluded in-house maintenance costs, when building their macro-estimate of own account production. However, businesses also use external services to maintain and repair their software. There is thus also the need to estimate external costs of maintenance.

267. For those countries using ISIC Rev.4, maintenance-type services are confined to *Computer consultancy and computer facilities management activities* (6202) and *Other information technology service activities* (6209). With the exception of that part of 6202 services deemed to be used in own account production of software, these should all be recorded as sources of intermediate consumption.

268. Regarding the European case, the situation is much the same.

Recommendation 4.8: In the supply approach, external costs of maintenance are to be excluded. When using either ISIC Rev.4 or CPA-2008 all but that part of 6202 or 62.02 providing services for own account software production should be excluded.

Step 6: Exclusion of household purchases and exports.

Exclusion of household purchases

269. An estimate should be made of household purchases using household budget surveys or other relevant statistics.

270. Games are an important part of software expenditures by households and need to be excluded if they are included in the supply estimates, above. *Software publishing* in ISIC Rev.4 (5820) and *Software publishing services* in CPA-2008 (52.80) include the supply of computer games services. In the case of the CPA, it is explicitly stated that 58.20 includes licences to reproduce and distribute. In the case of the CPA-2008, they are all included in *Publishing services of computer games* (58.21) and so they are readily excluded, but there is no further breakdown in ISIC Rev. 4.

271. Households also buy non-games software and that part used by individuals acting as own account workers should be recorded as GFCF, but the rest should be excluded.

272. Data obtained from Australia and USA seem to converge to an amount of 4 to 5% of total supply being assigned to household consumption. It is not clear, however, if the data include games or not.

Canada has a similar figure with a methodological note stating that its figures exclude spending on games. France has a smaller amount (2.1%).

Recommendation 4.9: In the supply approach, consumption by households should be estimated through household budget surveys or other equivalent sources and excluded from sales (adjusted for trade margins and indirect taxes).

Exclusion of exports

273. A previous paragraph has already discussed issues regarding external flows.

Summary of recommendations for implementation the supply approach for purchased software

274. The following table summarises the different steps to derive software GFCF, including specific parameter settings.

Table 4.2 Summary of implementation step for supply approach

ISIC Rev. 4: value of sales of capitalizable software services: *Software publishing* (582) plus *Computer programming activities* (6201) plus *Application service provisioning* (part of 6311) CPA-2208: value of sales of capitalizable software services: *Software publishing services* (58.2) plus *Computer programming activities* (6201) plus *Application service provisioning* (63.11.13), with contracts for more than one year., including royalties and licence fees, and games	A
Inclusion of imports (including royalties and licence fees and games)	B
Inclusion of trade margins and taxes on domestic supply and imports	C
Exclusion of software embedded by hardware industry (50% of purchases of packaged software by hardware industry), treated as intermediate consumption	D
Exclusion of sub-contracting flows between "software companies"	E
Exclusion of household consumption of packaged software and games if included above	F
Exclusion of exports (including royalties and licence fees and games)	G
Exclusion of maintenance	H
Total GFCF in purchased software	A+B+C-D-E-F-G-H

275. It is very important to note that the total value for GFCF in software should be adjusted if software already capitalized by businesses is included in total GFCF independently from this process. This adjustment is described at the end of this section.

276. Appendix 3 in annex 4.2 shows the concordance between CPA-2008, ISIC Rev. 4 and CPC ver.2. As can be seen, there is a many to one relationship between *Software publishing* (5820) and the CPC, but an almost one-to-one relationship between the CPA's *Software publishing services* and the CPC. It is a similar story for computer programming: there is a many-to-one relationship for *Computer programming activities* (6201) and the CPC, and almost one-to-one relationship between *Computer programming services* (62.01) and the CPC.

4.2.3.2.2 Own-account original software

General principles

277. The OECD Task Force found that the GFCF of own-account original software accounted for about a third of total software GFCF. This implies that it cannot be ignored and a reasonable amount of care should be taken in estimating it. In broad terms, own-account software GFCF can be estimated as follows:

Estimated value of own-account software production
equals
Labour costs of software personnel (*i.e*. compensation of employees)
plus
Non-labour costs of own-account software production
(intermediate consumption, administrative overheads.)
plus
User cost of fixed capital or gross operating surplus
minus
Costs linked to other activities
(maintenance, etc.)
minus
Costs linked to the production of original custom-made software and reproduction software to be sold

Explanations

278. To understand the estimation process used by individual countries at the macro level, the difference between *production of software personnel* and *own-account software production* needs to be clarified. Software production of software personnel refers to the total amount of software produced by all the software personnel, which includes both software to be used internally (own-account software) and software to be sold. Own-account software production refers to the total amount of software produced in-house by software personnel for internal use. It thus excludes the software production linked to software to be sold. It is important to note here that original software for reproduction (such as Windows for Microsoft) corresponds to software to be used internally. Only reproductions of Windows are sold, not the original.

279. Therefore, in order to estimate own-account software production carried out by software personnel, a "sales adjustment" needs to be made to exclude market activities (*i.e*. sale of original custom-made software and sale of reproductions). This adjustment allows that no double counting is recorded under the supply approach, because software sold has been already accounted for using sales data.

280. The production of own-account software is measured as the sum of production costs. These costs consist of compensation of employees, administrative overheads, intermediate inputs, indirect business taxes (*e.g*. payroll tax), user cost of capital, etc.

Labour costs

281. The labour compensation costs of software personnel can be measured by multiplying the number of the relevant labour force by their average compensation. Average compensation should be derived using the national accounts measure of compensation of employees. It is recommended that the

number of software personnel should be broken down by group of economic activity, including the government sector, and particularly the ISIC Rev.4 categories *Computer programming activities* (6201) and *Computer consultancy and computer facilities management activities* (6202).

282. The number of software personnel can be estimated either by direct business surveys or employment data by occupation, but most countries do the latter. The appropriate identification of software personnel is not straightforward, however. The OECD Task Force recommended that in the absence of direct survey data on the number of software personnel employment data by occupation should be used and limited to the number of computing services department managers and computing professionals according to International Standard Classification of Occupations 1988 (ISCO-88), codes 213 (computing professionals), in the hope that the contribution of other occupation codes associated with computer programming was insignificant. The reason for this assumption was that there was a lack of information as to how much time other software personnel spent on software development and the belief that it was not substantial.

283. A more recent consultation of key firms and institutions in the software industry by the Office for National Statistics (ONS), United Kingdom, has found that a wider range of occupations should be considered. Although software professionals constitute the most important occupational group, significant contributions are also made by computing services managers (ISCO-88, code 1236), computer assistants (code 3121), computer equipment operators (code 3122) and data entry operators (code 4113). Since this study included discussions with important firms in the software industry, *e.g.* CISCO Systems and IBM UK, and the broadening of the scope was found by the ONS to increase estimates of own-account software GFCF by about 20%, the broadened scope is recommended.

284. As the multiplication of the number of software personnel by their average compensation provides their total compensation, adjustments have to be made to obtain the labour costs of own-account software production. This can be done by subtracting the labour compensation that is not linked to own-account software production from the total labour compensation of software personnel. These adjustments are made based on data on the working time of the labour force classified by industry of activity by ISCO code. In a first step, the working time of the software personnel that is spent on the production of original custom-made software and reproduction software that are to be sold should be excluded, leaving the working time for the production of own-account software and of originals for reproduction. A second adjustment has to be made for the working time of software personnel linked to other activities such as system repair, maintenance of computer systems, etc. This part of their working time has to be estimated and deducted from their total working time. The UK ONS survey found the following approximate percentages of time spent on software development by software personnel occupation group. The data are reported in terms of the UK Standard Occupational Classification, along with closest ISCO-88 equivalents. The respondents to the UK survey reported that about 70% of the time of software professionals (213) was spent on software development, but the UK decided to adopt 50%, in line with the recommendations of the report of 2002 OECD Task Force.

Table 4.3 UK occupational codes used in estimating labour costs of own account software production

ISCO-88	UK SOC	Occupation	Proportion (%)
1236	1136	Information and communication technology managers	15
213	2131	IT strategy and planning professionals	35
213	2132	Software professionals	70 (50)
3121	3131	IT operations technicians	20
3122	3132	It user support technicians	15
4113	4136	Database assistants/clerks	5
213	5245	Computer engineers, installation and maintenance	5

285. The recommendations of the 2002 OECD Task Force were based on US experience. The US has adopted a 50% deduction rule for the time spent by software professionals on tasks other than software development. The 50% share originates from a 20-year old study on the share of software development and maintenance costs in 487 business organizations reported by Barry Boehm (Boehm 1981). The detailed shares are shown in the box 4.1. The categories that are classified as software investment are in bold italics.

Box 4.1 Time spent by R&D professionals in the US (Boehm)	
Development	49 per cent
Maintenance	*43 per cent*
a) Emergency program fixes	6 per cent
b) Routine debugging	4 per cent
c) Accommodate changes to input data, files	8 per cent
d) ***Accommodate changes to hardware, operating systems***	***3 per cent***
e) Enhancements for users:	
New reports	***8 per cent***
Added data for existing reports	***6 per cent***
Other	7 per cent
f) Improve documentation	3 per cent
g) ***Improve code efficiency***	***2 per cent***
h) Other	8 per cent
Other	2 per cent

286. Although the result of the study shows that 62% of time spent is on investment, a 50% share was chosen to emphasize the approximate nature of the estimate. The 50% share is also based on anecdotal evidence that the share has diminished with the growing importance of personal computer and prepackaged software. So far, no recent study on the matter has been identified. The 50% deduction rule is also adopted in Canada, France and Italy.

287. Statistics Netherlands conducted an analysis in order to compare the result of the labour costs of own-account software production derived from two different data sources: direct survey (Automation Survey) and a labour survey (employment and wages by occupation). The main conclusion is that the correction factor of 50% leads to an overestimate of the labour cost of own account software production.

Recommendation 4.10: If a country does not have reliable data on the share of time spent on the various tasks of computer professionals, the 50% deduction rule can be applied as an upper limit of the labour cost of own-account software production.

Non-labour costs

288. As direct data on non-labour costs of own-account software production is hardly available, it has generally to be estimated based on the relationship between labour costs and non-labour costs of relevant industries. The data for the relationship should generally be derived by survey or census data for computer services industries (if possible, custom software developers would be preferable). The calculated ratio of non-labour costs to labour costs is quite different across countries. This is mainly due to the availability of data on cost structure of related industries. Some countries have data at a detailed level of computer services industries, but others might have only data on service industry as a whole.

289. It is reasonable to assume that the cost structure of own-account software production is similar to custom software development or contract software programming industries. These industries tend to be more labour intensive than the service industry as a whole. However calculated, the ratio should be adjusted to exclude any double-counting of external costs that would have been already recorded in the other branch of the supply method, covering purchases. This is due to the fact that sales of programmer services included in the process of production of a final user's in-house software are to be recorded directly as investment. At the same time, the above process of estimating non-labour costs using the structure of the computer software industry, implicitly includes a mark-up for these external costs, because the computer software industry also purchases software services for its own use. There would therefore be a double-counting element if these costs were included both as purchases and, implicitly, in the mark-up process used in adding in non-labour costs. That is why a downwards adjustment of the ratio is recommended.

290. Furthermore, it is recommended that allowances for administrative overheads should be included to take account of their contribution to the process of software production.

Cost of capital services

291. The cost of the capital services provided all the non-financial assets used in the production of own-account software should be included. It is recommended that the ratio of the gross operating surplus to labour costs in the custom software development or contract software programming industries be used to make the imputation – see 1.4.3.

Sales adjustment

292. As described above, it is necessary to make an adjustment to exclude the costs of producing custom software to be sold, as not all software personnel produce own-account software. Many of them, especially in the computer services industry, are involved in the production of software to be sold, and this activity should not be included in the estimation of own-account software production. Ideally, surveys of the computer services industry should be undertaken to determine what proportion of their software personnel are used to produce custom software and what proportion is used to produce originals for producing copies and originals for internal use. In the absence of actual data, it is worth noting the experience and practice of the US (reference) and UK.

293. In the US, a sales adjustment is made in industries where software professionals constitute more than 2 per cent of total employment. In any industry where more than 2 per cent of those employed are software professionals (ISCO-88 codes 2131 and 2132) a sales adjustment is made of 2/(proportion of software professionals to total employment x 100)*.

Multiplicative model

294. The additive model described above for deriving supply-side estimates of own-account software GFCF may not be the best way of deriving estimates in practice. It may well be reasonable to assume that direct labour costs (*i.e*. compensation of employees) are directly proportional to some of the other factors in the model, *e.g*. costs other than direct labour costs (such as management, taxes, intermediate inputs, and the capital services from fixed assets) and the sales adjustment. If so, a multiplicative model, as shown below, or a mixed multiplicative- additive model should be used.

Model with multiplicative relationships between components

Own-account software GFCF

equals

Wages and salaries of software personnel

multiplied by
Mark-up to take account of other labour costs
multiplied by
Adjustments for time spent on other activities
multiplied by
All overheads (management overheads, intermediate inputs, user cost of fixed capital)
multiplied by
Sales adjustment

R&D and software

295. The 2008 SNA recognises R&D expenditures that meet the general definition of an asset as fixed assets. This change occurred after the 2002 OECD Task Force report and after the UK study described above. Nevertheless, the OECD Task Force was concerned that all costs associated with software R&D should be included in estimates of own-account software GFCF, and recommended that they should be capitalized as they occurred. With the recognition of R&D assets this recommendation it might seem that this recommendation needs to be modified, but in fact it does not. This matter is addressed in the R&D part of the Handbook.

Further adjustments ensuring consistency of national accounts

296. When the estimates of gross domestic product using the income approach are based directly or indirectly on business reports, an adjustment has to be made when compiling gross operating surplus to ensure consistency of the national accounts because the "supply approach" leads to a significantly different breakdown between current expenses (intermediate consumption) and investment (gross fixed capital formation) than in the business reports. These adjustments should be based on the difference between the independent "supply approach" estimate of gross fixed capital formation and what is declared capitalized by businesses. In order to compile this difference, surveys should continue to monitor capitalized software investment as they are recorded in business accounts.

297. Prior to the decision to implement the SNA recommendation on capitalizing software, and in order to be fully consistent with SNA, all software expenses should have been treated fully as intermediate consumption and not gross fixed capital formation. As a result, the above adjustment to corporate profits should not be a new feature in the process of compilation of the national accounts. In other words, before the implementation of 1993 SNA, corporate profits should have been adjusted by adding to intermediate consumption the software "wrongly" classified as investment in the business accounts. In parallel, gross fixed capital formation reported by businesses should have been diminished by the same amount.

298. Another source of double-counting of software capitalisation is the use of specific business reports. In applying the supply-side approach, double-counting of software investment already included in national accounts (sometimes under "hardware") occurs when the general process of estimation of gross fixed capital formation uses business reports which include software capitalized by business since sometimes this software, even bought separately from hardware, is included as hardware. That is why the built-in capitalized software already included as hardware in business reports has to be deducted from hardware investment. A possibility to do this is to compare the reports from respondents to the relevant survey (*e.g.* on capital expenditures) who declared software capitalisation to the software investment resulting from the commodity flow method. The resulting ratios can be applied to adjust the hardware data in order to avoid this kind of double-counting.

4.3 Databases

4.3.1 Introduction

299. The 1993 SNA described the treatment and measurement of databases as a special case of software and recommended that only large databases should be capitalized. There was a good deal of difficulty in implementing this recommendation for a number of reasons: there was no precise definition of what a database was, how should the qualification "large" be interpreted, should the value of information stored on a database be included in its value or not and, hence, how should a database be valued in general. As a result, many countries did not capitalise databases at all or not in an internationally comparable way. An OECD survey of Member countries in 2004 (OECD 2004) found that of the 13 countries who responded 5 said they excluded databases from their estimates of GFCF and the remaining 8 said that they included them in principle, but the values were not separately identifiable.

300. All of these issues were addressed by the Canberra II Group, and its proposals for addressing the above deficiencies led to changes reflected in the 2008 SNA.

4.3.2 Definition and treatment

301. The 2008 SNA identifies databases as a separate sub-category of the asset category "software and databases", and in paragraphs 10.112 to 10.114 clarifies what databases are and how their value should be determined.

> 10.112 D***atabase consist of files of data organized in such a way as to permit resource-effective access and use of the data.*** Databases may be developed exclusively for own use or for sale as an entity or for sale by means of a licence to access the information contained. The standard conditions apply for when an own-use database or a purchased database or the licence to access a database constitutes an asset.
>
> 10.113 The creation of a database will generally have to be estimated by a sum-of-costs approach. The cost of the database management system (DBMS) used should not be included in the costs but be treated as a computer software asset unless it is used under an operating lease. The cost of preparing data in the appropriate format is included in the cost of the database but not the cost of acquiring or producing the data initially. Other costs will include staff time estimated on the basis of the amount of time spent in developing the database, an estimate of the capital services of the assets used in developing the database and costs of items used as intermediate consumption.
>
> 10.114 Databases for sale should be valued at their market price, which includes the value of the information content. If the value of a software component is available separately, it should be recorded as the sale of software.

302. This definition implies that all databases holding data with a useful life of more than one year should be recorded as fixed assets providing they meet the general definition of an asset (*i.e*. are expected provide benefits to their owners and over which ownership rights are exercised). Databases created on own-account and those for sale are included in the asset boundary if they meet this criterion notwithstanding their size or their type. The value of the DBMS will normally be recorded elsewhere as software. The definition also implies that the scope of databases should not be limited to specific types of databases nor to databases created by specific activities and that the reference to "large" mentioned in 1993 SNA no longer applies.

303. Databases produced for outright sale should be valued at their market prices. Likewise, expenditures on licences to use databases should be recorded at their market prices and recorded as GFCF if the licences meet the definition of an asset, or as intermediate consumption if they do not, in the same way as software licences, see above.

304. Most databases are produced on own-account, either for internal use only or for distribution via licences-to-use or reproduce. The GFCF of those databases that satisfy the definition of an asset has to be estimated by summing costs in the same way as software. However, there is one important difference between a piece of software and a database (excluding the DBMS); unlike software, the data on a database that meets the definition of an asset does not require maintenance. The value of data may decline over time due to obsolescence but it does not decline due deterioration, and the cost of updating a database that qualifies as a fixed asset should be recorded as GFCF.

305. The recommendation in the 2008 SNA not to include the cost of obtaining information when summing costs to value database GFCF was made for measurement reasons and because otherwise the door to the capitalisation of knowledge in general would have been opened indirectly. In addition, the capitalisation of knowledge would create an inconsistency in the SNA, because its capitalisation would depend on how it was stored. If the knowledge was stored and embodied in a database it would be capitalized, however, if it was stored elsewhere, *e.g*. on paper files, it would not be capitalized. In addition, the data/information may already be recorded in the accounts as fixed assets, in the category "entertainment, artistic or literary originals", or they may not be, *e.g*. paper records.

306. A key question is which information provides services for more than one year since it is the length of the expected working life of the data/knowledge that determines whether the database should be recorded as a fixed asset. A good indication that it should, is if either of the following two conditions is met:

a. a typical datum is expected to be stored on the database for more than a year, or

b. if a typical datum is expected to be updated and replaced within a year on the principal database, then it will be archived on a secondary database.

Recommendation 4.11: a database should be recorded as a fixed asset if a typical datum is expected to be stored on the database, or archived on a secondary database, for more than a year.

4.3.3 Measurement

307. Most creation of databases occurs on own-account, either for internal use or for sale via licences-to-use. The rules for determining whether the purchase of a licence should be treated as GFCF or intermediate consumption are the same as those for software.

308. A feature of most, but not all, databases is that they are frequently updated, and external users of a database pay for a copy that is frequently replaced with an updated version. This is the case for many statistical databases, for example. Access to frequently updated databases is generally obtained by annual subscription and users are undertaking consumption of database services rather than fixed capital formation. There are exceptions, such as the sale of population census data on a CD-ROM by a national statistical office and for which the database may be used for five or ten years. However, there is a dearth of information as to how significant the GFCF of databases by purchase is.

309. As for software, estimates of database GFCF can be derived using the demand-side and/or supply-side approaches, at least in concept. But unlike software, purchases of databases or database services that qualify as GFCF is thought to be very minor, with examples such as population census data being very much the exception. It is therefore recommended that the focus should be on measuring own-account database GFCF and that purchases of databases or database services only be recorded as GFCF on an exceptional basis, if and when such sales come to light.

310. It has been difficult to determine how great expenditures on database creation are. There is no particular database industry and CPC Ver. 1.1 did not provide an adequate set of categories that covers databases without including too many other things besides. With the introduction of CPC Ver. 2, this has changed and now there is a single category "Original compilations of facts/information" (83940) that relates to databases. How well data can be collected for this category remains to be seen.

4.3.3.1 Demand-side approach

311. The scope of an "ideal" survey should be all units in the economy. There would be considerable advantage in combining it with a software survey or more general survey, as this could minimise costs and may help avoid including the value of a DBMS in the value of a database created on own account. As for software, the survey should distinguish between external costs (expenditures) related to databases for own final use and internal costs of in-house database creation. In addition, the survey should ask for the company's own estimate of its capitalized databases, if any.

312. Concerning external costs (expenditures), businesses should be requested to include expenditures made on original databases (on which the company retains all property rights, and from which the company may make copies to be sold) but excluding all expenditures made on databases to be re-sold and all payments for data base management software. External costs should exclude all payments for data or other information to be incorporated in a database, but include the cost of any services entailed in preparing or loading the data into a database.

4.3.3.1.1 Costs of in-house database creation

313. This category covers the internal costs of developing a database original on which the company retains all property rights and of which the company will sell copies or embed copies in hardware or other material. It also covers databases developed for internal use. But it does not include the costs of creating databases intended for outright sale. It comprises the costs of utilising a DBMS (but not the cost of the DBMS itself) and loading data/information into a database, including updates. It requires the calculation of total labour costs and other costs as follows:

Total labour costs:

a. The number of in-house staff involved in the specification of the DBMS and loading data/information into it, including updates;

b. Estimate of average percentage of time spent by in-house staff on database tasks;

c. Average compensation of the staff engaged in database creation, including wages, salaries, bonuses, employer social contributions and other special benefits.

Other costs:

d. Overheads associated with employing the staff engaged on database creation and updating*, includes management costs, training, personnel management, office requisites, electricity, rent, etc. and the cost of using the enterprise's fixed assets;

e. Any other intermediate consumption associated with database creation, including the costs of software not recognised as a fixed asset;

f. Taxes associated with the cost of database creation, such as payroll taxes*;

*In proportion to the spent on database creation.

4.3.3.2 Supply-side approach

314. The method to be used is the same as that for own-account original software (section 4.2.3.2.2). In the absence of any data on the proportions of time spent by occupation groups on database creation, it is recommended that the direct labour costs be determined by the time spent by database assistants/clerks (ISCO-88 4113) not allocated to software production. Non-labour costs, the user cost of fixed assets should be derived in the same way as for software.

315. Not all database creation qualifies as GFCF. In the absence of any information on the proportion that does, it is recommended that it be assumed to be 50%.

4.4 International trade in software and databases

4.4.1 Introduction

316. The need for valid, detailed and international comparable data on trade in services has increased as its share in international trade volumes has augmented over the last years. The key interest focuses especially on data on trade in software since this is assumed to be extensive and very dynamic.

317. However, measuring international trade flows of software can be very difficult. These difficulties result from the fact that software may be traded on a variety of media, both tangible and intangible, and by a variety of means. Moreover, software sales may take the form of licences to use or reproduce software, which may or may not be accompanied by a physical supply of software.

318. Software is often bundled with hardware or other computer or consultancy services. Computer software is only one of a number of so called digitized products along with, for example music, film, data, TV programmes, news and literature that may be regarded as presenting analogous measurement problems regarding international trade.

319. International trade is for practical reasons partitioned into goods and services more rigidly than production. Eight examples of ways in which software can be traded as goods or services internationally are distinguished in the following (there may be more).

a. The most straightforward case is where packaged software is traded with manuals on a physical disk, *e.g.* a CD-ROM. However, valuation is sometimes a problem here, if it is based on the medium rather than the software content and/or the extent of the user licence.

b. Software may be installed on equipment or machinery, *e.g.* a PC. The software traded then may be counted simply as trade in that type of equipment. Both case (1) and (2) are treated as trade in goods.

c. A single (physical or online) copy of some software may be sold to a foreign firm which pays a licence fee to make further use of it. The licence payments are counted in trade in services but will not be separately identified as software in the current international classifications. It should be noticed that it is not uncommon for large firms/organisations to renegotiate the licence-to-use agreements and ensuing payments can be divorced from any physical supply of software.

d. A single (physical or online) copy of some software may be sold to a foreign firm, possibly an affiliated firm, under licence to reproduce/sell further copies within certain (geographical/numerical) limits or bundle the software with hardware or software for resale. The royalty payments are counted in trade in services but again will not be separately identified as software in the current international classifications.

e. Traded customized software, if sold in physical format, is likely to be counted as trade in goods in the Customs reports, but may transferred to trade in computer services, following BPM5 guidelines or possibly to purchase of assets depending on the nature of the transaction. No change is expected in BPM6.

f. Software may be traded internationally online and in such a case it will by default not be counted in Customs reports. BPM6 will recommend that downloaded software should be treated as computer services.

g. Customers can subscribe to software services where the software is frequently updated, e.g. anti-virus software or databases, and access updates online (possibly downloading all or part).

h. Finally, software may be sold internationally from one firm to an affiliated firm within the same multinational. This is likely to form a significant part of trade in software. Here, there is no guarantee of uniform treatment and although this may be treated as in the cases above another possibility is that such transactions maybe treated as internal computer services, royalties, classified as miscellaneous management charges, trade in services with related enterprises, goods trade, or in extremis not recorded at all. There is also no guarantee of a market price valuation.

320. This section gives a definition of international trade in software and addresses its measurement whether or not particular sets of transactions are regarded as part of capital formation. The aim is to identify areas where measurement could be improved and to make recommendations on improvements to classifications, reporting practice and further work, in particular on the measurement of trade in software goods, of computer services and of software royalty payments. Furthermore, it addresses both specific problems concerning software delivered online and the borderline between merchandise trade and trade in services.

321. It seems probable that nearly all expenditures on database services are consumption and not capital formation.

4.4.2 Concepts and classification issues

322. The product “computer software” is not well identified in current international trade codes or balance of payments (BOP) items, but a number of items in the goods and services classifications are relevant.

323. The international standard for recording merchandise trade is set out in the United Nation’s publication “International Merchandise Trade Statistics: Concepts and Definitions” (IMTS, Rev. 2), edited in 1998. There, trade is classified into detailed products based on the “Harmonized Commodity

Description and Coding System, 1996 version" (Harmonized System 1996 or HS96). Meanwhile, a third and a fourth edition of the "Harmonized Commodity Description and Coding System", the HS02 and HS07, have been published. For trade in services the international standard is the International Monetary Fund's "Balance of Payments Manual" in its fifth edition (BPM5), which also sets out a classification of services. In certain countries the BPM5 categories are further disaggregated according to the "Joint OECD/Eurostat Trade in Services Classification". In order to obtain more detailed, more comparable and more comprehensive statistics, six international organisations[27] jointly compiled a new "Manual on Statistics of International Trade in Services" where an "Extended Balance of Payments Services" (EBOPS) classification was introduced. The EBOPS classification is a disaggregation of the BPM5. EBOPS is being updated in parallel with BPM6.

324. For merchandise trade there are a number of categories of HS products which may approximately relate to trade in software goods. The IMTS in its paragraph 27 sets out guidelines for the recording of software goods in international trade. It describes goods that are carriers of software within HS heading 85.24. "This category includes, for example, ... packaged sets containing diskettes or CD-ROMs with stored computer software and/or data developed for general or commercial use (not to order), with or without a users' manual. ..... However ... diskettes or CD-ROMs with stored computer software and/or data developed to order .... are to be excluded from international merchandise trade statistics." IMTS goes on to add that where these goods are carrying software and/or data developed to order they should be treated as part of trade in services. It should be noted that the HS codes do not distinguish media carrying customized software from packaged software. In the 2007 update of the HS, HS07, 85.24 is replaced by 85.23 and the situation is even worse, as there is no distinction between media with and without anything recorded on them.

325. On valuation of trade in software goods IMTS paragraph 123(b) states "Goods used as carriers of information and software, such as packaged sets containing diskettes or CD-ROMS with stored computer software and/or data developed for general or commercial use (not to order) be valued at their full transaction value (not at the value of the empty diskettes or CD-ROMS, paper or other materials)".

326. IMTS paragraph 48 (c) says that software goods purchased by travellers, including non-resident workers, or by foreign governments through their embassies or foreign military or other installations located in the host country are to be recorded as trade in services (such transactions would not normally separately identify software).

327. For online delivery of standard (*i.e*. packaged, not customized) software or databases no clear classification guidance currently exists as is the case for some other digitized products. However, BPM6 will recommend that downloaded software be recorded as computer services.

328. Software related royalty payments, which are counted in trade in services, are not at present separately identifiable from other royalty and licence fee payments in the international classifications. BPM6 will recommend that royalty and licence payments should be included in either *computer services* or *fees for franchises and other proprietary rights*, but at present it is unclear which.

329. There are some points of difference between the basic trade data and the basis on which investment assets are measured in the SNA. First, the BOP trade series make no distinction as to the length of time traded goods or services are used, whereas the SNA recommends that only software for use in production for more than one year should be recorded as a fixed asset. Second, the BOP records by

[27] The United Nations (UN), the Statistical Office of the European Communities (Eurostat), the International Monetary Fund (IMF), the Organisation for Economic Co-operation and Development (OECD), the World Trade Organisation (WTO) and the United Nations Conference on Trade and Development (UNCTAD).

exception repairs in computer services rather than in goods without clearly demarcating the extensiveness of the repair, whereas the SNA includes improvements to existing fixed assets that go beyond ordinary maintenance and repair. This difference is expected to be remedied in BPM6.

4.4.3 Conclusions and recommendations

330. Current international trade and balance of payments classifications and statistics are not as helpful as they could be in identifying international trade in computer software. Only a few countries appear to have access to a satisfactory set of data concerning trade in software. Supply-use tables should be made more consistent with trade flows in software.

331. The following four measures in trade and balance of payments are proposed. Their combined realisation would mark an important advance in effectively assessing international trade in computer software and their incorporation in the product balances of the national accounts in a more internationally comparable way.

a. the product "computer software" in international trade statistics and in national accounts should be regarded as having broadly three main trade components. These are software goods, computer services and software royalty and licence fee payments. This would clarify trade flows of software and increase international comparability.

b. the separate identification of trade in computer services (BOP code 263, see Box below) from computer and information services where this is not already done should be implemented.

c. it is recommended that software royalty and licence fee payments in the balance of payments services classification (part of BOPS code 266 at present) and in country reporting should be separately identified.

d. standard international grouping of Harmonized System codes that represents trade in software goods to improve international comparability is desirable and the following are proposed: HS96 codes 8524.31; 8524.40; 8524.91 and 8524.99. However, this has not been implemented in HS 2007.

332. In addition, two main areas for follow up work are identified where questions are unanswered and it appears premature to make any specific recommendations is needed. First, research should be undertaken into how software goods are valued and whether and how countries coordinate software measurement (valuation) in trade in goods and services to ensure a standard allocation, full coverage and avoid double-counting. Second, the online sale/purchase and delivery of software to/from other countries needs to be further investigated, probably through Internet use and e-commerce surveys. A further task is to identify the CPC Ver. 2 codes associated with the relevant HS and BOP codes mentioned above.

Box 4.2 Relevant International BOP Codes

262 Computer and information services, includes 263 and 264

263 Computer services

EBOPS Description: Computer services consist of hardware and software related services and data processing services. Included are hardware and software consultancy and implementation services; maintenance and repair of computers and peripheral equipment; disaster recovery services; provision of advice and assistance on matters related to the management of computer resources; analysis, design and programming of systems ready to use (including web page development and design) and technical consultancy related to software; development, production, supply and documentation of customized software, including operating systems made on order for specific users; systems maintenance and other support services such as training provided as part of consultancy; data processing services such as data entry, tabulation, and processing on a time-sharing basis; web page hosting services (*i.e.*, the provision of server space on the Internet to host clients' web pages); and computer facilities management.

Excluded from computer services are the provision of packaged (non-customized) software (classified as goods and therefore not included in EBOPS) and non-specific computer training courses (included in other personal, cultural, and recreational services).

264 Information services

EBOPS description:

a) News agency services which include the provision of news, photographs, and feature articles to the media. In the GNS/W/120 list of services that was a basis for the GATS commitments in the Uruguay Round, these services are a part of "recreational, cultural and sporting services" rather than computer and information services in the case of BPM5. These services are therefore separately identified in the EBOPS classification, thus facilitating a linkage with GNS/W/120.

b) Other information provision services which include database services – database conception, data storage and the dissemination of data and databases (including directories and mailing lists), both online and through magnetic, optical or printed media; and web search portals (search engine services that find Internet addresses for clients who input keyword queries). Also included are direct, non-bulk subscriptions to newspapers and periodicals, whether by mail, electronic transmission or other means.

266 Royalties and licence fees

EBOPS description: This Manual recommends a disaggregation of the BPM5 component into franchises and similar rights and other royalties and licence fees. Franchises and similar rights comprise international payments and receipts of franchising fees and the royalties paid for the use of registered trademarks. Other royalties and licence fees include international payments and receipts for the authorised use of intangible, non-produced, non-financial assets and proprietary rights (such as patents, copyrights and industrial processes and designs) and with the use, through licensing agreements, of produced originals or prototypes (such as manuscripts, computer programs, and cinematographic works and sound recordings). Payments and receipts for the outright purchase or sale of these assets and rights are excluded (following BPM5, these are recorded as capital account transactions, not as services). Excluded also are distributive rights for audiovisual products for a limited period or a limited area; these are included in audiovisual and related services.

4.5 Prices and volumes

4.5.1 Introduction

333. When deriving volume estimates of software and databases it is advisable to decompose software into three components: packaged (or off-the-shelf), custom-made and own account, and to deflate them and databases separately. There are several reasons for doing this. First, the three components of software and databases vary in the extent to which price data are available to compile price indexes. Second, it is likely that their prices and volumes grow at different rates, particularly between packaged, the other two software components and databases. Third, despite the previous point, price indexes for packaged software may be used to construct price indexes for the other two software components if more appropriate price indexes are unavailable. Fourth, volume estimates of the items are useful indicators in their own right.

334. Packaged software is purchased on a very large scale, generally via licences-to-use, and there is an abundance of price data available. The challenge is to construct price indexes free of the effects of changing specifications and any other aspects of quality change. With ever larger numbers of copies of popular software being sold, growing economies of scale allow prices to fall. Custom-made software is also sold on the market, but each custom-made software product is a one-off, which presents an obvious problem for compiling price indexes. Although each custom-made product is different, different products may share common components, or a strategy used to develop one product may be able to be used for another. This not only suggests a possible way of compiling a price index, but also suggests means by which productivity gains could be made that would put downward pressure on prices.

335. The 2002 OECD Task Force found that the deflators used to derive volume estimates of software GFCF varied enormously between Member countries. This largely reflected the fact that many countries did not have suitable price indexes and used the price indexes of other goods and services as proxies. Partly as a result of the OECD Task Force's report and partly as a result of the EU decision to make it mandatory for its members to adopt more appropriate deflators those differences are being reduced. In making its decision, the EU provided indications of what form suitable price indexes might take. But these are of a general nature, and reflect the fact that there is still more work to be done in determining the best way to derive suitable price indexes for these products in practice.

336. One thing that is clear is that best results can be achieved in an input-output framework. This ensures that solutions made in the deflation are internally consistent. For many countries a significant share of purchased software is imported. If prices and volumes on the use side are consistent with imports, then errors, at least at the GDP level, will not be very significant.

337. There are two particular features of software GFCF that make the derivation of suitable price indexes challenging. First, there are rapid quality and specification changes, and, second, price data are only readily available for purchases of packaged software. This section begins by giving an outline of the two main methods used for measuring price changes when quality changes occur frequently and price data are available. It then goes on to describe how price indexes for software and databases should or could be compiled. The recommendations distinguish between packaged software, customized software, own-account software and databases. When the most desirable way of compiling price indexes may only be possible in the long term, then recommendations for second-best, short-term solutions are given.

4.5.2 Recommendations

4.5.2.1 Packaged software deflators

338. Generally, all OECD member countries should develop price indexes for packaged software in the long term. These should cover software acquired by both businesses and households (including games)

and adequately take into account qualitative changes of software. As shown above, developing an unbiased index is difficult and adjustments might still be needed. If that is the case, adjustments should be based on available objective data and made transparent to users. Improvement of the comparability with other countries is an important criterion in the adjustment procedure.

339. The US has been the leader in developing price indexes for packaged software. The US producer price index for packaged software is compiled by the Bureau of Labor Statistics (BLS) and was first published in December 1997. It is based on a survey of producer selling prices, *i.e.* at the first line of distribution, collected from a sample of manufacturers of packaged software. The BLS collects price quotes from both the Original Equipment Manufacturer (OEM) and finished goods channels, and for full versions and upgrades.

340. The methodology of the BLS price index for packaged software is a fixed basket matched-model Laspeyres price index, with plans to update the weights every five to seven years. Because of the bias in price changes measured by matched-model price indexes, the US Bureau of Economic Analysis (BEA) began, in 2000, to make an adjustment to the BLS packaged software price index. This adjustment is based both on a matched-model price index for spreadsheets, word processors, and databases (Oliner 1994) and on a BEA hedonic price index for spreadsheets and word processors. The average annual difference between these two sets of price indexes over the 1985 to 1993 time period is – 6.3 percent. The BEA calculates its bias adjustment as one-half of this difference, or – 3.15 percent. Self-evidently, use of mechanically adjusted price index is not an acceptable solution in the long term.

341. Nevertheless, the BEA's price index is recommended for use in the short term, because on the one hand the US has a dominant share in the market and on the other hand the use of the same index ensures the best comparability between countries. For use outside the USA, the US price index could be adjusted on the basis of either changes in exchange rates or purchasing power parities (PPPs) and it should reflect different timings of releases of new software in the USA and in the country where the modified US price index is used. The problem with using exchange rates is that they can be volatile, and the software supplier may not adjust the prices of imported software in accordance with them for practical as well as competitive reasons. The problem with PPPs is that they are unlikely to be available in sufficient detail and they are only collected at infrequent intervals. In between times they are extrapolated using GDP IPDs.

342. One possibility is to contact major software importers and ask them how they set and adjust their prices, and at the same time ask them what the usual lag is between software released in the US and software released in the home country.

343. Although prices for domestically-produced software do probably not develop in the same way as prices for imported software, it is better to use the US BEA price index, appropriately adjusted, than a price index not directly related to software. It is suggested here that the BEA index be adjusted by the relative inflation rate between the home country and the US (preferably producer price index for the home country vis-à-vis producer price index for the US).

4.5.2.2 Customized software deflators

344. The standard price index techniques described above cannot be applied to customized software, at least not in a straightforward way, because each product is unique. Methods for constructing price indexes for unique products are described in the *2004 Producer Price Index Manual*. They include model pricing, repeat recent real sale, specification pricing and component pricing. Of these possibly the first, model pricing, is the best possibility. Model pricing involves asking a producer to specify a notional product, based on recent orders. For each period the respondent is asked to supply a hypothetical price. Model specifications need to be changed over time to reflect changes in the market.

345. However, for customized and own-account software the PPI Manual suggests function point analysis as a potential means of constructing price indexes. The function point metric was devised as a means of measuring software size and productivity. It uses functional, logical entities such as inputs, outputs, and inquiries that tend to relate more closely to the functions performed by the software as compared to other measures, such as lines of code. Basic function points are categorized into five groups: outputs, inquiries, inputs, files, and interfaces. A function point is defined as one end-user business function, such as a query for an input. Determining the size of a software product involves counting the number of each type of function point and weighting them. This is a time-consuming business and there is the question of whether two trained analysts would make the same count for a software product. Nevertheless, there is a large number of software enterprises and others engaged in function point analysis and efforts are being made to address the difficulties just described (Carnegie Mellon Software Engineering Institute 2007).

346. At the time of writing we are unaware of any satisfactory price index that has been compiled for customized software, and so it is premature to make a recommendation as to how such price indexes should be compiled, but model pricing and function point analysis look to be the best prospects.

347. The US derives its price index for customized software as a weighted average of its packaged software index and an input price index based on the costs of producing software (wage rate indexes, PPIs for intermediate inputs, etc.). Weights of the two indices are arbitrarily defined, for packaged software 25% and input price index 75%. The rationale is that some productivity growth can be expected in the production of customized software, but not at the same rate as for the production of packaged software. At least two other countries (Australia and Canada) have adopted the US approach. To do so, countries should take a weighted average of the US packaged index, adjusted for differential inflation rates (see above), and an input cost index compiled for their own country.

348. Another second-best approach is to adjust the input price index for customized software using estimates of multi-factor productivity growth in related industries where it is observable.

4.5.2.3 Own-account software deflators

349. In the long term, when price indexes for customized software become available, it would be reasonable to use them for own-account software production. In the interim, countries could follow the same approach they use for customized software.

4.5.2.4 Database deflators

350. Databases are generally heterogeneous products with a small market since most databases are made for in-house purposes. This makes it difficult, if not impossible, to develop a true output price index. We must therefore consider second-best alternatives; there appear to be three. The first is to compile an input price index, but this would imply zero productivity growth. The second is to adjust the input price index by assuming MFP growth in database production is similar to some other industries. The third is to use a price index of some related activity for which there is a price index of reasonable quality.

4.6 Capital measures

4.6.1 Introduction

351. The capital measures referred to in the 2008 SNA comprise gross fixed capital formation, capital services, net capital stock and consumption of fixed capital. Their definitions and the roles they play are all described there. Methods for estimating GFCF are discussed earlier in this part of the Handbook and methods for estimating the other three measures are discussed in the first part of the Handbook (1.7) and is

the subject of the new edition of the OECD manual *Measuring Capital*. Note should be taken of recommendation 1.14: when using the PIM, it is important to have reasonably accurate service lives. The geometric model has a number of advantages and should be used unless there are strong conceptual or practical objections.

352. Nearly all countries derive their estimates of capital services, net capital stock and consumption of fixed capital using the perpetual inventory method (PIM). As its name suggests, the PIM involves aggregating GFCF over time, but allowing for declines in efficiency and value until assets reach the end of their service lives and are retired. The PIM is applied to groups of assets, generally at the most detailed level at which GFCF data are available.

353. The key parameters in the PIM are the expected service life of a group of assets of a similar type, the rate at which its productive capacity, or efficiency, is expected to decline as it ages and the rate at which its value is expected to decline as it ages. The last two are interdependent and their relationship hinges on a discount rate. Not all assets within a group can be expected to have exactly the same service life, and so a probability distribution function is usually specified. This chapter addresses the matter of setting values for these parameters for software and databases.

4.6.2 Service lives

354. The most important PIM parameter is the service life. Specifying a service life of 10 years rather than 5 years would make a huge difference to the estimates of the capital measures. Net capital stock would be approximately double, and with a typical scenario of strong growth, consumption of fixed capital would be appreciably smaller. It therefore deserves a good deal attention. There are several ways of obtaining estimates of service lives, they include: surveying software users, surveying software suppliers and consulting software consultants.

Surveying software users

355. This could entail asking software users what their expectations are of the service lives of the different forms of software they have acquired in the latest year, *i.e*. packaged, customized and own-account. Alternatively, they could be asked what the service lives have been of recently retired software products. A natural place to pose such questions would be in a demand-side survey (section 2.4.1).

Surveying software suppliers

356. Most packaged software is acquired by licences-to-use. Software suppliers can be expected to have records that may indicate the length of time of licences. But can they differentiate between business and household users?

Consulting software consultants

357. There are many IT consultancy firms, and some may have conducted studies into this matter. They generally do not provide such information free of charge, but it could still be a cost-effective solution. They may also be able to supply information on databases.

4.6.3 Country practices

358. Many countries currently do not derive estimates for capital services and they do not specify an age-efficiency function. But they do specify an age-price function which determines how the value of an asset, or group of assets, declines as it ages. The 2002 OECD software task asked Member countries to

report the service life assumptions they used, and the functional forms of the age-price function and the retirement distribution function they use. Table 1 presents the results.

Table 4.1: Estimating the capital stock of software, PIM parameters
Responses to Questionnaire, 2002

Country	Service lives		Age-efficiency or age-price function	Retirement distribution function
	Own-acc't & Customized	Pre-recorded/ packaged		
Australia	Pre 89/90 - 8 Post 89/90 6	6 4	Hyperbolic for age efficiency function	Skewed retirement for packaged & other
Canada	5	3	Straight line	Truncated normal
Czech Republic	5		Business accounts	Any
Denmark	6[a]	4[b]	Straight line	Winfrey S3
Finland	5		Straight line	Skewed Weibull
France	5		Straight line	Lognormal.
Italy	5		Straight line	Truncated normal
Japan	5		Straight line	None
Netherlands	3		Straight Line	Weibull
Spain	4		Straight Line	Delayed linear
Sweden	10[a]	5[b]	Geometric	None
United Kingdom	5		Straight Line	Normal
United States	5	3	Geometric	None

(a) Own-account software only; (b) all purchased software.

359. With the exception of Sweden, most respondent countries reported service lives of approximately 5 years. A few countries specify service lives for customized and own-account separately from packaged, and invariably specify a shorter life for the latter. Given the high cost and specialised nature of customized and own-account software this is only to be expected. One country, Australia, indicated that it had found that service lives had declined over time, and had set shorter service lives from 1989-90.

360. Australia uses a hyperbolic age-efficiency function and derives corresponding age-price function by assuming a real 4% per annum discount rate. The other responding countries mostly reported using straight line depreciation, *i.e.* the age-price function is assumed to decline linearly. Two exceptions were Sweden and the US who reported using a geometric age-price function.

361. Nearly all those countries who did not report using a geometric age-price function reported using a retirement distribution function, but with little commonality.

ANNEX 4.1 LESSONS FROM BUSINESS ACCOUNTING

Even before the introduction of the 1993 SNA, business accountants recognised that software whether purchased or produced in-house had asset characteristics. Generally, business accounting standards recommend the capitalisation of software as long as technical feasibility is established. In this section, three accounting standards will be described in more detail: The US Generally Accepted Accounting Principles, the International Financial Reporting Standards and the French business accounting recommendations. Finally, some problems of identifying software costs due to their ways of reporting in business accounts are mentioned.

The US Generally Accepted Accounting Principles

Forerunner for other national accounting standards of software was in many ways the US accounting system GAAP (Generally Accepted Accounting Principles). Financial Accounting Standards Board (FASB) Statement No. 86 was the first statement to address a standard method for accounting for software. Although this statement did not cover software developed in-house, for internal use, clear guidance was given for software to be sold or leased (including "originals" produced for reproduction). According to this statement all costs of the software to be sold or leased during the research and development stage are to be expensed. At the point in time that the software becomes technologically feasible for use the costs should be capitalized and treated as a product master copy with subsequent costs capitalized as an intangible asset. After a clarification by the FASB which became effective in December 1998 guidance was also given for software developed or purchased for internal use. It was stated that the costs of that software should also be capitalized but not the costs in the final stage of implementation/operation such as training and maintenance which were to be expensed.

The International Financial Reporting Standards

The International Financial Reporting Standards (IFRS) announce in statement # 38 that an enterprise should recognise an intangible asset (at cost) only if it is probable that the future economic benefits that are attributable to the asset will flow to the enterprise and that the cost of the asset can be measured reliably. Furthermore, it is stated that during the research phase all costs should be expensed as incurred. In the development phase costs are to be capitalized if the enterprise can demonstrate all of the following requirements: Technical feasibility; intent to complete the asset for use or for sale; ability to use or sell the asset; record of the way how future economic benefits of the intangible asset can be generated; availability of adequate resources to complete the process for sale or use and ability to measure expenditures during the development stage. The value of the intangible asset should be based on the accumulated costs of development. Costs of internally generated software would include expenditures on materials and services used in production; salaries, wages and other employment related costs of personnel directly engaged in production; any expenditure directly attributable to generating the asset; overheads that can be allocated on a reasonable and consistent basis. Software costs should not include selling, administrative and other general overhead expenditure nor should they include training costs for staff.

The French business accounting system

The French business accounting recommendations split an in-house software project in eight stages:

i. Pre-analysis of feasibility;

ii. Functional analysis;

iii. Detailed analysis;

iv. Programming;
v. Tests;
vi. Documentation;
vii. Training;
viii. Maintenance.

According to the recommendations only costs of stages (2) to (6) should be included in the valuation of the in-house software. The objective is to make a fair estimate of the market price of the intangible asset thus created. Since the first stage is to precise the demand for the software it is not to be taken into account. Stages (7) and (8) should be excluded because training costs and maintenance are not embedded in the asset.

Identification of software costs in business accounts

Proper identification of software costs can be a problem due to the accepted ways accounting information is reported in business accounts. For capitalized software, costs are grouped under the general heading "intangible costs". Intangible costs can include scientific or technical knowledge, design and implementation of new processes or systems, licences, intellectual property, trademarks (including brand names and publishing titles). Examples include computer software, patents, copyrights, motion picture films, customer lists, mortgage servicing rights, import quotas and marketing rights. In addition, the amortisation of intangible costs may include any or all of the above intangible assets without any specific identification of software related items.

Expensed software can also be problematic since the actual costs are often split among multiple accounts, which include consultancy expenses, research and development costs, computer expenses, labour costs, payroll costs, equipment depreciation, software amortisation, office supplies, direct manufacturing costs, miscellaneous accounts, utility costs, and other expense accounts. This heterogeneity makes it particularly difficult to have a comprehensive picture of the total costs on software. The expenditure problem can be particularly difficult related to product enhancements and updated versions (compared to original development costs).

ANNEX 4.2 SOFTWARE-RELATED CLASSIFICATIONS

Contents

CPA Concordance Table

What follows are concordance tables based on the European product classification system (CPA 2008). Where the treatment is non-contentious (and evident) no further explanation is given.

The first table considers purchases of software and the second own-account production. That is, where software is intended for final-use by the purchaser and not intended for further processing nor for bundling/embedding (including outsourced purchases) in a subsequent sale, nor where the software is purchased as part of own-account production.

Table 1a – Purchases of Software		
CPA 2008 Code	Product Description	Intermediate or Investment
58.2	Software publishing services	
	Our understanding is that this category includes sales of pre-existing originals (including games) and software copies (off-the-shelf software, whatever the media). It includes licences to use and licences to reproduce and rentals.	
	◆ Original software – (purchases of pre-existing software originals)	GFCF
	◆ Other reproduced, rented, leased or licenced software. Including payments for "multiple-copy" licences. (*Payment can include, royalties, commissions, fees etc)*:	
	- When purchased for bundling/embedding into products for subsequent sale or other software products or just sold on	IC
	- With a contract for no more than one year	IC
	- With a contract for more than one year	GFCF excluding games[28]
	◆ Payments for licences-to-reproduce software for subsequent sale:	
	- If the licence has the appearance of a change of economic ownership of part or a whole of the software original	GFCF
	- If the licence has the appearance of an operating lease	IC
62.01	Computer programming services	
	◆ IT design and development services for applications	GFCF
	◆ IT design and development services for networks and systems	GFCF
	◆ Software originals	GFCF
62.02.20	Systems and software consultancy services	
	◆ Software expected to be used in production for more than one year:	
	- For inclusion/embedding in an own-account 'original' – the value of own-account production should not include these costs if they are directly capitalized	GFCF
	- If the software is purchased by a final-user for inclusion in an own-account "original" the expenditure may also be treated as intermediate consumption as long as its value is included in own-account production	IC
	◆ Software expected to be used in production for less than one year. (This includes "customized" software purchased to be sold-	IC

[28] Unless purchased by games arcades, game rental companies, etc

	on to another user/client.)	
62.02.30	IT technical support services	IC
62.03	Computer facilities management services	IC
62.09	Other information technology and computer services	IC
63.11.11	Data processing services	IC
63.11.12	Web hosting services	IC
63.11.13	Application service provisioning	
	◆ With a contract for no more than one year	IC
	◆ With a contract for more than a year	GFCF
63.11.19	Other hosting and IT infrastructure provisioning services	IC
63.12.10	Web portal content	IC

The table below describes items that could be included in the cost of own-account production of software.

Table 1b – Own-account production		
CPA 2008 Code	Product Description	Intermediate or Investment
62.02.20	Systems and software consultancy services	
62.02.30	IT technical support services	
62.03	Computer facilities management services	

ISIC Rev. 4 Concordance Table

What follows are concordance tables based on the International Standard Industrial Classification of All Economic Activities (ISIC), Rev.4.

Table 2a – Purchases of Software		
ISIC Rev. 4 Code	"Product" Description	Intermediate or Investment
5820	Software publishing This category is similar to CPA 58.2	
	◆ Original software – (purchases of pre-existing software originals)	GFCF
	◆ Other reproduced purchased, rented, leased or licenced software. Including payments for "multiple-copy" licences. (*Payment can include, royalties, commissions, fees etc)*:	
	- When purchased for bundling/embedding into products for subsequent sale or other software products or just sold on	IC
	- With a contract for no more than one year	IC
	- With a contract for more than one year	GFCF excluding games[29]
	◆ Payments for licences-to-reproduce software for subsequent sale:	
	- If there the licence has the appearance of a change of economic ownership of part or a whole of the software original	GFCF
	- If the licence has the appearance of an operating lease	IC
6201	Computer programming activities This category is similar to CPA 62.01	GFCF
6202	Computer consultancy and computer facilities management activities This category is similar to CPA 62.02, meaning that it includes CPA 62.02.10 'Hardware consultancy services', plus CPA 62.02.20 'Systems and software consultancy services', and CPA 62.02.30 'IT technical support services'. The definition of this category says that services can include the provision of hardware. If hardware is included, then it should be classified as GFCF in hardware. Some services include the provision of software or enabling software and in general should be included in either purchased software or included in the costs of developing own account software	
	◆ Software expected to be used in production for more than one year:	
	- For inclusion/embedding in an own-account 'original' – the value of own-account production should not include these costs if they are directly capitalized	GFCF
	- If the software is purchased by a final-user for inclusion in an own-account "original" the expenditure may also be treated as intermediate consumption as long as its value is included in own-account production	IC
	◆ Software expected to be used in production for less than one year. (This includes "customized" software purchased to be sold-on to another user/client.)	IC

[29] Unless purchased by games arcades, game rental companies, etc

6209	Other information technology and computer service activities This category is similar to CPA 62.09	IC
6311	Data processing, hosting and related activities	
	◆ Application service provisioning	
	- With a contract for no more than one year	IC
	- With a contract for more than one year	GFCF

Table 2b – Own-account production		
ISIC Rev. 4 Code	"Product" Description	Intermediate or Investment
6201	Computer programming activities	
6202	Computer consultancy and computer facilities management activities	

Appendix 1: CPA 2008 Detailed description list		
58.2	**Software publishing services**	
58.21	Publishing services of computer games	
58.21.10	Computer games, packaged	
58.21.20	Computer games downloads *This subcategory includes:* *- electronic files containing computer games that can be downloaded and stored on a local device*	
58.21.30	On-line games *This subcategory includes:* *- provision of games that are intended to be played on the Internet such as provision of: role-playing games (RPGs); strategy games; action games; card games; children's games* *Payment may be by methods such as subscription or pay-per-play.* *This subcategory excludes:* *- on-line gambling services, see 92.00.14*	
58.21.40	Licensing services for the right to use computer games *This subcategory includes:* *- licensing services for the right to reproduce, distribute or incorporate computer programs, program descriptions and supporting materials for computer games* *This subcategory excludes:* *- acquisition of rights and publishing services, see division 58* *- off the shelf (packaged) software, see 58.2* *- limited end-user licenses as part of packaged software, see 58.2*	
58.29.1	Systems software, packaged	
58.29.11	Operating systems, packaged *This subcategory includes:* *- low-level software which handles the interface to peripheral hardware, schedules tasks, allocates storage, and presents a default interface to the user when no application program is running.* *Includes all client and network operating systems.*	
58.29.12	Network software, packaged *This subcategory includes:* *- software that is used to control, monitor, manage and communicate with operating systems, networks, network services, databases, storage and networked applications in an integrated and cooperative fashion across a network from a central location* *Includes all network management software, server software, security and encryption software, middleware, etc*	
58.29.13	Database management software, packaged *This subcategory includes:* *- collection/suite of software programs that enables storage, modification and extraction information from a database* *There are many different types of DBMSs ranging from small systems that run on computers to huge systems that run on mainframes.*	
58.29.14	Development tools and programming languages software, packaged *This subcategory includes:* *- software used to assist in the development and/or authoring of computer programs* *- software products that support the professional developer in the design,*	

	development, and implementation of a variety of software systems and solutions	
58.29.2	Application software, packaged	
58.29.21	General business productivity and home use applications, packaged *This subcategory includes:* *- software used for general business purposes to improve productivity, or at home for entertainment, reference or educational purposes* *Includes office suite applications such as word processors, spreadsheets, simple databases; graphics applications; project management software, computer-based training software, reference, home education, etc.*	
58.29.29	Other application software, packaged *This subcategory includes:* *- cross-industry application software, i.e. software that is designed to perform and/or manage a specific business function or process that is not unique to a particular industry.* *Includes professional accounting software, human resource management, customer relationsmanagement software, Geographic Information System software, web page/website design software, etc.* *- vertical market application software, i.e. software that performs a wide range of business functions for a specific industry such as manufacturing, retail, health care, engineering, restaurants, etc.* *- utilities software, i.e. a small computer program that performs a very specific task, such as compression programs, anti-virus, search engines, font, file viewers, and voice recognition software (utilities differ from other applications software in terms of size, cost and complexity)* *- application software n.e.c.*	
58.29.3	Software downloads *This category includes:* *- electronic files containing software that can be downloaded and stored on a local device for a later execution/installation*	
58.29.31	System software downloads	
58.29.32	Application software downloads	
58.29.40	On-Line software *This subcategory includes:* *- software that is intended to be executed on-line* *This subcategory excludes:* *- on-line games, see 58.21.30* *- software downloads, see 58.29.3* *- on-line gambling services, see 92.00.14*	
58.29.50	Licensing services for the right to use computer software *This subcategory includes:* *- licensing services for the right to reproduce, distribute or incorporate computer programs, program descriptions and supporting materials for both systems and applications software. This applies to various levels of licensing rights:* *• rights to reproduce and distribute the software* *• rights to use software components for the creation of and inclusion in other software products* *This subcategory excludes:* *- limited end-user licenses as part of software, see 58.29.1-58.29.4*	
62.01	**Computer programming services**	
62.01.1	IT design and development services	
62.01.11	IT design and development services for applications *This subcategory includes:*	

	- services of designing the structure and/or writing the computer code, including updates and patches, necessary to create and/or implement a software application, such as: *• designing the structure and content of a web page and/or of writing the computer code necessary to create and implement a web page* *• designing the structure and content of a database and/or of writing the computer code necessary to create and implement a database (data warehouse)* *• designing the structure and writing the computer code as necessary to design and develop a custom software application, other than programming for websites, databases, or packaged software integration* *• customisation and integration, adapting (modifying, configuring, etc.) and installing an existing application so that it is functional within the clients' information system environment* *This subcategory excludes:* *- service contracts where the design and development of a web page is bundled with the hosting of the web page, see 63.11.13* *- service contracts where the design and development of the application is bundled with the hosting and management of the application on an on-going basis, see 63.11.19* *- service contracts where the design and development of a database is bundled with the on-going management of the data holdings, see 63.11.19*	
62.01.12	IT design and development services for networks and systems *This subcategory includes:* *- designing, developing and implementing customer's networks such as intranets, extranets and virtual private networks* *- network security design and development services, i.e. designing, developing and implementing software, hardware and procedures to control access to data and programs and to allow for the safe exchange of information over a network* *This subcategory excludes:* *- service contracts where this service is bundled with the day-to-day management of the client's network,see 62.03.12*	
62.01.2	Software originals *This category includes:* *- copyrighted intellectual property produced without contract for outright sale (i.e. with all-attendant property rights)* *- intellectual properties for sale that are implicitly or explicitly protected by copyright (e.g. computer software)* *This category excludes:* *- software produced under contract for others, see 62.01.11* *- wholesale and retail sale services of software, see 46.14.11, 46.51.10, 47.00.31*	
62.01.21	Computer games software originals	
62.01.29	Other software originals	
62.02.20	**Systems and software consultancy services** *This subcategory includes:* *- provision of advice or expert opinion on IT matters related to the IT systems and software, such as:* *• advice on matters such as software requirements and procurement* *• systems security*	
62.02.30	**IT technical support services** *This subcategory includes the provision of technical expertise to solve problems for the client in using software, hardware, or entire computer system, such as:*	

	- *the provision of customer support in using or troubleshooting the software* - *upgrade services* - *the provision of customer support in using or troubleshooting the computer hardware, including testing and cleaning on a routine basis and repair of IT equipment* - *technical assistance in moving a client's computer system to a new location* - *the provision of customer support in using or troubleshooting the computer hardware and software in combination* - *the provision of technical expertise to solve specialised problems for the client in using a computer system, such as services of auditing or assessing computer operations without providing advice or other follow-up action including auditing, assessing and documenting a server, network or process for components, capabilities, performance, or security* *This subcategory excludes:* - *computer disaster recovery services, see 62.09.20*	
62.03	**Computer facilities management services**	
62.03.1	Computer facilities management services *This subcategory includes:* - *services of managing and monitoring communication networks and connected hardware to diagnose networking problems and gather capacity and usage statistics for the administration and fine-tuning of network traffic.* *These services also remotely manage security systems or provide security related services.*	
62.03.11	Network management services *This subcategory includes:* - *provision of day-to-day management and operation of a client's computer system*	
62.03.12	Computer systems management services	
62.09	**Other information technology and computer services**	
62.09.10	Installation services of computers and peripheral equipment *This subcategory excludes:* - *installation services of mainframe computers, see 33.20.39*	
62.09.20	Other information technology and computer services n.e.c. *This subcategory includes:* - *data recovery services, i.e. retrieving a client's data from a damaged or unstable hard drive or other storage medium, or providing standby computer equipment and duplicate software in a separate location to enable a client to relocate regular staff to resume and maintain routine computerised operations in event of a disaster such as a fire or flood* - *software installation services* - *other IT technical support services, n.e.c.* *This subcategory excludes:* - *computer programming services, see 62.01.1* - *IT consultancy services, see 62.02* - *data processing and hosting services, see 63.11.1*	
63.11.1	**Data processing, hosting, application services and other IT infrastructure provisioning services**	
63.11.11	Data processing services *This subcategory includes:* - *complete processing services and specialised reports from data supplied by clients or providing automatised data processing and data entry services, including database running services*	
63.11.12	Web hosting services	

	This subcategory includes: *- provision of the infrastructure to host a customer's website and related files in a location that provides fast, reliable connection to the Internet, which may be:* *• limited to storage on a single server, in either shared or dedicated capacity, without the service provider managing or integrating software applications (Software hosted on the server is the client's responsibility and service level guarantees are standardised and limited in scope)* *• a bundled service package that consists of the hosting and management of the website and related applications* *An important characteristic of this service is the promise of a secure and reliable site and Internet connections that can be quickly scaled to accommodate variations in traffic use. Frequently, consulting, customisation and systems integration are part of the package. Applications are frequently e-commerce related and enable online storefronts, shopping carts and catalogues with advanced and complex features such as order processing, fulfilment, procurement, invoicing, transaction processing, customer relational management and back-end database and data warehouse integration and migration services.*	
63.11.13	Application service provisioning *This subcategory includes:* *- provision of leased software applications from a centralised, hosted, and managed computing environment:* *• with integration to the systems and infrastructure of the client (Frequently, consulting, customization and systems integration services are bundled with the hosting and management of the application)* *• where the leased application is not customized and not integrated with other applications of the client* *(the application is usually accessed over the Word Wide Web. A common example is office suite software applications).*	
63.11.19	Other hosting and IT infrastructure provisioning services *This subcategory includes:* *- collocation services, i.e. the provision of rack space within a secured facility for the placement of servers and enterprise platforms (The service includes the space for the client's hardware and software, connection to the Internet or other communication networks, and routine monitoring of servers. Clients are responsible for the management of the operating system, hardware, and software.)* *- data storage services, i.e. the service of managing or administrating the storage and back-up management of data such as remote back-up services, storage, or hierarchical storage management (migration)* *- data management services, i.e. the on-going management and administration of data as an organisational resource (Services may include performing data modelling, data mobilisation, data mapping/rationalisation, data mining and system architecture.)*	
63.12.10	Web portal content *This subcategory includes:* *- content provided on web search portals, i.e. extensive databases of Internet addresses and content in an easily searchable format* *This subcategory excludes:* *- published on-line directories and mailing lists, see 58.12.20*	

Appendix 2: ISIC Rev. 4 Detailed description list		
ISIC Rev. 4 Code	"Product" Description	
5820	Software publishing *This class includes:* *- publishing of ready-made (non-customized) software:* *• operating systems* *• business and other applications* *• computer games for all platforms* *This class excludes:* *- reproduction of software, see 1820* *- retail sale of non-customized software, see 4741* *- production of software not associated with publishing, see 6201* *- on-line provision of software (application hosting and application service provisioning), see 6311*	
62	Computer programming, consultancy and related activities *This division includes the following activities of providing expertise in the field of information technologies: writing, modifying, testing and supporting software; planning and* *designing computer systems that integrate computer hardware, software and communication* *technologies; on-site management and operation of clients' computer systems and/or data processing facilities; and other professional and technical computer-related activities.*	
6201	Computer programming activities *This class includes the writing, modifying, testing and supporting of software.* *This class includes:* *- designing the structure and content of, and/or writing the computer code necessary to create and implement:* *• systems software (including updates and patches)* *• software applications (including updates and patches)* *• databases* *• web pages* *- customizing of software, i.e. modifying and configuring an existing application so that it is functional within the clients' information system environment* *This class excludes:* *- publishing packaged software, see 5820* *- planning and designing computer systems that integrate computer hardware, software and communication technologies, even though providing software might be an integral part, see 6202*	
6202	Computer consultancy and computer facilities management activities *This class includes:* *- planning and designing of computer systems that integrate computer hardware, software and communication technologies* *The units classified in this class may provide the hardware and software components of the system as part of their integrated services or these components may be provided by third parties or vendors. The units classified in this class often install the system and train and support the users of the system.*	

	This class also includes: *- provision of on-site management and operation of clients' computer systems and/or data processing facilities, as well as related support services* *This class excludes:* *- separate sale of computer hardware or software, see 4651, 4741* *- separate installation of mainframe and similar computers, see 3320* *- separate installation (setting-up) of personal computers, see 6209* *- separate software installation, see 6209*	
6209	Other information technology and computer service activities *This class includes other information technology and computer related activities not elsewhere classified, such as:* *- computer disaster recovery* *- installation (setting-up) of personal computers* *- software installation* *This class excludes:* *- installation of mainframe and similar computers, see 3320* *- computer programming, see 6201* *- computer consultancy, see 6202* *- computer facilities management, see 6202* *- data processing and hosting, see 6311*	
631	Data processing, hosting and related activities; web portals *This group includes the provision of infrastructure for hosting, data processing services and related activities, as well as the provision of search facilities and other portals for the Internet.*	
6311	Data processing, hosting and related activities *This class includes:* *- provision of infrastructure for hosting, data processing services and related activities* *- specialized hosting activities such as:* *• Web hosting* *• streaming services* *• application hosting* *- application service provisioning* *- general time-share provision of mainframe facilities to clients* *- data processing activities:* *• complete processing of data supplied by clients* *• generation of specialized reports from data supplied by clients* *- provision of data entry services*	
6312	Web portals *This class includes:* *- operation of web sites that use a search engine to generate and maintain extensive databases of Internet addresses and content in an easily searchable format* *- operation of other websites that act as portals to the Internet, such as media sites providing periodically updated content*	

Appendix 3: Concordance Table between CPA 2008 / ISIC Rev. 4 / CPC Ver. 2

(Note: the symbol '*' identify where there is more than one single relationship beween classifications)

ISIC Rev.4	CPA 2008	CPC Ver. 2
5820	58.2	-
-	58.21.10	47822
-	58.21.20	84342 *
-	58.21.30	84391
-	58.21.40	73311 *
-	58.29.11	47811
-	58.29.12	47812
-	58.29.13	47813
-	58.29.14	47814
-	58.29.21	47821
-	58.29.29	47829
-	58.29.31	84341
-	58.29.32	84342 *
-	58.29.40	84392
-	58.29.50	73311 *
6201	62.01	-
-	62.01.11	83141
-	62.01.12	83142
-	62.01.21	83143 *
-	62.01.29	83143 *
6202 part * (includes hardware consultancy service)	62.02.20	83131
6202 part * (includes hardware consultancy service)	62.02.30	83132 *
6203 *	62.03.11	83161
6203 *	62.03.12	83162
6209	62.09	-
-	62.09.10	87332
-	62.09.20	83132 *
6311 part (e.g. includes streaming services)	63.11.11	
6312	63.12	84394

Appendix 4: Concordance Table between ISIC Rev. 3.1 and ISIC Rev. 4

ISIC Rev. 3.1	ISIC Rev. 4
7221 7240	5820
7229*	6201
7210 7211 7212 7229* 7230* 7290*	6202
7290 *	6209
7230*	6311

Appendix 5: Concordance Table between CPA 2002 and CPA 2008

CPA 2002	CPA 2008
72.21.20 *	58.2
72.21.12 *	58.21.10
72.40.11*	58.21.10
72.40.11*	58.21.20
72.40.11*	58.21.30
74.87.17 *	58.21.40
72.21.11*	58.29.11
72.21.11 *	58.29.12
72.21.20 *	58.29.12
72.21.11 *	58.29.13
72.21.20 *	58.29.13
72.21.11 *	58.29.14
72.21.20 *	58.29.14
72.21.12 *	58.29.21
72.21.20 *	58.29.21
72.21.12 *	58.29.29
72.21.20 *	58.29.29
72.21.11 *	58.29.31
72.40.11 *	58.29.31
72.21.12 *	58.29.32
72.40.11 *	58.29.32
72.40.11 *	58.29.40
74.87.17 *	58.29.50
72.22.12 *	62.01.11
72.40.13 *	62.01.11
72.22.13	62.01.12
72.22.12 *	62.01.21
72.22.12 *	62.01.29
72.22.11	62.02.20
72.22.14	62.02.30
72.30.10 *	62.03.11
72.30.10 *	62.03.12
72.60.10	62.09.10
72.22.15	62.09.20
72.40.13 *	63.11.11
72.40.12	63.12.10

5. Entertainment, literary and artistic originals

5.1 Introduction

362. One of the changes made in the 1993 SNA was the recognition of entertainment, literary and artistic originals as fixed assets. In 2003 a task force was set up by the European Union (EU) to develop guidelines for measuring their gross fixed capital formation (GFCF), capital stock and consumption of fixed capital. The report was presented to the GNI Committee in November 2003 and a few amendments to the recommendations followed. The amended recommendations were subsequently accepted in a written procedure of the EU.

363. This part of the handbook mainly consists of an edited version of the amended EU task force report. It only differs substantively in two respects. First, the recommendations concerning licences to use and reproduce and the measurement of GFCF when summing costs were amended in the 2008 SNA, and so the EU task force's recommendations have been amended a little. Second, the report of the EU task force does not address the derivation of volume estimates, and so the recommendations on this issue were developed by the OECD task force responsible for developing the handbook.

5.2 Definition and scope

364. In the 2008 SNA, entertainment, literary and artistic originals are defined as follows:

> 10.115 ***Entertainment, literary and artistic originals consist of the original films, sound recordings, manuscripts, tapes, models, etc., on which drama performances, radio and television programming, musical performances, sporting events, literary and artistic output, etc., are recorded or embodied.*** Such works are frequently developed on own account. Subsequently they may be sold outright or by means of licences. The standard conditions on when the originals and copies are recognized as fixed assets apply. If an original is acquired as a valuable, its production does not count as own account production of a fixed asset but it may have been classified as work-in-progress.

The definition and scope have not changed from the 1993 SNA. However, the measurement of GFCF is affected by other changes in the SNA, such as those concerning the treatment of leases and licences and the measurement of GFCF when summing costs.

5.3 Coverage of entertainment, literary and artistic originals

5.3.1 Introduction to coverage

365. This section considers a wide range of products that could potentially be categorized as originals. The EU task force developed a set of four criteria to assist in determining whether they should be treated as originals or not. The main components are discussed in turn with arguments for and against inclusion. Special cases are considered and proposals suggested. The section ends with a final list of proposed products that could be included under the entertainment, literary or artistic originals component of the national accounts. For some of these items there is a strong case for inclusion, while for others it is not so clear cut and it is recommended that countries should make their own assessment using the four criteria.

5.3.2 Criteria for inclusion

366. After some considerable discussion and consideration the EU task forced concluded that for an item to be considered an entertainment, literary or artistic original it should satisfy the following criteria:

1. The item must be covered by copyright.
2. The work should have primary artistic intent. This means that the original should be produced with the original itself as the end product, not as an interim part of the production process of another product or asset.
3. The item must satisfy the capitalisation criteria, as for any capital item to be included as gross fixed capital formation. That is, the ESA95 requirement[30] that a capital asset must be intended to be used in the process of production repeatedly or continuously for more than one year.
4. The item is not covered elsewhere in the national accounts. If the item satisfies the criteria above and it is not capitalized elsewhere in the accounts then the item should be included as an entertainment, literary or artistic original. Items which would be excluded here include software originals and valuables.

367. The EU task force identified copyright law as being an important element in deciding the coverage and measurement of originals, and Eurostat undertook some research to discover more about this extremely complex area. Annex 1 contains the summary results of this investigation.

368. One could argue that there is an inconsistency here between the treatment of R&D and the treatment of originals because legal protection is not a necessary condition for R&D to be recognized as a fixed asset. The rationale is that units often find it not worthwhile to seek legal protection for R&D because they are able to gain the benefits of exploiting it without doing so and it may better not to draw attention to it. Originals have value only because they are able to be copied and/or distributed, and so legal protection is vital.

369. The EU task force found that copyright law was not fully harmonised across EU countries, but there were a number of international conventions (and some European legislation) that provided general guidelines for copyright protection and the handling of copyright-related monetary flows within and between countries.

370. The following sections discuss each potential original, whether it satisfies the criteria above and also some special cases for which the EU task force provided guidance.

5.3.3 Case discussion and proposals

5.3.3.1 Films

371. This category should include all short and long films that satisfy the inclusion criteria. Films will include those produced initially for cinema showing and those produced for the DVD, video and television markets. All types of film originally produced as silent movies or those with special effects such as 3-dimensions should be included. Foreign translations, reworked originals and director's cut films often released after the first original do not generally have separate copyright (though this may vary country by country) and therefore should in theory be included under the original film.

372. Residency of the film producing company must be established so that the value of the original is recorded in the national accounts of the correct country. This is particularly pertinent for film production, which can often involve a large number of "location" shots that could be filmed in various places across the world.

[30] See paragraph 3.102, European System of Accounts 1995.

373. It is important to understand what constitutes a film, *i.e*. what is the original? During film production many thousands of shots will be taken and the film may constitute many parts. Many processes such as script writing, auditioning, filming, editing, re-filming, graphical editing, sound editing and many more will be necessary before the film is ready to be screened or distributed. Only the edited final version of the film should be recorded as the original with an asset value. All other processes or sections including unedited shots cannot be considered as originals in themselves. These would not satisfy the criterion of primary artistic intent because they were produced with the intention of including them as part of the finished film. They are also unlikely to be issued with separate copyrights.

374. Film scripts (and by extension music created specifically for a film) are a special case. The legal treatment of copyrights for these – as part of the copyright of the film or as individual items with their own copyrights – differs between countries. The script, like the unedited shots could be considered as a component part of the film and not necessarily produced with the intention to be a stand alone item. However, film scripts are marketable in their own right and they can have their own separate copyright from the film. As such it is possible that the script will be de-facto treated as an original and recorded as a literary work (since royalty payments associated with film scripts are unlikely to be distinguishable from other literary works), but it should not be recorded separately under the category of films.

5.3.3.2 Television and radio programmes

375. Copyright law covers television and radio programmes, therefore they both satisfy the first criterion. In general, most television and radio programmes will also satisfy the primary artistic intent criterion.

376. With respect to the remaining criteria, the treatment of television and radio programmes is simplified if they are considered as virtually the same items. Except for the addition of visual media for television programmes the nature of the programmes produced is very similar.

377. Both industries categorize programmes as either "stock" or "flow". Stock includes documentaries, drama, music, arts, history and education programmes. It also includes TV formats, *i.e*. the idea for a type of programme, such as certain specific types of reality television or game shows. Flow programmes include news and game show episodes. The distinction is derived from the nature of the programmes. Stock programmes have a longer life because they are suitable for repeat performances or replicated in different countries. Flow programmes have a shorter life and are unlikely to be repeated. For example, a news programme is likely to be relevant only when it is shown close to the time of the newsworthy event. Shown later, the meaning and title of the programme would be different, probably transferring from news into history or documentary.

378. The distinction between stock and flow programmes provides a natural break between those programmes that satisfy criterion 3, the capitalisation criterion, and those that do not. Only stock programmes should be included as entertainment originals. It was felt that this is more important for TV than for radio. Flow programmes do not satisfy the criterion of use for more than one year so should be excluded.

379. Sports programmes are a special case. Although initially the sport programme would seem only relevant when shown live or very close to the time of the sporting event, there is often a desire for such programmes to be seen again, sometimes many years later. As such, the distinction between stock and flow programmes for sporting events is not so clear. It is suggested that sports programmes be excluded from the category of entertainment originals and hence treated as flow programmes. The reason for this is that it was felt that the rights to broadcasting sporting events, while often very valuable initially, would

usually decline very quickly in value even if highlights from the events themselves were subsequently re-broadcast.

380. Advertisements are a further special case. First of all one has to decide whether to consider individual advertisements or advertising campaigns. The EU task force decided to consider individual advertisements for inclusion or exclusion. It is suggested that the advertisement, although it probably satisfies the criterion of primary artistic intent, would generally be used for less than one year as part of an advertising campaign and hence should be excluded from entertainment originals.

5.3.3.3 Literary Works

381. All published works with separate copyright should be included in this category as long as they satisfy the inclusion criteria.

382. All full books, regardless of subject or style should be included. It is suggested that audio books and multimedia versions (e.g. e-books) of literary works could also be included here. However, there would need to be a separate copyright otherwise the addition of new media would not necessarily distinguish the item as a separate original.

383. Other examples for inclusion in this section are pamphlets and music scores. Although it could be argued that music scores are part of the piece of music, which is a final original, it is equally possible that the score has value as itself in the same way as a film script discussed earlier in this section. However, like film scripts, music scores should not be recorded separately under music.

384. Newspapers and magazines generally have a life of less than one year in the same way as news programmes on television or radio, and therefore should be excluded from capital expenditure estimates on literary originals.

5.3.3.4 Musical Works (including music videos)

385. As with most intellectual property products, the concept of a musical work is not straightforward. First of all we must consider what is to be defined as the original. For any piece of music there is a composer and/or writer, the musicians and performers. There are similarities with film production. In theory, various stages or parts of the music production could be considered an original, for example, the music score or the sound itself and the finished article such as the performance whether recorded or live. As discussed later, it is important that the “chain” of originals is properly measured, so as to avoid possible double counting.

386. The proposed inclusion criteria simplify the problem. All music under copyright should be included in musical originals if they are likely to last more than one year. The primary artistic intent criterion is satisfied in all cases as long as we consider the "music" itself as the important article not the medium through which it is listened or the component parts that are required to produce the music, e.g. the music score, the musician or singer.

387. It is suggested that all music regardless of the intended medium should be included as an original. Therefore, music videos should be included.

388. All advertising jingles should be excluded in parallel with the treatment of advertisements on television or radio.

5.3.3.5 Slogans and brand names

389. Slogans and brand names are legally protected under "Trade Mark" and should not be considered as originals.

5.3.3.6 Technical and Architectural Drawings

390. Most buildings or sizeable structural projects require advanced and detailed technical or architectural drawings and plans. In their own right it could be argued that these drawings have artistic value. However, the criterion of primary artistic intent is not satisfied because the drawings have been produced as part of the productive process of the building or structure under construction. Therefore, technical and architectural drawings should not be considered as originals, even if they can have individual copyrights.

5.3.3.7 Models

391. The available guidance does not clearly specify what should be included as models. There are numerous possibilities from scaled down versions of large objects such as famous buildings to prototypes.

392. The purpose of a prototype is to aid the design process of the finished product. Therefore, prototypes do not satisfy the criteria of primary artistic intent for the same reasons as architectural drawings discussed above. Prototypes should be excluded.

393. Similarly, a model used in the same way as architectural drawings does not satisfy the primary artistic intent criterion and should therefore be excluded.

394. In theory a scaled version of a famous object produced after the "original" object could be considered as an original. However, scaled models of this kind would probably not satisfy the criteria to be considered an original (in fact they would probably only enter consideration as a valuable, if they acquired a rarity value), and should be excluded from the definition.

5.3.3.8 Paintings, sculptures, antiques, fine art and jewellery

395. Originals should be distinguished from valuables, defined as objects of fine art such as paintings, sculptures, antiques and other stores of value such as jewellery.

396. The distinction between some items mentioned in the 2008 SNA and ESA95 for inclusion under artistic originals such as "renderings" (e.g. portraits, images, reproductions and pictures) and the items listed above for valuables is not clear. The term "renderings" causes some problems. Some decisions have to be made so that in practice all of these items can be collected in the accounts. The inclusion criteria help to simplify the problem.

397. Portraits and pictures should be treated the same as paintings and therefore they fail the fourth criterion as they are covered elsewhere in the national accounts, *i.e*. as valuables.

398. All other valuables explicitly included as valuables in ESA95, such as sculptures, antiques and other stores of value such as jewellery should not be considered as artistic originals because they would not satisfy the fourth criterion and to include them could lead to double counting.

399. Images and reproductions are covered in the next section along with photographs.

Table 5.1 Coverage of Entertainment, literary and artistic originals - Final List

Category	Item	Inclusion criterion satisfied? (Y or N)				Include as original? (Y or N)	Comments
		1	2	3	4		
Entertainment: Film	Film (any length or style), but only the edited final version	Y	Y	Y	Y	Y	
	Location shots forming complete sections of a film	N	N	N	N	N	
	Unedited shots	N	N	N	N	N	
	Translated films	Y	Y	Y	N	Y	If separately copyrighted
	Reworked original films	Y	Y	Y	N	Y	If separately copyrighted
	Director's cut movies	Y	Y	Y	N	Y	If separately copyrighted
Entertainment: Television and Radio	Stock programmes (documentaries, drama, arts, etc.)	Y	Y	Y	Y	Y	
	Flow programmes (news, game shows)	Y	Y	N	N	N	
	Sport programmes	Y	Y	N	N	N	Recommend sport be treated as flow programmes
	Advertisements	Y	Y	N	N	N	
Literary Works	Full books regardless of media (e.g. paper, audio, e-books)	Y	Y	Y	Y	Y	Status in copyright important for audio and e-books.
	Pamphlets	Y	Y	Y	Y	Y	
	Music score	Y	N	N	N	N	
	Newspaper articles	Y	Y	N	N	N	
	Magazine articles	Y	Y	N	N	N	
Musical Works	Music under copyright (regardless of medium e.g. CD, music video etc)	Y	Y	Y	Y	Y	
Artistic Originals	Models as used to produce a building or structure	Y	N	N	N	N	
	Models as a scaled version of original produced later (e.g. for collectors or as a toy)	Y	Y	N	N	N	
	Prototype	Y	N	N	N	N	
	Paintings	Y	Y	Y	N	N	Treat as a valuable in GCF
	Sculptures	Y	Y	Y	N	N	Treat as a valuable in GCF
	Antiques	Y	Y	Y	N	N	Treat as a valuable in GCF
	Jewellery	Y	Y	Y	N	N	Treat as a valuable in GCF
	Photographs and images (not paintings)	Y	Y	Y	Y	Y	
	Maps	Y	Y	Y	Y	Y	

5.3.3.9 Photographs and Images (reproductions or copies from books)

400. Photographs could potentially satisfy the main criteria and they can be highly valuable and are very marketable. Photographs can be covered by copyright. There is a degree of repeatability with respect to the use of the image dependent on the subject matter. The image may be used in newspapers, magazines, on posters, in books or on television. There are also vast photograph libraries, now available on the web. Therefore photographs should be included as originals as long as they are covered by copyright, they are created with primary artistic intent and they satisfy the remaining inclusion criteria.

5.3.3.10 Maps

401. Maps have a clear purpose to provide directional guidance and show where things are located. Maps are covered by copyright and they can also be created with primary artistic intent. In many respects there is little difference between a map and any other literary work included earlier in this section. Indeed the royalty flows associated with maps are highly unlikely to be separately distinguishable from those of other publications. Therefore, for practical reasons, maps should be included as literary originals.

Recommendation 5.1: Originals should be defined to include as a minimum - films, TV and radio stock programmes, literary works and musical works. Other originals should be included if they meet all of the following four criteria:

1. *The item must be covered by copyright.*
2. *The work should have primary artistic intent.*
3. *The item must satisfy the capitalisation criterion the same as for any capital item to be included as gross fixed capital formation.*
4. *The item is not covered elsewhere in the national accounts.*

Recommendation 5.2: TV and radio stock programmes should include fiction, drama, documentaries, drama, music, arts, history and education programmes.

5.4 Conceptual issues

5.4.1 Nature of originals

402. Originals have three features which warrant particular attention.

5.4.1.1 Embedded originals

403. It is very common for one original to be used in the production of another. For example, a piece of music may be used in a film, or a script may be written for a TV drama series. The music or the script may have a value in its own right. If an original is completely embedded in another original and does not produce income otherwise, then it should not be recorded as a separate asset. However, if an original contributes to the production of another original and in addition earns income from the provision of other services, then it should be recorded as a separate asset in the same way an industrial piece of equipment used to produce other fixed assets is recorded as a fixed asset in its own right.

404. Consider the following example, which arises because of different valuation methods for different originals (which are discussed later).

Example

405. A film company pays royalties to a musician to use her music in a film. The music original is valued using royalty flows, and the film is valued using production costs.

406. Assume we have two types of assets: Asset **F** (Film) valued by the production cost approach and asset **M** (Music) valued by the net present value approach. Asset F has a 2-year service life and asset M has a 3-year service life. We have perfect information – that means that we know all the flow of income the two assets generate during their service life. In this example the rate of interest is 0, so the NPV of future payments is simply the sum of the future payments.

407. Asset M is produced just before period 0, and it generate royalties in each of the following 3 years equal to 100 per year. Using the net present value approach, the value of asset M is worth 300 (100 in each of the three years) at the end of year 0.

408. Please note that the payments of royalties in years 2 and 3 regarding asset M is payment from other users of asset M, for instance radio stations.

409. Asset F is produced during year 1 and its production cost is equal to 1,100, including royalties. Using the production cost approach the value of asset F is equal to 1,100 at the end of year 1.

410. The value of asset M is reduced by 100 at the end of year 1 compared with the end of year 0 because the NPV of future royalty payments is now 200.

Table 5.2 Example of music original used within a film

		End of year 0 (stock)	Year 1 (flows)	End of year 1 (stock)	Year 2 (flow)	End of year 2 (stock)	Year 3 (flow)	End of year 3 (stock)
Asset F	Production cost, excl royalties		1000					
Asset F	Royalties (payment for use of asset M)		100					
Asset F	Income flow generated by asset F				550		550	
Asset F	Value (production cost approach)	0		1100		550		0
Asset M	Royalties		100		100		100	
Asset M	Value (NPV)	300		200		100		0
Asset F+M	Value	300		1300		650		0

411. It can be seen that there is no double counting on the balance sheet. In year 1, when asset M contributes to the production of asset F, the increase in the value of the former is offset by the decrease in the value of the latter due to the consumption of fixed capital. The same would be true of the total value of production if it were measured net of consumption of fixed capital.

412. Double counting can occur if assets are valued by summing costs and the same costs are used to value different assets. Of course, this needs to be avoided. In some cases, the way the data become available is helpful. For example, it is common in the music industry for flows of royalties to be divided up by rights management agencies, rather than be paid to the performer (who will then have to arrange payments of rights to the composer, etc). Rights management systems have evolved to avoid this situation. Thus, the use of royalties flows to measure the original held by the performer and the original held by the composer involves a low risk of double counting.

5.4.1.2 Divisible rights

413. As noted in the Annex, originals often have several different types of rights associated with them. This issue is considered under "Royalties and rights", below. The conclusion there is that originals are in principle divisible, although there are practical dangers of attempting to do so.

5.4.1.3 Originals and copies

414. Many of the artistic creations in originals are subject to copying for distribution to final users. The EU task force felt that the proportion of artistic originals legally copied for further productive use is likely to be relatively small (perhaps limited to prints of films for distribution), once account is taken of the value threshold for capitalisation in ESA95 (€500 in 1995 prices) and therefore it would not be productive to consider the issue further.

The above recommendation is still under review by the OECD TF

5.5 Valuation of entertainment, literary and artistic originals

415. The 2008 SNA allows four different possible valuations for entertainment, literary and artistic originals:

a) The purchase price of the original, if traded.

b) The purchase prices of similar originals.

c) The production costs of the original.

d) The discounted net present value of future receipts.

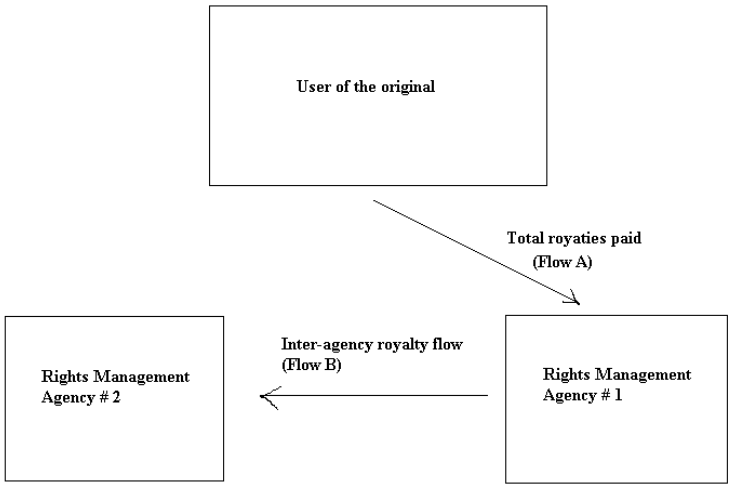
416. Clearly option (a) is the preferred valuation method, but many originals are produced on own account and so one of the other valuation methods must be used. Option (b) is not viable since, by definition, there are very unlikely to be "similar originals" for reliable valuation. This leaves options (c) and (d) as the only viable options for valuing non-traded originals.

417. Under business accounting standards (for example, International Accounting Standard 38), companies are required to capitalize those intangible assets which have a reliable valuation and which the company fully controls – this means that the purchase of an original (which is equivalent to the re-assignment of all of the rights to the original) would lead to an entry in the balance sheet of the purchasing company. From the point of purchase, the company is required to either depreciate or to periodically review the fair value of the asset. The EU task force examined the accounts of several major companies in the fields of literature and music, and concluded that these companies were indeed capitalizing the

purchase of originals. This means that a data source is potentially available from business statistics for traded originals, though in practice it will not be possible to combine business data with the valuation methods set out below (due to the inherent risks of double-counting). Future developments in business accounting (e.g. through changes to accounting for takeovers) could nevertheless improve the available data from business accounts.

418. The EU task force concluded that the production cost approach would be most appropriate for films and TV/Radio productions.

419. The EU task force concluded that the net present value of future receipts approach would be most appropriate for industries where there is an established system of royalty flows (musical, literary and photographic and imaging works). It is important to realise that all receipts to the originals should be considered when valuing the original – for example in Denmark, libraries pay a fee to the authors of books lent out and this fee should be included in the measured receipts. Royalty flows for literary and musical works are usually handled by a small number of rights management agencies, or are dealt with directly by publishers (who ensure that royalty flows go to all those with a claim for a particular original). There are flows of royalty payments between agencies, and this could lead to double-counting of receipts for valuing originals. Enquiries by several members of the EU task force concluded that the agencies are able to separate royalty flows into those to/from other agencies and those to/from abroad. In the diagram below, the flows of royalties between the two agencies (flow B) should not be taken into account when calculating the value of the original.



420. The other issue to address for the net present value approach is how to use flow data to derive an underlying stock figure for originals. The EU task force recommended the following formula[31] that is used by several countries in Europe:

$W_j = H_j * (1+r_j-i_j)$ (1)

Where W_j is the present value of originals produced in year j, H_j is the sum of royalties paid in the total economy during the year j, r_j is the growth rate of royalties compared with the previous year and i_j is the interest rate used for discounting. The estimates of r_j and i_j could be estimated from a single year or by a moving average over up to five years.

Recommendation 5.3: The value of film, TV and radio programme originals should be measured by summing production costs. Production costs should include royalty payments made for the use of other originals.

Recommendation 5.4: The value of literature, music and photographic/image originals should be measured by the modelling of royalty flows (from whatever source), using a formula $W_j = H_j * (1+r_j-i_j)$, with r_j and i_j being estimated separately, or an equivalent formula. Where W_j is the present value of originals produced in year j, H_j is the sum of royalties paid during the year j, r_j is the growth rate of royalties compared with the previous year and i_j is the interest rate used for discounting. The estimates of r_j and i_j could be estimated from a single year or by a moving average over up to five years.

5.6 Royalties and rights for originals

421. There are three kinds of flow associated with entertainment, literary and artistic originals that need to be considered:

i. Payments for the outright sale of some or all of the rights associated with an original.

ii. Payments for limited rights over an original that do not constitute a change of ownership.

iii. Payments for the one-off use of an original.

422. In principle, the outright sale of part of the total rights over an original diminishes the value of the original to the seller, and conversely generates something of value to the purchasing enterprise (which would be recorded in business accounts as an asset). It is of course always possible that the seller, such as an artist, retains a significant proportion of their rights (for example in Austria, where an artist will retain artistic rights over a work, but can sell the rights to exploit the work to others), but these rights will be worth less if certain rights of exploitation have already been sold.

423. However, there is a practical obstacle to recording the "splitting" of originals, and that is the separation of the flows. If flows of payments relating to the purchase and sale of permanent rights cannot be distinguished from royalty flows relating to a one-off use of the original, then it will not be possible to split originals satisfactorily. Basic statistics do not appear to contain separately identified outright sales and purchases of originals.

[31] The derivation of this formula is described in *Background document to doc.CN 383*- Item 4, Meeting of the EU Working Party on National Accounts, 10 October 1998. It was derived empirically by the German NSO, DESTATIS. Briefly, using royalties and interest rate data from the early 1950s, the net present value of copyrights was derived using six different service life and age-price profile combinations. The above formula was found to closely approximate the average of the six results.

424. The second category also relates to the sale of rights over the original. The distinguishing feature between the first and second categories is that in the first the buyer assumes the risks and rewards of ownership, whereas in the second the buyer does not. Licences to reproduce and distribute can occur in both categories and they are likely to be the predominant type of transaction in the second category. In the latter case, restrictions in the licence agreement imply no change of ownership has occurred and the payments should be treated as royalties (or rentals).

5.6.1 Domestic flows

425. It appears that data for domestic transactions concerning originals are not commonly collected in business surveys. The EU task force examined questionnaires from the UK (for films and TV) and Greece (audiovisual industries) which showed that direct data collection (of both royalty flows and costs) is conceivable, provided that the business register is sufficiently detailed to allow the suitable population of firms to be identified. Existing data collections could be examined to see if new questions could be added to satisfy the needs of national accounts in estimating originals.

426. National-level representative organisations could also be a useful source of data, and government records (for subsidies, or special taxation records) might be useful if an industry is subject to special arrangements.

427. Other promising sources of data, already mentioned, are rights management agencies. Surveys of these agencies should ask for the following splits:

a) Royalties for one-off use separate from payments for rights over a longer or indefinite period,

b) Royalties payments paid and received to/from other domestic rights management agencies, and

c) Royalty payments paid and received to/from non-resident rights management agencies.

5.6.2 International flows

428. In terms of *cross-border flows*, the 2002 Manual on Statistics of International Trade in Services[32] (MSITS) introduced specific categories in the Extended Balance of Payments (EBOP) categories for "other royalties and licence fees", for "audio-visual services", and a memorandum item for "audiovisual transactions".

429. "Other royalties and licence fees" includes many different elements and is likely to be dominated by software-related flows. The Balance of Payments manual (5th edition) (BPM5) recommends that outright purchase or sale of assets and rights should be recorded in the capital account under non-produced non-financial assets, but there is usually no provision in country collections for a breakdown of these payments by type.

430. The "audiovisual services" category includes many types of flows including fees to actors, fees for limited distribution rights and fees for motion picture production.

431. The "Audiovisual transactions" memorandum is defined to include:

32 http://unstats.un.org/unsd/tradeserv/TFSITS/manual.htm

"…services that may be included in either audiovisual services or royalties and license fees, and also the acquisition and disposal of non-produced, non-financial assets relating to audiovisual activities such as patents, copyrights, trademarks and franchises."

432. Apart from this last category, the EBOP definitions place the different types of flow identified earlier into different headings. However, each of the headings contains other items which are not separately distinguished and "audiovisual transactions" is too broad to be useful. Thus in practice it is impossible to separately identify the required items. It is therefore recommended that statistical offices try to isolate cross-border royalty flows from rights management agencies for those originals where it is possible[33]. For some countries the accurate measurement of cross-border royalty payments and asset sales can very significant. For example, due to tax law differences, some foreign companies exploit their originals from the Netherlands.

433. Given that existing, centralised data collection mechanisms do not meet the requirements, it will be necessary for statistical offices to collect data directly from enterprises and organisations in the industries.

Recommendation 5.5: Countries should examine existing direct data collections from the originals-producing industries (for example, audiovisual questionnaires) to determine if new questions could be added to assist measurement of originals. Collection of royalty data from rights management agencies should ensure that there are breakdowns for inter-agency transfers and also for cross border royalty flows.

5.7 Prices and volumes

434. The EU task force made no recommendations concerning volume measurement and so what follows are the recommendations of the OECD task force responsible for developing this handbook.

435. The value of an original is determined by a combination of a number of factors, including:

a) the tastes of consumers

b) the size of the consumer market

c) the popularity and reputation of the producer of the original

d) the extent of advertising and promotion

e) the intrinsic quality of the original

436. With the exception of (c), and possibly (b), all of these factors are unquantifiable. This makes it very difficult, if not impossible, to measure change in the market price of originals.

437. As noted above, one way of valuing originals is as the net present value of future receipts, and indeed this method is recommended for valuing originals where there is an established system of royalty flows (musical, literary and photographic and imaging works). It is also recommended that the formula (1) should be used to value these originals. The royalties are in fact rentals payable for services. H_j can therefore be decomposed into constituent price and volume components, such that

$$H_j = \sum_1^n Q_{ij} P_{ij} \qquad (2)$$

where Q_{ij} is the volume of services provided by product i in period j, and P_{ij} is the corresponding price of the services. Substituting (2) in (1) gives

[33] A revision to the MSITS is expected to be released in 2010. The OECD TFIPP has proposed substantial changes to the EBOP that if implemented would go a long way to meeting the needs of the national accounts.

$W_j = [\sum_1^n Q_{ij} P_{ij}] * (1+r_j-i_j)$ (3)

438. A volume measure of the left hand component can be derived if there is a suitable price index for royalties. Of the right hand component, the value of the real growth rate (r_j) of royalties paid can be readily calculated, likewise. A real value of the interest rate (i_j) can be obtained by simply keeping it equal to the value in the base period. Hence, deriving a volume measure of the value of an original, valued using the formula in (1), can be obtained if there is a suitable price index for royalty payments. But deriving a price index for royalty payments faces the same difficulties as deriving a price index for originals.

439. Most royalty payments arise from the sale of copies, and it is possible to measure changes in the prices of copies (on CDs, DVDs or books, for example) or services provided using copies (by cinemas and theatres, for example). Thus, if it can be assumed that there is a strong correlation between the prices of copies and the prices of royalties, then price indices of copies could be used as surrogates for price indices of royalties and so volume measures of originals could be derived.

440. There would be a strong correlation between the prices of copies and the prices of royalties if royalties are determined as a fixed proportion of the sale price of copies. If this is not the case, then a high correlation is most likely if royalties account for a large proportion of the sale price of copies.

441. The only other option is to measure the price change of originals as the price change in the inputs.

Recommendation 5.6: If royalties are predominantly determined as a fixed proportion of the sale price of copies, or royalties account for a large proportion of the sale price of copies, then the price indices of copies can be used to derive volume estimates of originals. Otherwise, suitably weighted input price indices should be used.

5.8 Capital measures

442. As for other forms of intellectual property products, capital measures should be derived using the perpetual inventory method (PIM). The EU task force noted that the legal life of the copyright on an original is generally the lifetime of the author plus 70 years, or 50 years for a performed work. However, they considered that the legal life of the typical original would be very much longer than the economic life of the original, and (based on an examination of existing country practices) concluded that a 5-10 year life could be recommended for all types of originals.

443. The EU task force considered the form of the depreciation function to be applied to originals, and concluded that the function must reflect relatively rapid depreciation in the first few years of an original's life. For some originals, such as recorded music, it is entirely possible that the majority of their value is realised in the first two years of life. The EU task force noted that ESA95 (paragraph 6.04) specifies that linear depreciation is the general approach recommended, but that geometric depreciation is also possible according to the pattern of decline of the asset.

444. The EU task force members did not feel that they could specify a single preferred depreciation function, but two possibilities were mentioned:

- Linear depreciation with a suitably defined Winfrey retirement function.
- Geometric depreciation with at least a double-declining balance.

Nevertheless, the EU task force concluded with the following recommendation:

- Originals should be depreciated with a model which leads to fast depreciation in the early years of the originals' lives. Service lives should be set between 5-10 years.

445. Given this and recommendation 1.14 (the geometric model has a number of advantages and should be used unless there are strong conceptual or practical objections), the case for using the geometric model seems particularly strong for using a geometric depreciation function for entertainment, literary and artistic originals.

ANNEX 5.1 COPYRIGHT

The definition of copyright has evolved over several hundred years in various countries, but it was only in the twentieth century that copyright conventions were negotiated internationally. Successive international meetings in Berne and Rome in the 1950s and 1960s set down some common definitions and standards for copyright, which have generally been incorporated into national legislation. The conventions also established systems through which payments related to copyright could be channelled. Most, but not all, EU countries are signatories to these conventions.

Copyright is intended to provide protection for the rights of an author in works of his or her "authorship". These works must be "original" (that is, they cannot be copied from pre-existing work) and they must be "fixed" (sufficiently permanent to be used, perceived, reproduced or communicated for more than a transitory period). No artistic merit or beauty is required for copyright protection to apply. Thus a business directory could qualify for copyright protection, for example.

The definition of "original" is a source of considerable ongoing discussion. A work can be original even if it contains elements taken from elsewhere (for example a book may contain pre-existing photographs), though of course the copyright for the work covers only the new elements, with the pre-existing elements having their own copyright protection. The legal definition of whether a work is "substantially similar" to another work (and therefore cannot be considered an original) is being continuously redefined by court cases in many countries.

Copyrighted work does not now have to be marked with a copyright sign. Copyright is automatic upon creation of the work, although it will usually be necessary to register the copyright if the author wishes to exploit it economically. Registration can be made several years after the creation of the work, if it has remained unpublished until that point. The copyright of a work generally rests initially with the author, unless the author is working "for hire" (ie. an employee or on contract) for a company, in which case the company has initial ownership of the copyright.

Copyright can be viewed as covering a number of rights. The rights identified in the conventions were:

- Reproduction Right
- Modification Right
- Distribution Right
- Public Performance Right
- Public Display Right

In most countries, these rights can be "assigned" (ie. bought and sold) either together or separately. Each right can potentially be licensed by the owner to another party. In certain circumstances, the author cannot enforce a copyright even if their work has been used – for example where there has been "de-minimus" copying, or where the use has not been for commercial purposes. For two EU countries (Germany and Austria) the copyright must stay with the creator of the work and cannot be sold, however that does not prevent the licensing of the work.

The European Commission has introduced legislation over the last decade to improve the harmonisation of copyright in the EU. The main two legal acts have been:

Council Directive 93/98/EEC of 29 October 1993 "harmonizing the term of protection for copyright". This act sets the period for the rights of an author of a literary or artistic work to the lifetime of the author plus 70 years. The rights to a film or audio-visual work rest with at least the principal director, and possibly other co-authors. Rights of performers shall expire 50 years after the date of the performance.

Directive 2001/29/EC of 22 May 2001 on "the harmonisation of certain aspects of copyright and related rights in the information society". This act clarifies copyright, and related matters, so that it can be applied consistently to new forms of creativity arising from the 'information society'. It defines reproduction and distribution rights, and requires countries to ensure adequate protection against illegal copying.

There are also separate legal acts relating to copyright protection for computer programs, broadcasting of TV programmes by satellite and cable retransmission, and databases.

The Commission has recently introduced a new proposal for a Directive on measures and procedures to ensure the enforcement of intellectual property rights. This proposal would harmonise the systems of protection and redress in Member States. Nevertheless, it is quite clear that the EU does not have a fully comprehensive system for the definition and protection of copyrights in every country. The European Commission is actually prevented by the Treaty from interfering with the system of property rights in any member country, and the existing specific elements of legislation have been pursued under the auspices of improving the internal market.

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