Handbook on Deriving Capital Measures of Intellectual Property Products

OECD

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FOREWORD

The latest System of National Accounts (the 2008 SNA) explicitly recognises, for the first time, that expenditures on research and experimental development (R&D) should be recorded as capital formation. This is a natural extension to the 1993 SNA, which recommends recording many acquisitions of software and databases, mineral exploration, and entertainment, artistic and literary originals as capital formation, too. These products have a common characteristic, namely that their value reflects the underlying intellectual property they embody, which is why they are referred to collectively here as intellectual property products (IPPs). But they also share another important characteristic: their measurement is not straightforward, and, in the absence of clear guidance, it is highly likely that estimates will not be comparable between countries.

One of the most important lessons learned from the implementation of the 1993 SNA occurred when it became evident that countries were capitalising software in significantly different ways, thus impairing cross-country comparisons of economic activity. In response to this, the OECD-Eurostat Task Force on Software was formed to investigate the measurement of software across countries and to provide practical recommendations on how estimates of software stocks and flows should be derived in both current prices and in volume terms.

The recording of R&D expenditures as capital formation will almost certainly present similar challenges to statistical institutes, and there is a high risk that without clear, practical and widely-agreed guidance, international comparability may again suffer.

The Canberra II Group on the Measurement of Non-financial Assets was created to investigate issues pertaining to non-financial assets as part of the update of the 1993 SNA. Following a long and detailed investigation the Group concluded that it was both conceptually desirable to capitalize R&D and feasible to do so in a comparable way across countries. The subsequent decision by the United Nations Statistical Commission in 2007 to recognise expenditures on R&D as GFCF and to agree to other changes in the 2008 SNA affecting IPPs led to the creation of a formal OECD task force to develop practical guidance on the measurement of R&D and other IPPs. This handbook reflects the culmination of the work of that task force.

At the time of writing all EU countries and most OECD countries have begun, or will soon begin, to develop R&D satellite accounts. The intention of most of these countries is to develop and evaluate them over a number of years before deciding whether to introduce the data into their core accounts. This Handbook is designed to facilitate these aims and to minimise the costs of developing R&D satellite

accounts for those countries embarking on this work, whilst all the while maximizing cross-country comparability. Recognising the commonalities across IPPs (including the measurement difficulties), the Handbook goes further than merely providing guidance on R&D, however, and provides guidance on all IPPs identified in the SNA.

The Handbook is the work of the OECD Task Force on R&D and Other Intellectual Property Products. The Task Force's chairman was Brent Moulton (US BEA) and the OECD secretaries were Charles Aspden (through 2008) and Nadim Ahmad (through 2009). Charles was the editor of various drafts and Nadim was the editor of the final version.

The chapter on mineral exploration is largely based on a paper prepared by the Australian Bureau of Statistics, the chapter on software and databases is largely based on the report of the 2001 OECD Software Task Force, and the chapter on entertainment, literary and artistic originals is largely based on the report of an EU task force presented to the EU GNI Committee in 2003.

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EXECUTIVE SUMMARY

Introduction

One of the major innovations 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*[1], 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 recognised, 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.

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 development of the 2008 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 the 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 clear that further work will need to be undertaken in the data development area. In particular, the handbook describes and advocates the development of dedicated surveys for R&D service lives and international trade in R&D. With regard to service lives, pilot surveys conducted by some member countries of the Task Force have proved encouraging.

It is important to state that whilst this Handbook provides information on the conceptual basis, and often intellectual rationale, for the recording of transactions involving IPP products, its primary purpose is to provide practical recommendations on measurement consistent with the concepts and recommendations described in the 2008 System of National Accounts.

Chapter I of the Handbook begins by discussing the treatment of IPPs in a generic sense, concentrating on their shared characteristics, the common general approaches that can be used to measure transactions in IPPs, and the common problems that impact on measurement. Subsequent chapters look at each of the four main categories of IPPs (R&D; mineral exploration and evaluation; software; and entertainment, artistic and literary originals) in more detail, focusing, in particular, on specific measurement aspects of each and their sub-categories.

Overview

The key characteristics that, in many ways, differentiate IPP products from other goods and services are that they:

- are typically one-off (unique) but reproducible,
- are often produced on own-account,
- are not subject to wear and tear like conventional assets, and
- can be readily reproduced with minimal physical production costs.

These characteristics raise a number of issues related to measurement. The most important is the differentiation between gross fixed capital formation (GFCF) and intermediate consumption. In concept, IPPs should be treated like any other good or service, and expenditures on IPPs should be recorded as GFCF if they satisfy the definitions provided in the System of National Accounts (2008 SNA paragraph 3.30).

But, there are some specific issues peculiar to IPPs where an elaboration of the rules that determine whether expenditures should be classified as GFCF is needed. Many IPPs, for example, can be reproduced and these reproductions may also satisfy the requirements to be recorded as assets in their own right. In addition, companies are able to purchase the rights to reproduce IPPs, and these rights may also satisfy the requirements to be recorded as assets.

In considering how these transactions should be recorded it is essential to make a distinction between what is known as the 'original' IPP (which may be used solely for the purposes of 'producing' reproductions or used directly in the production of different goods and services), and the copies and rights to copy. Not all copies should be recorded as assets but all original IPPs expected to be used in production for more than one year should be, irrespective of whether they are used solely to produce copies or directly in the production of other goods or services.

Licenses to use

Licenses to use (reproductions) are separate products, and costs of their acquisition can also be recorded as GFCF if they too satisfy the asset requirements of the 2008 SNA (in particular the licenses must be for more than one year). The value of the original is related to the expected (net present value) sales of these licenses but it is important to note that whatever the eventual actual sales of the licenses, which may differ from the expectations, GFCF for the original does not change. The value of the original on the balance sheet, however, should change in line with any change in prices or volumes (in the other changes in assets accounts).

Licenses to reproduce

Licenses to reproduce are also products whose costs of acquisition can be recorded as GFCF if they satisfy the asset requirements of the 2008 SNA. However, if they do, they should be regarded as the sale of part or whole of the original. If they do not meet the asset requirements of the 2008 SNA then the costs of acquiring them are recorded as intermediate consumption.

Valuing originals

Valuing the 'original' is arguably the biggest challenge for statisticians, as the great majority of originals are either produced wholly or partially on own account and it is relatively uncommon for originals to be traded. Therefore there is generally no market price observable and given the nature of IPPs it is generally not possible to impute the basic price. As such, the Handbook (and the SNA) advocates a sum of costs approach (including an estimate of the return to capital used in producing the original). But this is not the end of the story. Many originals take longer than one year to build and so, strictly speaking, expenditures on producing originals that occur in earlier years should be recorded as works-in-progress (with these expenditures reallocated to GFCF in the year of completion). This is not easy to achieve in practice and, so, instead, the SNA and the Handbook pragmatically recognise that these expenditures should be recorded as GFCF when they occur.

Unsuccessful originals

Not all expenditures and effort in producing IPPs lead directly to the successful creation of an original. This raises the contentious question of how to deal with unsuccessful 'originals'. There are conceptual arguments both for and against the inclusion of unsuccessful originals as GFCF. Recognising the merits of both arguments, the Handbook adopts a pragmatic approach, and recommends that expenditures incurred in the creation of originals that eventually prove unsuccessful should be recorded as GFCF. Moreover the Handbook does not recommend that the value of the assets is recorded at zero at the point they are proven to be unsuccessful.

Freely available IPPs produced by government

One of the requirements for an asset to be recorded in the SNA is 'ownership', that is for owners to have effective management and control of the assets that result in economic benefits for the owner. Certainly IPP assets produced by government and used in the provision of non-market services such as health and education satisfy this requirement, even if the assets are themselves made freely available for use by others, including the market sector. But the issue of ownership in cases of IPP expenditures by government to create assets, given away freely, and not intended for use in the provision of non-market services by government is contentious. Philosophical arguments, both for and against the recording of these expenditures as GFCF exist and both positions have merit. In the end, this Handbook recommends, for pragmatic reasons, that all such expenditures by government, intended to result in an IPP that can be used in production for more than one year, should be recorded as GFCF.

Double Counting

IPPs can be developed for use in the production of other IPPs, for example software might be used or developed in developing R&D or vice-versa. If any of the IPPs produced on own account as inputs also satisfy the asset criteria then they should be recorded as such. The capital services they provide should then be included when summing costs to estimate the GFCF of the IPP they are being used to produce. Therefore the Handbook recommends that when asking units to estimate the costs of producing assets on own account they should be asked to separately estimate the costs of each IPP asset in the current period,

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including the capital services provided from the use of other assets including other IPPs if possible. It is important to ensure, in using the sum of costs approach to valuating of IPP assets produced on own-account, that the same costs are not included in the valuation of more than one asset. Only those parts of intermediate consumption, labour, capital services etc used in creating an IPP asset should be included in the sum of costs.

Depreciation

Net measures of output, operating surplus, capital formation and capital stock are always important but the fact that both originals and copies of IPPs can be recorded as GFCF reinforces this importance. Therefore the Handbook provides comprehensive guidance on the approaches and potential surveys that could be used to ensure adequate measures of depreciation and capital more generally. The Handbook advocates the use of the perpetual inventory method (PIM) and encourages the use of the geometric model for age-price and age-efficiency functions.

Supply and demand approaches to measurement

The Handbook provides detailed guidance on the approaches and sources that can be used to measure GFCF for each IPP category. For most categories, in particular software and R&D, it advocates the use of both supply and demand approaches to measurement. In the case of the demand approach, particularly for R&D, the handbook provides examples of surveys that can be developed and used to collect data. In the case of R&D the Handbook also provides a detailed exposition of data sources used in collecting information as per the recommendations of the Frascati Manual.

Trade in IPPs

An area where considerable future action will be necessary is the measurement of international trade. Fortunately, steps to improve on the current situation are already being taken, notably in the area of product classifications such as the EBOPS classification system, the latest version of which will provide a much more detailed breakdown of IPP types. However, cross border trade between affiliated enterprises remains a priority development area.

Prices and Volumes

IPPs can be decomposed into three broad types: copies for sale, originals for sale, and originals for own-use. The Handbook makes explicit recommendations for volume estimates in each case, recognising the differences between each type, including, specifically, the availability of price data. For copies, the Handbook recognises the rapidly changing nature of IPPs and, so, strongly advocates hedonic methods. For originals for sale, the Handbook refers to the Producer Price Index Manual, which describes the various 'model' based approaches that can be used. Finally, for originals for own-use, the Handbook encourages the use of methods that capture quality and productivity changes, but when these cannot be applied recognises and accepts the necessity of input-based methods.

Key Recommendations

A number of recommendations are made within the Handbook. The key recommendations are repeated for convenience below.

Differentiating between GFCF and intermediate consumption

Recommendation 3: As a general rule, all expenditures on intellectual property products, either purchased or produced on own account, should be recorded as gross fixed capital formation if they are expected to provide economic benefits for the owner. Only in cases where units 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, or other specific information exists such as the existence of a license with a duration of one year or less.

Recommendation 30: It is very important to distinguish between licences to use for more than a year and licences to use for a year or less. Expenditures on the former, purchased by production units and not embodied and sold on within other products, are recorded as GFCF, while expenditures on all other licenses to use are recorded as consumption. Whatever approach is used it is vital that the accurate discrimination between the two should be central to measurement.

Estimating own-account production

Recommendation 10: When asking units to estimate the costs of producing assets on own account they should be asked to itemize their costs, separately identifying expenditures on other fixed assets. The latter should not be included in sum of costs. But estimates of the user cost of capital should be (but only the depreciation component for non-market producers). This can be done either by applying the perpetual inventory method to past estimates of capital expenditures or by making an imputation based on data for units specialising in the production of the particular intellectual property product.

Unsuccessful Developments

Recommendation 8: When summing costs to estimate gross fixed capital formation of intellectual property products, all costs should be included, irrespective of whether the activity is eventually successful or not. Values of assets that subsequently prove unsuccessful should not be written off in the other changes in volume account. Instead they should be depreciated in the same way as similar classes of assets that prove successful.

Research and Development

Recommendation 16: Ownership of an asset exists when the owner has effective management and control of the R&D output in order to ensure the expected benefits are obtained by the owner. There are more ways of ensuring this than patenting the R&D, for example by publishing R&D in a scientific journal. By doing this, others are prevented from claiming ownership.

Recommendation 17: As a practical solution, when the rights to benefit from the results of R&D are not clearly assigned by intellectual property protection, the owner should be deemed to be the purchaser or, in the case of own account R&D, the owner is deemed to be the producer.

Recommendation 19: As a general rule, all R&D purchased or produced on own account should be treated as gross fixed capital formation by the producer, except when the original is produced for sale (in which case it should be recorded as GFCF of the acquiring unit).

Recommendation 20: *Unless specific information to the contrary exists, all* expenditures on purchases of R&D or on R&D production by market producers in the Scientific Research and Development industry (Division 72 ISIC Rev. 4) should be recorded as intermediate consumption, or otherwise expensed, on the presumption that such units produce R&D for sale, and any purchases are

incorporated in products for sale. Only when specific information is available to the contrary should acquisitions of R&D be recorded as gross fixed capital formation, such as *R&D performed by start-ups that do not yet have sales or* cases when a unit takes out a patent and sells licences to use.

Mineral Exploration and Evaluation

Recommendation 26: 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.

Recommendation 27: Care needs to be taken to avoid double counting the stock of mineral exploration and evaluation in the stock of sub-soil assets.

Software

Recommendation 28: 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.

Entertainment, literary and artistic originals

Recommendation 39: Entertainment, literary and artistic originals should be defined to include at 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.

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

CHAPTER I: MEASURING INTELLECTUAL PROPERTY ASSETS

Introduction

The 2008 SNA describes five categories of intellectual property assets:

- research and development;
- mineral exploration and evaluation;
- computer software and databases;
- entertainment, literary and artistic originals; and
- other IPPs.

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. Intellectual property assets and gross fixed capital formation

1.1 Defining GFCF

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.*

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 issue licences (or leases) that, in effect, transfer economic ownership.

- 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.

Fixed assets are produced assets that are used by their final users in production. It follows from the definition of an asset that fixed assets are to be used in production for more than a year. There are two exclusions, however; one based on concept and the other practice. The first is the exclusion of products, acquired by a household to provide services to the household, because the production of household services (with the exception of dwelling services) is outside the production boundary. Thus, IPPs, such as computer software, acquired by a household for the provision of services for itself is not regarded as

GFCF. The second exclusion 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.*

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 are good practical reasons for doing so. Given the ways estimates of GFCF of intellectual products are derived in practice, however, there appears to be little occasion to make this exclusion.

Recommendation 1: Small expenditures should only be excluded from estimates of intellectual property products gross fixed capital formation if there are good practical reasons.

One of the difficulties to be overcome in measuring GFCF of IPPs is distinguishing between expenditures of a capital nature and intermediate consumption (IC). There are four particular cases that cause most of the difficulties: maintenance and repairs; licences to use; licences to reproduce; and IPP assets used in producing other IPP assets.

1.2 Maintenance and repairs

The SNA defines ordinary, regular, maintenance and repairs as IC, 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. IPPs are not subject to wear and tear, or any other form of physical deterioration[2], but for various reasons 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. However, in practice, identifying these types of augmentations is not always clear cut. Paragraphs 10.45-10.47 of the 2008 SNA address this matter, and conclude with the recommendation that substantial, planned improvements should be recorded as GFCF, while minor, unplanned improvements are better recorded as IC.

Recommendation 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 gross fixed capital formation, while minor, unplanned improvements are better recorded as intermediate consumption.

1.3 Licences to use and reproduce

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

> *10.99 Some IPPs 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.*
>
> *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 by type of IPP and the application of the above recommendations is not straightforward. Therefore, it is best to consider them asset by asset.

1.4 IPP assets embodied or used in producing other IPP assets

The general principles that determine whether *purchased products* should be recorded as GFCF or IC are as follows:

(i) IC if it is expected to be used up in a year or less;

(ii) IC if it is to be completely embodied in part of a specific IPP; and

(iii) as the acquisition of a fixed asset if it is expected to be used repeatedly, or continuously, in production for over a year.

In case ii), the acquired product becomes a part of the new original being produced on own-account, even if the product could in isolation be treated as GFCF. For example, if a piece of software is acquired for the sole purpose of being incorporated in an own-account software original then, in principle, its

acquisition should be recorded as IC. Its cost should simply be included in the measurement of GFCF of the own-account software original. However, if the acquired software is used repeatedly, or continuously, in the production of the software original for more than a year then it should be recognised as a fixed asset in its own right and the value of the capital services it provides in each period should be used in measuring the GFCF of the original in each period; following the guidelines described later in this Handbook.

The same arguments apply to products *produced on own account* that are subsequently used to produce other products. For example, suppose in the staged production of own-account software there is an additional R&D stage. If the R&D output is used up in a year or less in the production of a 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 the R&D is used up in a year or less to produce more than one software original then, in principle, its costs should be divided and included in the costs of creating each of the software originals. If, however, the R&D output is expected to be used in the development of one or more software originals for more than a year, 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 in each period.

Making such distinctions is difficult to do in practice, irrespective of whether the IPPs used in producing new IPPs are purchased or produced on own-account. Moreover, it is probably uncommon for purchased or own-account IPPs, such as software and R&D, to be completely used up in a year. It follows (see also below) 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 IPP 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 3: As a general rule, all expenditures on intellectual property products, either purchased or produced on own account, should be recorded as gross fixed capital formation if they are expected to provide economic benefits for the owner. Only in cases where units 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, or other specific information exists such as the existence of a license with a duration of one year or less.

Hence, in general, when R&D is undertaken to develop software on own account and the GFCF of software is estimated by summing costs, the costs should include the cost of the capital services provided by the R&D. Likewise, when summing costs to estimate the GFCF of R&D the cost of capital services provided by software developed to undertake the R&D should be included. This can be done either by applying the perpetual inventory method to past estimates of capital expenditures or by making an imputation based on data for units specialising in the production of the particular intellectual property product.

Box 1: Spillovers

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, (see also section 9.1 of this Handbook).

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 was 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 4: Spillovers should not be considered in valuing fixed assets.

2. Estimating GFCF of intellectual property

All IPP assets can be split into two categories: *Purchased assets* and *Assets produced on own-account for own-use.* In practice the methods used to estimate the two classes are necessarily different and the distinguishing characteristics of each are described below.

Irrespective of whether the assets are purchased or produced on own-account however it is imperative that estimates of the GFCF of IPPs are produced at, at least, the first four broad category headings of IPPs in the 2008 SNA. Indeed, 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 indices 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 indices). 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.

As already noted, the 2008 SNA has separate sub-categories for software and databases, but it is recommended that software be decomposed into *packaged software*, *customised software* and *own-account software*, at least for estimation purposes, because different deflators and service lives apply. In addition, the components of entertainment, literary or artistic originals are quite heterogeneous, and it is clearly preferable that these too are estimated separately.

Recommendation 5: 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, taking account of the rate of price change and variation in service lives.

2.1 Purchased assets

Estimates of GFCF on purchased assets can be obtained either by surveying enterprises and government to ask for details of their expenditures, termed the demand-side approach, or they can be obtained by estimating the supply of capital products (as output plus imports) and allocating it to different uses. This is most often achieved by taking GFCF as the residual of supply and estimated expenditures on exports, intermediate and final consumption, and changes in inventories and is termed the supply-side or commodity flow approach.

The principal advantage of the demand-side approach is that it is a direct measure that provides estimates by sector or industry of activity. Its principal disadvantage however is that it often leads to underestimates because respondents do not typically identify all their expenditures on IPPs in a way that is consistent with the SNA definition of an IPP asset. The principal advantage of the supply-side approach is that the major components of supply and use for **capital products** (output, imports and exports) are comparatively well measured **at a detailed product level**, although there is considerable room for improvement[4]in respect of IPPs. The principal disadvantages are that the estimates of supply are valued at basic prices, not purchasers' prices, and the supply-side approach 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 the estimates differ and re-assuring if they are similar.

Recommendation 6: Whenever possible, estimates of purchased fixed assets should be derived using both the demand and supply-side approaches, and then confronted and reconciled with each other.

2.2 Assets produced on own account

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 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.

IPPs are generally unique, and so they fail the condition of being sold in sufficient quantities to enable reliable market prices to be determined. In such cases the usual approach is to estimate own account GFCF by summing costs. However, some IPPs, such as most entertainment, literary and artistic originals and packaged software, derive their value from sales of copies or licences to use them, which 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 are 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 costs of production are not, and so this method may offer the only viable way of making reasonable estimates.

Two different approaches are used to derive estimates of own account GFCF by summing costs. The first, commonly referred to as the 'micro-approach', entails surveying enterprises (or establishments) and government units to obtain their estimates of the costs of producing their fixed assets. The second is to adopt an approach based on labour-input, which requires estimates of the number of people in the occupations that produce these products and the proportion of time they spend doing so to obtain the

quantum of labour input. This is then multiplied by wage rates and other costs (non-wage labour and overheads that can be attributed to the costs of producing the asset) per unit of labour input. This gives an estimate of the total output of IPP originals from which an estimate of those produced for sale must be deducted to give estimates of IPP assets produced on own-account for own-use. This "macro" approach is commonly used to estimate own-account software GFCF.

Again, as was the case for purchased IPPs, it is best if two independent estimates of own-account GFCF are derived and compared. In this case, it is a matter of confronting estimates from surveys, *i.e.* the "micro" approach with estimates derived using the "macro" approach. For convenience of presentation, elsewhere in the Handbook, the micro approach is categorised as a demand-side approach and the macro approach is categorised as a supply-side approach.

Recommendation 7: Whenever possible, estimates of own-account gross fixed capital formation should be derived using both micro and macro approaches, and then confronted and reconciled with each other.

An additional point concerning the time of recording assets produced on own-account for own-use is also important. 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. However, assets produced for own use should be recorded as GFCF as they are produced, (see paragraph 10.54 of the 2008 SNA).

Unsuccessful developments

The fact that expenditures on assets produced for own use are recorded as GFCF at the time they are occur has important implications for the treatment of unsuccessful developments. Two options merit consideration. The first is to record the value of the asset as GFCF in the usual way during development, 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. This, general, approach is, however, less appropriate when dealing with IPPs especially when one takes into consideration the methods used to value successful IPPs in practice – namely by summing costs.

For a start the concept of an unsuccessful IPP is itself contentious. The realisation that a particular drug may not work, for example, is often a central part of the experimentation process that results in the development of a successful drug, and so these costs could legitimately be viewed as forming part of the costs of the successful drug. Indeed, even if it were possible to determine that expenditures resulting in an unsuccessful IPP were not part of a continuous process that would eventually lead to a successful IPP, if only the costs of successful activities were used to value the assets produced there would be a potentially significant understatement of GFCF and the value of assets on the balance sheet. This is because the development of IPP products, such as mineral exploration and R&D, are inherently high risk, and those that undertake them expect that the benefits obtained from the few successes will more than compensate for the cost of the many failures. 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 failures occurring, and the same argument applies. In these circumstances, it appears unlikely that total own-account GFCF of IPPs would be overestimated by summing costs of both successful and unsuccessful development projects.

Recommendation 8: When summing costs to estimate gross fixed capital formation of intellectual property products, all costs should be included, irrespective of whether the activity is eventually successful or not. Values of assets that subsequently prove unsuccessful should not be written off in the other changes

in volume account. Instead they should be depreciated in the same way as similar classes of assets that prove successful.

Freely available IPPs

A feature of IPPs is that they can be physically reproduced at minimal or zero cost. This characteristic means that their dissemination is often widespread. Market producers often sell copies or rights to use IPP originals that have been developed in-house, even if they were originally only developed for in-house use. But occasionally copies, or the right to use the original without restriction, are distributed for free. Typically this coincides with the expiry of patent rights or the expected service life of the asset, in which case the value of the original becomes zero. But this is not always the case. Occasionally market producers make their originals available for free before the end of their physical and economic service life. But the fact that the IPPs are made freely available does not of itself exclude the IPPs from being recorded as assets. As long as the original producer still expects to obtain economic benefits from the IPP an asset remains.

A complication arises however when market producers produce IPPs that are intended, **at the outset**, only for free dissemination and never for own-use. In these circumstances the economic benefits to the owner/producer are less obvious but that is not to say impossible. A market producer may choose to make IPPs freely available for a number of reasons that still provide economic benefits, for example to increase the goodwill of the company, or to develop a presence in a new market.

This suggests that information on own-account production of IPPs not intended for own-use by market providers is also required, as in some cases the expenditures could conceivably not satisfy asset requirements. However, to do so would be unnecessarily complicated. Especially when one considers the very likely insignificant size of such transactions – market producers are not generally altruistic. As such the Handbook recommends that no such distinction is needed in the case of market-producers.

Although such a pragmatic approach holds for market providers on the grounds that the size of such transactions is likely to be minimal, the same arguments, relating to size and, indeed, a lack of altruism, cannot be applied in the case of government. Two points of view exist in considering the treatment of IPPs produced by government but not intended for own-use by government. The first is to simply treat such expenditures as intermediate consumption on the grounds that government itself gains no direct economic benefits from the development of the asset.

The second point of view takes a more holistic perspective on the role of government. An, albeit imperfect, analogy can be used to illustrate the underlying philosophy of the argument. Roads, which in many countries are made freely available for use are still recorded as assets of government. The analogy is only imperfect because the roads retain a potential value to government which can be realised by eventual charging for use or through their sale but, typically, when governments make IPPs freely available they forfeit all subsequent ownership rights. However the point is that government is in the business of producing assets that it itself may not use in its own production but make freely available because it invests for the overall public good.

The crux of the argument revolves around the role of government and so the delineation between government and non-government sectors. Consider, for example, the case where government invests in medical research for use in hospitals classified within the government sector. Such expenditures should be recorded as investment, even if the same knowledge (the research IPP) is made freely available to hospitals in the non-government sector (be they public or private), because government will directly obtain benefits in its production of hospital services. But if all of the hospitals were outside of the government sector, and so the asset was not used directly by government but indirectly via purchasing services from the hospital

sector, the counter-argument to the recording of the medical research as an asset results in an asymmetric treatment of the related expenditure, depending on whether the hospitals are inside or outside of the government sector. This is somewhat incongruous. Indeed, it is important to note that the argument extends beyond hospitals, or indeed other activities traditionally viewed as being within the scope of government, as the government sector can, in theory and in practice, even if rare, subsume many other activities such as agriculture and industrial production. The argument holds even if one considers drawing the line between 'assets' provided freely to market producers from whom government purchase services and those that it does not: (the grounds being that for the former group government receives economic benefits through reducing its costs whereas for the latter group this is not so obvious). This is because one could argue that by providing assets that reduce the costs of production to market producers government reduces costs to the general public (so providing a public service), or even to itself if the alternative to the asset was an on-going subsidy or grant say.

Notwithstanding the conceptual arguments, nor the arguments related to the role and delineation of the government sector, other practical considerations argue in favour of the treatment of all expenditures by government on IPPs as GFCF. In practice very few countries collect information that would allow expenditures on IPPs by government to be broken down into the categories of 'to be used by government' and 'not intended for use by government'. The OECD Task Force on R&D investigated the use of expenditures recorded according to Socio-Economic Objective (SEO) data, as recommended by the FM as proxy indicators, but only half of OECD countries currently collect this information in their R&D surveys. The Task Force also considered the use of SEO data from government budget appropriations, which are also described in the FM. While these data are available for nearly all countries, the Task Force found that there were substantial difficulties in using them for this purpose. As a result, the Task Force came to the conclusion that while it may be possible to use SEO data, from one source or another, to determine which government R&D expenditures should be recorded as GFCF and which should not, accurate measurement is problematic and there is a real risk of significantly reducing international and temporal comparability. Therefore, the recommendation of this Handbook is that all expenditures by government on IPPs, including R&D, should be recorded as GFCF, if they satisfy the requirement that the IPP is intended for use in production for more than one year.

Recommendation 9: All expenditures by government on IPPs, including R&D, should be recorded as GFCF, if they satisfy the requirement that the IPP is intended for use in production, whether directly by government or by another user, for more than one year.

3. Demand and Supply side approaches

The following sections provide a more detailed description of demand and supply side approaches in practice.

3.1 Demand Side

As noted above, the demand side approach is based on using surveys in which enterprises and government are asked to provide details of their expenditures on, or own-account production of, IPPs. While it is not sensible to prescribe a generic survey form because of the quite different nature of IPPs, 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.

The scope of a survey should be all the units – private and public enterprises, government and NPISHs – undertaking GFCF in any particular category of IPP. The scope for software should be the whole economy, given the fact that many production units produce some form of own-account software.

However, for other types of IPPs, keeping in mind the constant desire to minimise reporting burdens, a more selective approach is encouraged. 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. This general principle should guide the development of surveys related to other IPPs.

In addition, the survey should distinguish between purchases of IPPs for own final use and the unit's estimates of the costs of producing IPPs for its own final use. It is important 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.

Purchases of intellectual property products

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

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

b. Payments for services that constitute fixed assets, such as the development of customised 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, 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.

Own-account production of intellectual property products

An important point to note in the estimation of own-account production of IPPs is that an original asset is created whether it is designed to produce internal services or made available to other users via licenses to use (including copies) or licenses to reproduce, so long as it satisfies the standard asset criteria.

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.

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

Where the following items should be recorded under each category:

i) *Intermediate consumption* - includes overheads associated with employing the staff engaged on asset development (in proportion to the time spent by employees on asset development), such as management costs, training, personnel management, office requisites, electricity, rent, etc., and the use of fixed assets owned by the enterprise and any other intermediate consumption associated with producing the asset.

ii) *Compensation of employees* – which should reflect the number of in-house staff involved in the development of the IPP multiplied by the average percentage of time they spend on own-account intellectual property asset development, excluding maintenance and commercial tasks, but including time spent on R&D, multiplied by their average compensation.

iii) *Consumption of fixed capital* – which should include the depreciation of all fixed assets when used in producing the own-account IPP.

iv) *A net return to fixed capital:* reflecting all fixed assets used in producing the own-account IPP, in proportion to the amount of time spent on asset development, see Box 2 below.

v) *Other taxes (less subsidies) on production*: reflecting all taxes/subsidies associated with the cost of producing the asset, such as payroll taxes.

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.

Box 2: User Costs of Capital

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.*

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 IPP. 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 IPPs.

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. It is probably unrealistic to expect respondents to provide reasonable estimates of these costs and so it is recommended that this component is imputed by the national statistical office (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 IPP 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 IPP 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.

Collecting detailed cost data for own-account GFCF of widespread IPPs, 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 10: 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 not be included in the sum of costs. But estimates of the user cost of capital should be (but only the depreciation component for non-market producers). This can be done either by applying the perpetual inventory method to past estimates of capital expenditures or by making an imputation based on data for units specialising in the production of the particular intellectual property product.

Using business records

For some types of asset, 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 record less expenditure on experimental development than recommended by the SNA (IAS 38). In any case, businesses have a strong general tendency to minimise their recording of capital expenditures on IPPs, particularly those produced on own account, to such an extent that their estimates are often inappropriate for national accounts purposes. This is due to a number of factors, including a desire to be prudent (to meet the requirements of accounting standards, which stress prudence) as well as a desire to minimise tax payments by depreciating assets as quickly as possible or not recognising them as assets in the first place. Hence, the use of business records to estimate the GFCF of IPPs is not generally recommended.

Recommendation 11: Business records of asset acquisitions should only be used to derive estimates of gross fixed capital formation of intellectual property products with extreme caution.

4. Supply-side approach

4.1 Purchases of intellectual property products

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

Domestic output + imports

minus

Exports, households' expenditure and exclusions to avoid double counting

Production on own account needs to be excluded from domestic supply to avoid the possibility of double counting. Both domestic supply 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.

4.2 Own-account production of intellectual property products

As already discussed, the underlying approach for demand and supply estimates of own account production of assets cannot be distinguished. Like the demand-side micro-approach the supply-side macro-approach entails identifying the number of people in those occupations that produce the target IPPs and the proportion of their time spent undertaking this production to derive the quantum of labour input. This is then multiplied by wage rates and other labour costs, and the cost of all the overheads in undertaking the production of the IPP. Naturally, the types of costs to be included at the macro level are exactly the same as at the micro level. The only difference between the two approaches relates to the source information. The micro-approach is based on detailed survey response information whilst the macro-approach is based on more aggregated information, often from a variety of sources. For example, estimates of the proportion of time that employees spend working on own-account production, can often be based on information gleaned from survey data, or failing that using rules of thumb based on international experience.

The equation for estimating the value of own-account IPP production can be presented as follows:

Value of own-account production =

Total number of employees working on own-account production

x

Average compensation of employees

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 (capital services) (only depreciation for non-market producers)

+

Other taxes (less subsidies) on production

Clearly, especially for software, the occupation category of individuals working on own-account IPP developments can be very varied, with the average proportion of time spent on own-account production also varying significantly by occupation. For harmonisation and measurement purposes therefore, 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 88) should be used.

There are several ways of estimating non-labour intermediate input costs. One is to refer to data from demand-side surveys, but the more likely option when using the macro approach is to refer to the activity data of units specialising in the production of the target asset.

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 of the industry in question or from the activity data of units specialising in the production of the target asset. Because own-account software is more typically produced across a range of industrial sectors (and not just the software producing industry) than own-account R&D, the first option is probably the best in the case of R&D, while the second is probably the best for software.

Care needs to be taken to ensure that only production for own-use is included. Production of the target asset for outright sale, such as custom-made software, should not be included.

5. International trade in intellectual property products

5.1 International Trade, GFCF, and supply-based methods

With the exception of mineral exploration and evaluation, IPPs are subject to substantial international trade. Commonly the trade relates to copies of IPPs, such as packaged software, and musical and film recordings, or the services provided by them, but trade in originals, such as R&D, can be important. Given their importance, and the widespread use of the supply-side approach to estimating GFCF, ensuring the accurate measurement of exports and imports of IPPs is essential.

Transactions in originals and copies of IPPs and IPP services are recorded in the goods and services account of the balance of payments (BOP) and Chapter 10 of the *Sixth Edition of the IMF's Balance of Payments and International Investment Position Manual* (BPM6) describes the categories in which they are recorded. Unfortunately, the level of detail that is, at present, typically collected on international transactions in IPPs is less than ideal for the purposes described in this Handbook.

This situation is further complicated by the fact that IPPs can have a dual categorisation – both as goods or services, depending on the mode with which they are transported, which means that, in practice, the information required to compile total imports of a particular IPP category, in particular software, comes from two different sources.

One of the most important sources for estimating international trade in services are surveys conducted in accordance with the *Manual on Statistics of International Trade in Services* (MSITS). The 2002 edition of this manual, which is consistent with both the 1993 SNA and BPM5, includes the *Extended Balance of Payments Services Classification* (EBOPS). The text below, which looks at the three main types of IPP that are internationally traded, describes why the breakdown into product groups currently defined in this classification systems, is often not sufficient for national accounts purposes However, revisions to both EBOPS and the MSITS have recently been agreed, which should improve the situation in the future, and these changes are also described.

Computer software and databases

The effective use of a supply-side approach to estimating GFCF requires that a breakdown of products purchased by producers allows for a robust delineation between intermediate consumption and GFCF: both from a conceptual and a collection perspective. For the former, as described in more detail later in this manual, such a breakdown has been developed; and is shown in summary detail below with the corresponding entry (in brackets) for the treatment in the accounts of purchases by producers.

- Customized software and non-customized originals (GFCF)
- Non-customized software – outright sales of copies and long-term (more than one year) licences to use (GFCF)
- Non-customized software – short-term (one year or less) licences to use (IC)
- Non-customized software - licences to reproduce (resembling an operating lease) (IC)
- Non-customized software - licences to reproduce (not resembling an operating lease) (GFCF)
- Hardware and software consultancy, implementation and installation services; analysis, design and programming of systems ready to use (GFCF)
- Repairs and maintenance of computers and peripherals; data recovery services, provision of advice on matters related to management of computer resources; systems maintenance and other support services, such as training; data processing; web page hosting services; provision of applications, hosting clients' applications, and computer facilities management (IC).

However, the product breakdown currently provided in the MSITS (2002) is considerably more aggregated. The current (2002) version of the EBOPS classification contains a specific classification for *Computer Services* but with no further breakdown. Moreover, it does not capture trade in *Licences to use non-customised products provided on disks, etc. and which convey perpetual use,* which are instead recorded as trade in goods rather than trade in services. Neither does it capture *licenses to reproduce* software, which although captured under *Royalties and License fees*[5], includes other IPPs which are not separately identified.

However, partly in response to the work of the OECD Task Force on Intellectual Property Products, the new MSITS (2010), and corresponding EBOPS, have been developed to better accommodate the needs of the national accounts in this regard. At its March 2009 meeting, the Interagency Task Force on Statistics of International Trade (TFSITS) approved a number of changes to the EBOPS classification. Those affecting the measurement of software are as follows:

- A separate category, *Licenses to reproduce and/or distribute software*, within *Charges for the use of intellectual property (previously referred to as Royalties and License fees).*

- A breakdown of *Computer Services* into *Computer software* and *Other computer services,* with a further *of-which* item for the former, reflecting *software originals.*

- The inclusion of a supplementary item *Computer Software Transactions* (which includes *licenses to reproduce/distribute software*, *computer software* and importantly, transactions in *computer software goods*).

- The inclusion of a further supplementary item *licenses to use computer software* (which includes all licenses to use computer software, irrespective of whether they are classified as goods or services).

Such a breakdown will provide considerable scope for improvement in the quality of supply-based methods of GFCF.

Entertainment, literary and artistic originals (Audiovisual products)

The national accounts requirements for audiovisual products, vis-à-vis the type of product breakdown required, are essentially the same as they are for computer software. Moreover, like software, MSITS (2002) contains two product categories within which audiovisual products might be found *Audiovisual and related services* and *Royalties and License fees*.

As was the case for software, a product breakdown that facilitates supply-based estimates of GFCF, is also essential. Fortunately, like software, planned and agreed revisions to the EBOPS will also improve the situation here. Those affecting the measurement of audiovisual products are as follows:

- A separate category, *Licenses to reproduce and/or distribute audiovisual and related services*, within *Charges for the use of intellectual property.*

- A breakdown of *Audiovisual services* into *Audiovisual products* and *Other audiovisual services,* with a further *of-which* item for the former, reflecting *Audiovisual originals.*

- The inclusion of a supplementary item *Audiovisual transactions*

- The inclusion of a further supplementary item *Licenses to use audiovisual products.*

This new product classification will significantly improve the quality of GFCF, supply-based, estimates. The supplementary item L*icenses to use audiovisual products* will, for example, include transactions in audiovisual 'goods' (CDs, DVDs etc), and *Other audiovisual services* will separately record those transactions in audiovisual products, such as fees to actors, payments to encrypted television channels etc that should not be recorded as GFCF.

R&D

In the 2002 MSITS, R&D transactions fall into three categories: Other royalties and licence fees, Research and development services and Acquisition or disposal of non produced, nonfinancial assets. The first two of these categories are in the current account and the third is in the capital account. In BPM6 R&D transactions fall into two categories: Charges for the use of intellectual property and R&D services. As far as R&D is concerned, the major change in categorization is that payments for the acquisition of patents have been moved from Acquisition or disposal of non produced, nonfinancial assets in the capital account to R&D services in the current account.

The definition of *R&D services* in BPM6 is wider than that in the 2008 SNA and the FM because it includes testing and other product development activities that may give rise to patents (see BPM6 paragraph 10.148). The planned revision to EBOPS, however, has been designed to separately identify this component of R&D services, as shown below:

10.1.1 Creative work undertaken on a systematic basis to increase the stock of knowledge
10.1.1.1 Provision of customized and non-customized R&D services
10.1.1.2 Sale of proprietary rights arising from R&D (patents, copyrights, etc.)
10.1.1.2.1 Patents
10.1.1.2.2 Copyrights
10.1.1.2.3 Industrial processes and designs (including trade secrets)
10.1.1.2.4 Other

10.1.2 Other R&D services (testing and other product/process development activities)

5.2 Movement of IPPs between affiliated enterprises

One of the areas presenting considerable statistical challenges concerns 'transactions' in IPPs between affiliated enterprises located in different countries. The key difficulty reflects the fact that monetary transactions, implicit or otherwise, that are explicitly identifiable with the IPP are rarely recorded by either party. When an IPP is provided by one affiliated enterprise to another, either in its entirety or via a license to use or reproduce, a number of possibilities for recording the transaction arise:

a. *There is either a sale or licence agreement* between the provider and the recipient: the provider provides access to the IPP in exchange for a fee that is observable and should be recorded in the BOP and SNA goods and services accounts.

b. *There is a capital transfer* from the provider to the recipient, i.e. the IPP is a gift. This should be recorded in the BOP and SNA capital accounts, but it is very likely to go unrecorded.

c. *The IPP is provided by the parent to a foreign subsidiary without a fee* but with the expectation of receiving property income in the future. In effect, the parent is providing the IPP for a fee and then using the fee to increase its foreign direct investment in the subsidiary. This, too, is likely to go unrecorded. Both this and the case below include access related to reproduction rights without explicit observable fees charged.

d. *The IPP is provided to the parent by the foreign subsidiary without a fee* but in response to previous foreign direct investment. In effect, the parent is receiving the IPP in lieu of property income. This, also, is likely to go unrecorded unless steps are taken to monitor what is happening to the output of foreign-owned units created to undertake the production of IPPs.

Transactions between affiliates also impact on the valuation of the original IPP. In effect, there are two possibilities, when transactions occur:

e. The aggregate value of the asset has increased within the multinational: in other words the expected present value of future benefits has increased, as could occur, for example, if the multinational acquired a new affiliate and so obtained economic rights within a country that were not expected at the time of the original valuation. This would be recorded in the other changes in the volume of assets account of the provider. Such recordings have been rare in practice. A consequential difficulty is related to the split, if any, of the asset across the different countries where economic rights exist.

f. The aggregate value of the asset has not changed: the provider expected to share the asset in some way at the time it was acquired. In other words the original valuation reflected the scope for its use across different countries.

Clearly significant problems related to these flows implicit or otherwise exist. Moreover, the current scope for fully articulating such flows in the accounts is restricted by the sources of information available to measure them.

The MSITS identifies four different modes of trading in services within the General Agreement on Trade in Services (GATS) between economies. The two modes most relevant for measuring cross border trade in IPPs 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" where services are provided within an economy by a foreign owned enterprise, and which are usually associated with foreign direct investment (FDI) (2.18, 2.59). Statistics relating to these modes are therefore important for the measurement of cross-border IPP transactions, in particular between affiliates.

Mode 1 transactions are captured by conventional cross-border trade statistics and are reflected in exports and imports of goods and services, where the major problems, in a statistical sense, relate to the ability to differentiate between the different types of IPPs; as described above. Mode 3, on the other hand, as its title suggests is concerned with foreign-owned subsidiaries, where data are provided by Foreign Affiliates Trade in Services (FATS) statistics (MSITS 1.21, 1.24, 2.64, 2.65) and FDI statistics (MSITS 1.20, 2.46, 2.59).

Although both sources provide potential for recording the movements of IPPs between affiliated enterprises, considerable care needs to be taken. For example, just because a parent enterprise funds IPP production of a subsidiary in another country does not mean that the IPP is intended for use back in the parent country – this may be the case but funding or FDI data by themselves do not suffice to reach such a conclusion.

An important first step in addressing problems with properly recording movements of IPPs between affiliated enterprises is to separately identify transactions between them in surveys of trade in services. This provides a starting point for valuing flows which otherwise go unreported.

Statistics on transactions of international services associated with IPPs 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).

Evidently the national accounts should reflect economic reality, and changes in ownership of IPP assets and the associated transactions should be recorded. However, current data sources generally do not identify transactions such as (b), (c), or (d), above, and, so, it is generally not possible to record them in the accounts. Further research is needed to identify ways of obtaining the values of transactions between affiliated units and their nature. Likewise, if the aggregate value of the asset has changed it should, in principle, be recorded in the accounts but this too is stymied by a lack of information and so is also a matter for further research.

6. Prices and volumes

Determining prices and volumes is probably one of the most difficult measurement issues related to the measurement of IPPs. Essentially, there are three cases to consider:

a. The IPP original is sold. This is the case for a minority of all types of IPPs.

b. Copies of the IPP are sold. This is the case for a substantial portion of software and most of entertainment, literary and artistic originals.

c. The IPP is produced on own account. This is commonly the case for R&D, mineral exploration and evaluation, databases, and also, to a substantial degree, software.

Each case raises different issues for measuring volumes and prices. The following briefly considers each case, but the particulars for each type of IPP are addressed as they are presented later in the Handbook.

6.1 Intellectual property product originals for sale

In this case market prices are available, at least in principle, but there is a difficulty in separately identifying the price and volume components because originals are unique by definition. How to derive price indices of unique manufactured products is addressed in paragraphs 6.83 to 6.86 of the *Producer Price Index Manual*[6], and it may be possible to use one or more of the approaches described for types of IPP originals that have well defined means of production, or a limited number of means of production. However, the collection of price data is not costless to either the NSO or respondents.

For types of IPP original that do not have a well defined production process, or where there are many production processes, other solutions can be considered. For example, revenue figures may be available from which price indices may be inferred - given adequate quantity indices. Such revenue data would need to relate to the production by market producers of a type of IPP, and there would need to be a corresponding volume indicator that adequately approximated the growth in volume of IPP output. In the US, revenue data are available for the industry "Scientific Research and Development Services" (North American Industrial Classification System 5417). Under ISIC Rev. 4, it would be market producers in "Scientific Research and Development", industry 72.

Recommendation 12: For Intellectual property product originals that have a well defined means of production, or a limited number of means of production, then the methods described for deriving price indices for unique manufactured products in the Producer Price Index Manual can be considered. Otherwise, other solutions should be considered. One possibility is to infer a price index using the revenue earned by market producers of original Intellectual property products and a satisfactory volume output indicator.

6.2 Copies of Intellectual property products for sale

The principles for compiling price indices for non-unique products whose 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* and the OECD's *Handbook on Hedonic Indices and Quality Adjustments in Price Indices*. Section C of chapter 15 of the 2008 SNA addresses volume measurement, and paragraphs 15.149 to 15.156 address the volume measurement of IPPs.

Two prevailing methods exist for measuring quality-adjusted price changes in practice: matched-model and hedonic pricing. Hedonic pricing is based on regression techniques and is 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. 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, and R&D. Under these circumstances, matched-model methods are prone to not capturing quality changes.

Hedonic methods on the other hand assume that each product is made up of a multitude of definable characteristics whose implicit or shadow prices can be estimated, such that changes in the price of the overall product can be decomposed into a pure price change and a quality change (related to changes in the composition/quality of the components), making them more appropriate for IPP assets than matched-models, (more information on both methods is shown in Annex 1.1). As such, for products where price data are available and there is evidence of rapid quality change, as is the case for packaged software, then hedonic methods are the preferred approach for deriving volume estimates.

Recommendation 13: For products where price data are available and there is evidence of rapid quality change, as is the case for packaged software, then a method, such as the hedonic method, that takes account of quality change should be used to derive price indices.

6.3 Intellectual Property Products produced on own account

Many IPPs are produced on own account, and, so, no price data are observable. For non-market output, the 2008 SNA provides advice in paragraph 15.117. Some of this advice is often also applicable to the output of market producers not sold on the market.

> *15.117 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.*

The second of the two methods referred to in paragraph 15.118 applies to the production of individual and collective services by non-market producers, and does not generally apply to the production of IPPs. The third method, (paragraph 15.119) the "input method", is applicable to IPPs when no satisfactory output or pseudo output price index is available.

The possibilities for deriving pseudo output price indices depend on whether suitable data are available for similar products or comparable production processes. When no measures of output are available, there is little option but to apply input price indices. If productivity is rising in a perfectly

competitive market then it is expected that the output prices of a unit, or an industry, will show lower growth than the input prices. Hence, the use of input prices, rather than output prices, will tend to reduce the growth rate of the volume measure of output. But if markets are imperfectly competitive, such as in the case of R&D, the relationship between input and output prices is less clear.

Recommendation 14: For products where price data are unavailable, pseudo output price indices should be derived if practicable, otherwise input price indices must be used.

7. Capital measures

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 20. Methods for estimating GFCF are discussed elsewhere in this Handbook and methods for estimating the other three measures are the subject of a new edition of the OECD manual *Measuring Capital*.

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.

IPPs are not subject to wear and tear like most other fixed assets, such as motor vehicles and buildings, but their values do decline over time. First, they are subject to obsolescence. For example, in the case of R&D, more recent R&D may lead to new products or processes that displace those arising from previous R&D. Second, other units may be able to exploit the IPP without payment because the patent or copyright has expired, thereby leading to a reduction in the benefits accruing to the owner. This leads to reduced value and consumption of fixed capital (*i.e.* depreciation).

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[7]. 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[8]. 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.

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 IPPs is not readily observable. There are two reasons: many IPPs are produced on own account and aged IPPs are not commonly traded. In the absence of information of the functional forms of either the age-efficiency or the age-price function it is necessary to hypothesise as to what appears to be plausible.

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, 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 IPPs, for which the age-price function of an individual asset or a cohort of assets is unavailable. The geometric function also has the advantage that it is much easier to apply than any other functional form.

Another factor to consider in choosing a functional form for IPPs is what functional forms are used for other asset types when applying the PIM, as it may be judged impracticable to use geometric for IPPs and some other functional form for other asset types.

In practice, as for service lives, δ is rarely observable for IPPs and it has to be imputed by some means and, as for service lives, there are several ways that this can be approached. Whichever approach is taken, it is likely that respondents will 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. See the OECD's *Measuring Capital* for advice on choosing a value for X.

Recommendation 15: When using the perpetual inventory method, 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.

Two issues merit particular discussion here: the treatment of unsuccessful developments and government produced IPPs made freely available and not used in direct production. Paragraph 12.55 of the 2008 SNA provides examples of types of 'unsuccessful assets' that could be written off in the other changes in volume of assets account, rather than depreciated like equivalent successful assets. As stated above however, IPP assets do not fall into this category of 'unsuccessful assets' and so this Handbook recommends an equivalent treatment for measuring successful and unsuccessful assets as GFCF (Recommendation 8); following the arguments provided in section 2.2. The same arguments imply that for the same class of IPP assets the same average service lives, age-efficiency and age-price functions should be used for both successful and unsuccessful assets.

One could argue that government produced IPPs made freely available and not intended for direct use in production should be re-valued to zero at the time they become freely available, on the grounds that that is their effective market price at the time. However the same arguments evoked in section 2.2, (defining the government sector, defining government services for the public good, and the practical measurement difficulties) suggest otherwise. As such, the Handbook recommends that IPP assets made freely available by and produced by government but not used in direct production should use the same average service lives, age-efficiency and age-price functions as similar IPP assets used by government in direct production.

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2 Although they do decline in value for other reasons – see section 7.

3 Capital stock, consumption of fixed capital and capital services.

4 For example, in international trade statistics. See also section 5 for information on proposed changes to the Manual on Statistics of International Trade in Services and the Extended Balance of Payments Classification, scheduled for release in 2010, which should improve the situation.

5 Charges for the use of intellectual property in BPM6 replaces Royalties and licence fees in BPM5.

6 *Producer Price Index Manual: Theory and Practice* (Washington: International Monetary Fund). See also the OECD's M*ethodological 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.html).

7 In the case of a geometric model the age-efficiency and age-price functions are identical, irrespective of the discount rate.

8 If a geometric model is used this step is unnecessary.

ANNEX A: PRICE AND QUALITY CHANGE

Matched-model method

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.

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:

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

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

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

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

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.

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.

Hedonic pricing

The technique of hedonic pricing assumes, in principle, each product is made up of a multitude of definable characteristics, for each characteristic a price can be estimated and 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).

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.

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*.

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.

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.

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.

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.

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.

A comparison of price index studies in packaged computer software shows that hedonic price indices 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. Intellectual Property Products produced on own account.

CHAPTER II: RESEARCH AND EXPERIMENTAL DEVELOPMENT

Introduction

One of the major innovations in the 2008 SNA, and, so, rationale for the development of this handbook, 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:

> *Research and development should be treated as gross fixed capital formation in the SNA. It should be defined as in the Frascati Manual[9], 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.*
>
> *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.*
>
> *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.*
>
> *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 recognised, 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.

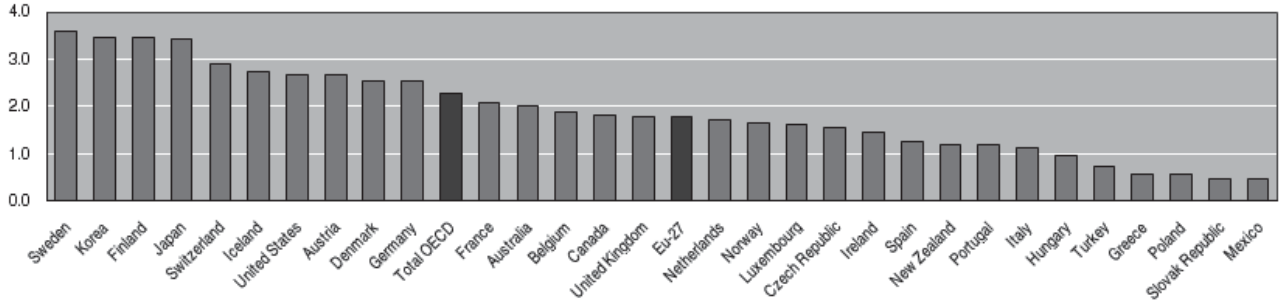
8. Quantitative impact

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[10] (GERD) to GDP. This ratio varies considerably between OECD countries. Figure 1 presents the value of this ratio for OECD Member countries in 2008. The ratio varies from about 0.5% for Mexico 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 R&D will have little impact on GDP growth rates for OECD countries.

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 two main 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.

Figure 1. Gross Domestic Expenditure on R&D as a percentage of GDP, 2008 or latest year



a) Source: OECD, *Main Science and Technology Indicators*, June 2009

9. Definition and scope of R&D GFCF in the 2008 SNA

The definition and scope of R&D GFCF read as follows in the 2008 SNA:

> *10.103 IPPs 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 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. The patent agreement is a form of licence to use which is treated as giving rise to payments for services or the acquisition of an asset.*

The criteria for determining whether expenditures on R&D should be recorded as GFCF are just the same as they are for any other product. Issues concerning maintenance and repair; licenses to use and

reproduce; the embodiment of IPP assets in other assets; and the treatment of unsuccessful developments apply to R&D, as they do other IPPs. The conceptual treatment of these issues is addressed in chapter I. This chapter simply addresses how to deal with them in practice. But there are two issues concerning the scope of GFCF that are of particular relevance to R&D, namely spillovers, which is addressed directly below, and some borderline issues between consumption and capital formation, which are discussed in the following section.

9.1 Spillovers

Spillovers are briefly discussed in chapter I (see Box 1), and a recommendation (4) is made that they should not contribute to the value of an asset. While spillovers can occur in respect of other IPPs, they are most relevant for R&D and a more detailed discussion is warranted here.

A feature of many R&D assets is that they can provide substantial benefits to units other than their owner without compensation – a characteristic they share to varying degrees with other IPPs. 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 economic owner 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 can also 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.

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 so, if, for example, a pharmaceutical company introduces a new type of important drug 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.

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.

10. Features of the FM data

Before describing in detail a set of guidelines that facilitate the measurement of R&D it is useful to first describe the information collected within the Frascati Manual framework as it is clear that these surveys provide a rich and readily available (in many countries) source of information on R&D.

The GERD data referred to above are obtained from R&D surveys conducted in accordance with the recommendations of the OECD's *Frascati Manual* (FM). Such surveys have been conducted by many countries for many years and they provide a wealth of information that can be used to compile R&D satellite accounts, including estimates of R&D GFCF. While the FM data fall short of what is ideal for national accounts purposes it has been shown (*e.g.* Mandler and Peleg (2004), ABS (2004), Robbins (2006), Galinda-Reuda (2007), and Tanriseven et al (2008)) that they can be successfully used to derive R&D satellite accounts and estimates of R&D GFCF.

The FM describes two types of expenditures 'intramural' and 'extramural'. The former relates to the expenditures a resident unit makes in producing R&D within the unit, whereas the latter measures the expenditures made by a unit in acquiring R&D produced by another unit and any grants provided to others for performing R&D. Additionally, the FM measures the sources of the funds used to perform intramural R&D, which provide an important mechanism to reconcile estimates by performers with those by funders.

10.1 Intramural expenditures

The FM recommends that intramural expenditures should be categorised in four independent ways (i.e. as single vectors and not as multi-dimensional arrays):

1. Three different kinds of R&D activity should be identified: basic research, applied research and experimental development.
2. Expenditures should be classified by socio-economic objective (SEO).
3. Expenditures should be classified by type: current costs and capital expenditure.
4. Expenditures should be classified according to the institutional sector of the reporting unit: business enterprise, government, private non-profit, higher education and abroad[11].

In addition, the FM prescribes the identification of supplementary extramural (see below) R&D expenditures[12].

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.

The composition of intramural expenditures is described in paragraphs 361 to 388 of the FM. Current costs and capital expenditures are further subdivided, with current costs having 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 as 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.

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.

Of the three types of activity (*basic research, applied research* and *experimental development*), the FM recommends that basic research be further sub-divided into *pure basic research* and *oriented basic research*. But most OECD countries just make the primary division. Pure basic research is carried out for the

advancement of knowledge, without seeking long-term economic or social benefits or making any effort to apply the results to practical problems or to transfer the results to sectors responsible for their application. Oriented basic research is carried out with the expectation that it will produce a broad base of knowledge likely to form the basis of the solution to recognised or expected, current or future problems or possibilities.

The SEO categories recommended by the FM (see paragraph 286) 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

Less than half of OECD countries currently collect these data[13].

10.2 Sources of funds

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. These transfers may be measured in two ways. One is performer-based reporting of the sums which one unit, organisation or sector has received or will receive from another unit, organisation or sector for the performance of intramural R&D during a specific period, including R&D funded by the unit for itself. The second is source-based reporting of extramural expenditures, which are the sums a unit, organisation or sector reports having paid or committed itself to pay to another unit, organisation or sector for the performance of R&D during a specific period. It is important to note that "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.

These 'transfers' differ in meaning from those used in a national accounts context which do not include expenditures made to procure R&D. However in practice not all countries are currently able to provide the split between purchases and grants shown above. The FM does recommend however that, where possible, both categories of transfer should be identified for government funded R&D in the business enterprise sector and further encourages a similar breakdown for government funds to the higher education sector.

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

10.3 Extramural expenditures

The FM recommends the following breakdown of extramural expenditure:

- 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

11. Guidelines for measuring GFCF on R&D in practice

11.1 Reconciling Performer and Source based reporting

One might expect the estimated total of R&D expenditure within a country based on performers' reports of their sources of funds to equal the total based on the reported extramural expenditures of those providing funding. In practice, this does not normally occur for a number of reasons. One reason is measurement error due to such factors as sampling error and different interpretations of what constitutes R&D. An important, reason is that the scope of R&D surveys is generally confined to R&D performers in the country and excludes R&D non-performers who may purchase R&D. Hence, the estimates of extramural expenditures are likely to be understated. Furthermore, more accurate reports can be expected from those performing R&D than those who are providing the funding. Nevertheless, 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.

As already noted, sources of funds data reported by performers and extramural expenditures comprise grants and purchases of R&D, and only a few countries distinguish between them. For national accounts purposes this needs to be remedied. Until other countries make the split or have information that indicates otherwise, a reasonable 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. In addition, as with intramural expenditures, there is the problem of different sectoring, particularly in respect of higher education.

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.

11.2 Determining which R&D expenditures should be recorded as GFCF

Ownership of an R&D asset can be legally established by a patent or by some other means, such as by publishing the results of R&D in a scientific journal. However, much R&D output is not legally protected because the owners do not think it is in their best interests to do so. Legal protection can be expensive and it requires making the R&D output publicly known. Also, if the time period over which the owner expects to obtain economic benefits is relatively short, there may be little point in seeking legal protection. Therefore, in the absence of legal protection, it seems reasonable that the owner should be deemed to be the purchaser of the R&D output, or in the case of own-account R&D, the owner is deemed to be the producer.

It is not uncommon for the owners of R&D output, 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 NPISHs, 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 owner still expects to obtain economic benefits. 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. Market producers are generally not altruistic, and it seems reasonable to assume that they expect to obtain economic benefits from all, or nearly all, of their R&D. But, for non-market producers, determining whether the owner is able to extract economic benefits can be a non-trivial matter. If government, for example, 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) or by reducing its costs (*e.g.* by supplying for free the output of its medical research to private medical providers that it pays to provide services to the public) then it is acquiring an R&D asset equal to the expected economic benefits. But if it undertakes or funds R&D in areas in which it will not be involved in direct production or in which it does not pay the eventual recipients of the knowledge to provide services to the public, it has been argued that this expenditure should not be treated as investment. As described in section 2.2, this corresponds to a more narrow view of the role of government and the meaning of economic benefits. An alternative view is that such expenditures should be recorded as investment as they serve a public good and the fact that government does or does not pay producers who use the knowledge to provide services to the public is not a relevant criterion.

Fortunately, resolving what is ultimately a philosophical discussion about the role of government is not necessary, as the Handbook takes a more pragmatic view on the two different approaches. In coming to its conclusion, the Task Force on IPPs considered whether the data sources available could support the measurement of non-market GFCF based on the more strict interpretation of economic benefits (and which is described in more detail in Box 3). Because only half of OECD countries currently have such data sources, the upshot of this assessment was to recommend a pragmatic approach; namely that most R&D expenditures by the non-market sector should be recorded as GFCF.

Recommendation 16: Ownership of an asset exists when the owner has effective management and control of the R&D output in order to ensure the expected benefits are obtained. 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**.**

Recommendation 17: As a practical solution, when the rights to benefit from the results of R&D are not clearly assigned by intellectual property protection, the owner should be deemed to be the purchaser or, in the case of own account R&D, the owner is deemed to be the producer.

Recommendation 18: When ownership is deemed to exist, the only relevant question for determining whether R&D should be capitalised is whether it is expected to provide economic benefits for its owner. - When it produces economic benefits for its owner, such as by increasing its productivity or reducing its costs, it should be capitalised.

In practice, the following is recommended for both market and non-market producers:

Recommendation 19: As a general rule, all R&D purchased or produced on own account should be treated as gross fixed capital formation, except when the R&D original is produced for sale (in which case it should be recorded as GFCF of the acquiring unit).

Box 3: Earlier views on R&D produced by non-market producers

The decision to record, in practice, all expenditures on R&D by non-market producers as GFCF was contentious, and ultimately driven by pragmatism. In its earlier deliberations the OECD Task Force (TF) on R&D arrived at an initial preference for not treating all R&D expenditures by the non-market sector as GFCF and developed an approach based on Socio-Economic Objective data that could support measurement. The approach provided relatively robust results but ultimately two factors led to the OECD Task Force reviewing its initial conceptual preference: the first was the continuing contention vis-a-vis the conceptual treatment, and by extension the interpretation of economic benefits for the non-market sector; the second, perhaps most important reason, was that half the OECD countries do not have the data needed to makes such estimates. Despite this decision however it is instructive to describe the approach in this Handbook, if only for posterity.

The TF investigated whether expenditures recorded according to classifications by Socio-Economic Objective (SEO) or by type (basic research, applied research and experimental development) from R&D surveys could be to allocated to GFCF, based on the stricter interpretation of economic benefits. Investigations revealed that 'type' was not a particularly useful source because some basic research, applied research and experimental development meet the stricter criteria and some do not. However, data based on SEO categories did provide meaningful results.

The TF concluded that government/NPISH could obtain economic benefits (based on a strict interpretation) for expenditures undertaken in SEOs 2 to 4, 8 and 12, (their principal activities) and SEOs 1 and 5 (via royalties arising from the exploitation of mineral discoveries). By contrast, government/NPISHs are not commonly engaged in agricultural or industrial production, SEOs 6 and 7, and so the TF concluded that related expenditures were not GFCF. Similar conclusions were drawn for SEOs 9 and 10, with a recommendation that the miscellaneous category, SEO 11, was reallocated as much as possible to the other 11 SEOs as appropriate.

Two sources of SEO data were considered: surveys of R&D performers and government budget appropriations or outlays for R&D by socio-economic objective (GBAORD). The former are regarded by the FM as being of higher quality than the latter, and are consistent with other performer data. When collected, there are separate SEO data for higher education and other general government. By contrast, GBAORD has an additional SEO category "research financed from general university funds" that comprises the bulk of funding by government for R&D undertaken by higher education units, and for many countries there is no further breakdown by SEO. GBAORD as a source of SEO is commonly only available for central government. Investigations have also revealed that SEO data from GBAORD are often not well allocated by SEO. However nearly all OECD countries have GBAORD data (whilst performer data are available for less than half of OECD countries). And the data are usually more timely than the performer data. Finally, the data are on a funder rather than a performer basis.

Moreover further adjustments are needed with the performer data, which relate to intramural expenditures, and so combine purchases and sales of R&D by the government and NPISH sectors. The TF concluded that extramural expenditures, preferably with a breakdown between grants and purchases, could be used to make the first adjustment but extramural expenditures are unavailable by SOE, and it was further assumed that purchases of R&D output are most likely to be for the purchaser's own benefit (GFCF). Sources of funds, preferably with a breakdown between grants and purchases, were identified for the second adjustment. The TF assumed that sales of R&D output made by the government and NPISH sectors are predominantly associated with those SEOs which are of primary interest to market producers, namely SEOs 6 and 7, and so the recommendation was to create two sub-totals for intramural expenditures by SEO: one relating to those SEOs that are candidates for GFCF (1-5, 8, 11 and 12) and those that are candidates for final consumption expenditure (6, 7, 9 and 10), with the value of sales of R&D being subtracted from the second sub-total (or the first sub-total if the value of sales exceeds the second sub-total). The TF further concluded that in the absence of performer data by SEO, GBAORD should be used for the government sector. GBAORD data are usually inconsistent with performer data and so the proportions of GBAORD data by SEO are used to allocate the aggregate of intramural and extramural expenditures by government to obtain expenditures by SEO. The adjustment for sales of R&D output by government was made in the same way as it was for performer data by SEO. As noted earlier, one of the shortcomings of GBAORD data is that most of the government funding for universities is commonly lumped into one category "research finance from general university funds" with no further breakdown by SEO. In these cases a breakdown by SEO can be imputed using the best available data. One possibility identified was to use a breakdown into field of science categories of R&D expenditures by performers. Another possibility was to use information from annual reports. In the absence of performer data by SEO for the NPISH sector it was recommended that a breakdown by SEO should be imputed using the best available data.

11.3 Duplication and omission with respect to other fixed assets

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 that 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 raises the level of GDP and why estimates net of consumption of fixed capital are preferred.

From a national accounts perspective, acquisitions of R&D performed by another unit should be recorded as either GFCF or consumption depending on the circumstances. But as discussed in chapter I, and concluded in recommendation 3: *As a general rule, all expenditures on intellectual property products, either purchased or produced on own account, should be recorded as gross fixed capital formation if they are expected to provide economic benefits for the owner. Only in cases where units 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 or other specific information exists such as the existence of a license with a duration of one year or less.*

Following this recommendation, all expenditures on R&D should be recorded as GFCF if they are expected to provide economic benefits for the owner unless the R&D is purchased or produced with the intention of future sale. This is most likely to occur in respect of market producers classified to the Scientific Research and Development industry (Division 72 ISIC Rev. 4). However this is not always the case. Start-ups in the R&D sector may for example develop R&D, before any sales have occurred, in anticipation of producing future products and sales, and in these cases the R&D should be capitalised. It follows therefore that unless specific information is available to the contrary, acquisitions of R&D should not be recorded as GFCF by units in this industry, such as cases when a unit takes out a patent and sells licences to use.

Recommendation 20: *Unless specific information to the contrary exists, all* expenditures on purchases of R&D or on R&D production by market producers in the Scientific Research and Development industry (Division 72 ISIC Rev. 4) should be recorded as intermediate consumption, or otherwise expensed, on the presumption that such units produce R&D for sale, and any purchases are incorporated in products for sale. Only when specific information is available to the contrary should acquisitions of R&D be recorded as gross fixed capital formation, such as R&D performed by start-ups that do not yet have sales or cases when a unit takes out a patent and sells licences to use.

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 section 1.4.

11.4 Licences to use

Data to estimate the sale of licences to use R&D are not currently available from FM surveys because funding is restricted to payments for the performance of current R&D. 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 from 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 and reconcile the results. 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.

11.5 Licences to reproduce

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.

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 the GFCF of licences to reproduce by contacting major R&D performers.

12. The bridge between FM and SNA sectors

Table 1 below 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 can be overcome by making a subdivision of the FM data for the higher education sector between:

a. Corporations and quasi corporations (including market NPIs);
b. General government units (including NPIs controlled by government); and
c. NPISHs

Table 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[14]
	Non-financial corporations
	Financial corporations
Higher education sector	Corporations and quasi corporations
	General government
	NPISH
Abroad	Rest of world

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.

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

13.1 Deriving estimates of R&D output

As stated in chapter I, the SNA recommends that own-account capital formation should be estimated at the basic price it could be sold on the market, or at its basic price (estimated by summing costs) if the former is not possible.

Fortunately, the FM-based R&D surveys provide much of the data required to compile estimates of own-account capital formation for each of the key components needed in the summing costs approach, as shown below. But R&D output in a Frascati sense, reflects the development of 'new' R&D, and so does not include output related to the production of sales of licenses to use or reproduce; which are included in the SNA definition of output (all licences to use and non-GFCF licenses to reproduce).

Intermediate consumption of goods and services

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.

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 of employees and value added. But where they are included in the sum of costs has no bearing on the measurement of output and GFCF.

The FM recommends that R&D expenditures should be recorded at factor cost[15], and VAT and similar sales taxes should be excluded. But estimates of intermediate consumption are at purchasers' prices and so any taxes *less* subsidies on products omitted from the R&D survey data but that are applicable to the unit's intermediate expenditure need to be added.

Other current costs include payments for licences to use intellectual property other than software licence fees that satisfy GFCF criteria. The 2008 SNA, however, recognizes that some of these payments for licenses to use should be recorded as GFCF and not as intermediate consumption. Ideally, R&D surveys should be amended to separately identify these expenditures and collect information that would enable the determination of whether licenses to use IPPs should be treated as GFCF, bearing in mind recommendation 20 concerning R&D purchased by market producers in the Scientific, Research and Development Industry. 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.

Acquisition of R&D output for use in R&D production

GERD is derived by adding the intramural expenditures of all resident R&D performers. Since intramural expenditures exclude purchases of FM R&D output performed in the same reporting period, GERD avoids "double counting" expenditures. Likewise, imported R&D used as an input by an R&D performer is excluded from GERD[16].

However, in the SNA, when output is measured by summing costs, all costs are included. Recommendations 19 and 20 are that acquisitions of R&D performed by another unit should be recorded as GFCF, except those by market producers in the Scientific Research and Development industry. Hence, when measuring output by summing costs, the costs of capital services provided by purchased R&D should be included, except for those purchases of R&D by market producers in the Scientific Research and Development industry, which should be recorded as IC.

Compensation of employees

Post graduate students who are either on the payroll of R&D performers and/or receive external funds (such as research scholarships) are included in those directly employed in R&D surveys in the FM. But the external funding component is not included in compensation of employees. To include it in compensation of employees requires re-routing the external funding received by the student and recording it as a current transfer from the funder to the R&D performer.

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

The user cost of capital[17] (*i.e.* the value of capital services provided by fixed assets) is equal to the consumption of fixed capital and a net 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 net return to capital is set to zero, and the value of capital services is equal to the consumption of fixed capital.

In measuring GERD, the FM includes capital expenditures on fixed assets (other than R&D and own-account software) and land. These expenditures should not be included when summing costs to measure output, but the cost of the capital services the fixed assets provide should be included. One way of estimating the value of capital services they provide is to apply the perpetual inventory method (PIM) to the capital expenditures for previous periods as reported by FM surveys. 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. Purchases of R&D are separately identified, as described earlier.

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.

Factors to consider in choosing between the various methods include:

a. The capital intensity of Division 72 may differ from that of other R&D performers and so the ratio of capital services or GOS to output or labour costs for Division 72 may not be appropriate.

b. The ratio of operating surplus to labour or output could vary considerably from year to year and, in addition, may 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 to 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. However, for practical reasons, it is recommended that the same rate is used as for other fixed assets.

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.

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.

In principle, past R&D can contribute to future R&D, and so these assets should also be included in estimating capital services but in practice it is generally difficult to measure this. Therefore, by convention, it is acceptable to ignore these expenditures unless specific information is available.

Other taxes less subsidies on production

Any other taxes less subsidies on production not already included in intramural expenditures need to be added to bring the value of output to basic prices. The FM recommends that expenditures on R&D should be recorded at factor cost, and so VAT and other similar sales taxes are excluded, irrespective of whether they are refundable or not. Nevertheless, some taxes on production are included in current expenditures. For example, payroll taxes are included in labour costs. On the other hand, other subsidies on production (i.e. subsidies on production other than subsidies on products) are not deducted from expenditure, but are shown as a financing source. Subsidies on R&D production may be quite substantial, and it is important to take them into account. Note that payable tax credits (see chapter 22 of the 2008 SNA) should also be recorded as subsidies.

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.

Taxes less subsidies on products

That part of R&D output produced for sale should be recorded at purchasers' prices. Hence, any taxes less subsidies payable on R&D products need to be added to this component.

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

14.1 Supply of R&D

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.

Output of R&D

Total supply of R&D is obtained by summing output and imports. R&D output 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-made, and
- speculative production.

Own account R&D is produced ('performed' in FM terminology) and used internally, regardless of funding source (internal or external). Custom-made R&D is produced on behalf of another unit, usually under contract. Speculative R&D[18] refers to self-funded production not intended for internal use and with no advanced, secured buyer.[19] [20]This is exemplified by commercial R&D service providers (the latter, of course, also perform custom-made R&D under contract). For intramural expenditures, speculative R&D will include the creation of an original designed to be used solely for the purpose of producing licenses to use and licenses to reproduce. Intramural expenditure will not however include the value of any copies in addition to the value of the underlying original. Speculative production in an SNA sense will however include the value of any such copies (licences to use and non-GFCF licenses to reproduce) produced in the reporting period as well as the value of the original (or costs incurred in the period relating to its production).

In principle the output of speculative and custom-made R&D should be recorded in inventories (finished or work-in-progress R&D) until it is disposed of to a final user. But in practice the difficulty of implementation will generally outweigh the benefits.

All three categories are principally derived from FM-based R&D survey data. Transactions in custom-made and speculative R&D are also expected to be reported in general economic surveys and in the export figures from surveys of international trade in services (SITS). The values reported for custom-made R&D in a general survey or SITS should, in principle, correspond to the funding data reported in FM-based R&D surveys, but this need not be so for speculative R&D. The costs of undertaking speculative R&D are reported in R&D surveys while the values reported in general surveys or SITS will be the sales price. Funding data reported in FM-based R&D surveys is for the performance of present or future R&D – not past R&D. So the sale of speculative R&D should not be included in the funding data reported by the R&D performer, but it should be included in the extramural expenditures of the purchaser, if the purchaser is also a performer and in scope of the R&D survey. Ideally, the sales price should be used to measure the output of speculative R&D, but marrying the data from the different data sources to achieve this is likely to be very difficult. In any case, care needs to be taken to avoid double counting.

Imports of R&D

As noted in the paragraph above, there are three types of output from R&D services. Only two of these outputs relate to imports in the form of purchase, transfer (gift), or license transactions: custom-made and speculative R&D. More specifically, custom made R&D imports involve purchase of an original, whereas speculative R&D (which for the SNA includes: purchased, licensed to use or reproduction, or received as a gift) may involve originals or copies. Some of these import transactions, especially those between affiliated companies and/or involving transfers or gifts may not be recorded or may not be easily separated from other activities in company, administrative (e.g., tax, customs), or statistical survey records. Lastly, outputs from current and prior R&D involved in import transactions may be protected by several forms intellectual property protection such as patents, copyrights, or secrecy. Table 2 summarizes these categories."

Table 2 R&D imports by type of transaction and IP protection

R&D Imports	**R&D Services (Originals)**	**IP (Original or Copies)**		
	(BPM 6 EBOPS 10.1.1.1)	**Purchases (BPM6 EBOPS 10.1.1.2)**	**Transfers (BPM6 EBOPS 10.1.1.2)**	**License to Use or Reproduce (BPM6 EBOPS 8.3)**
From speculative production by seller	X	X	X	X
From custom R&D services	X	X		

Extramural expenditures from R&D surveys comprise purchases and grants for the performance of R&D. Hence, they only include purchases of custom-made R&D (but only for R&D performers). SITS include data for R&D services and IP transactions but perhaps not with the desired detail or frequency, although it may be possible to supplement them with data from innovation surveys. Transfers and unrecorded transactions are unlikely to be available from SITS or foreign affiliates trade in services statistics (FATS), unless special steps are taken to collect or impute them.

Purchasers' prices

Supply-Use tables record output at basic prices. However consumption is measured at purchasers' prices. In theory therefore any trade margins and taxes/subsidies on products that might be applicable on R&D products should be included when sold. In practice these items are likely to be zero, certainly for margins but they are included in Table 4 below for comprehensiveness.

14.2 Uses of R&D

Uses of a product typically comprise final consumption, intermediate consumption, exports, GFCF and changes in inventories. 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.

Final consumption of R&D

Final consumption of R&D comprises household consumption, which is expected to be negligible, and any expenditures by government and NPISH on R&D that are not recorded as GFCF (nor as intermediate consumption, depending on how countries present their supply-use tables[21]. It is recommended that this item is shown separately, to satisfy the needs of users who are interested in a measure of total final expenditures on R&D.

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

This has already been dealt with above.

Net purchases of R&D between domestic sectors

The net purchases of R&D output between domestic sectors that constitute R&D GFCF need to be recorded in order to show uses, as opposed to output, by sector. If a split of the funding data is unavailable, then a practical solution is to assume that non-government R&D performers mainly make outlays to acquire R&D, while government R&D performers make almost none.

Inventories of finished R&D and work in progress

Since production of R&D generally takes longer than one year, whether own account, custom, or speculative, there will also be work in progress until the R&D is finished. 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 as work in progress. This is particularly important for R&D produced by affiliates of multinational firms, which may be ultimately be exported.

Exports of R&D

Exports may be classified as cross-border sales of custom-made 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 data on R&D services, whereas outbound transfers are not available from either R&D or trade surveys.

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 D *Additional Data Requirements*. (At the time of writing the NESTI group was 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 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 no 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.

Gross fixed capital formation in R&D

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 (also sent to the OECD's NESTI Group, which is responsible for the FM). This is presented in annex C. The most important improvements are to obtain funding and extramural expenditures that are sufficiently classified.

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 E. Pointers for future development of trade data sources are described in annex F.

Table 3 summarises the steps needed to derive an estimate of R&D output and table 4 summarises the remaining steps to derive GFCF of R&D.

Table 3 Summary of steps to derive output of R&D

Starting point: FM Intramural expenditures on R&D for each sector	
1. Output of licences to use and non-GFCF licences to reproduce	Add sales from licenses to use and non-GFCF licenses to reproduce (i.e. those not satisfying asset requirements).
2. 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 6 below and item 7 of table 4.
3. Intramural expenditures on own-account production of software	Subtract intramural expenditures on own-account production of software that satisfies the requirements to be recorded as GFCF.
4. 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 market producers in the Scientific R&D industry.
5. Compensation of employees	Add payments to postgraduate students not included in FM data.
6. 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.
7. Other taxes less subsidies on production	Add taxes not included in FM data Subtract subsidies
	Equals Output of R&D for each sector

Table 4 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	Including all expenditures on licences to use and reproduce R&D.
2. Add trade margins	In practice this is likely to be zero
3. Add taxes and subtract subsidies on products	In practice this is likely to be zero
4. Equals Total supply and Use of R&D	
5. Subtract Intermediate consumption of R&D	Same as item 4 from table 3
6. Subtract Acquisitions of R&D not expected to provide a benefit	In practice this is likely to be zero but licenses to reproduce not satisfying GFCF requirements should be recorded here.
7. Subtract Exports of R&D	Do not include sales of licenses to reproduce that satisfy GFCF requirements and that relate to an original produced in an earlier period. These sales concern pre-existing assets and are not included in output.
8. 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 5, 6, transfers and subsidies.
9. 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	

15. Impact on the accounts

Clearly, recognizing R&D as GFCF will increase estimates of GDP. But for non-market producers, where output is derived via the sum of costs, the overall impact will be smaller than the expenditures on R&D GFCF per se, and for this sector the increase in GDP will reflect only the CFC of R&D fixed assets, (since, ignoring the CFC component, the capitalization of R&D merely results in a shift of expenditures from general government final consumption to GFCF). In practice, changes to GDP may also arise from the introduction of FM-based R&D survey data replacing other data sources.

16. More on international trade

16.1 Data sources

Chapter I provided a detailed overview of the conventional approaches used to measure international trade in IPPs including R&D. This section provides commentary on some of the additional sources that can be used to complement the more traditional trade data sources.

R&D surveys

Data from R&D surveys are described at length earlier in the Handbook. Sources of funds data are a data source for exports and extramural expenditures are a data source for imports. Both have their strengths and weaknesses, as already described.

Other sources

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 should be viewed as providing 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 a potential source. The further development of data sources for international trade for the measurement of IPPs is discussed in annex 4.

Data adjustments

In the 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 IPPs may be included in such bilateral projects or be designed as stand-alone exercises, at least on a one-off basis.

16.2 Scope of R&D

As described earlier the scope of BPM5 includes development and testing activities, which go beyond the scope of R&D defined in the 2008 SNA. Thus, until countries begin to provide data on the basis of the 2010 EBOPS classification system which resolves this issue, transactions data obtained from services surveys will need to be adjusted down to correct for non-R&D components.

17. Quarterly estimates of R&D

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 to meet the needs of quarterly national accounts.

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[22]. 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 data

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

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 expenditure on wages and salaries. Intermediate inputs are probably minor and highly correlated with labour input, while capital services will 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.

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.

17.2 Annual intention data

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.

17.3 Proxy indicators

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[23]. 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.

17.4 Administrative data

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

17.5 An econometric or mathematical model

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 the least desirable option.

17.6 Conclusion

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 there is an existing source of sufficiently detailed employment data then a satisfactory solution would be to use a macro approach akin to the one recommended for software. This could be implemented more quickly and produce a long time series, which, amongst other things, would allow an evaluation of its performance in the past.

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, discussed above, produces good results. This could well be the most cost-effective solution.

18. Prices and volumes

Two features of R&D make it difficult to compile output price indices. First, it is very heterogeneous and second, most of it is produced on own account. Recommendations 12 to 14 describe the approaches that should be undertaken in creating price indices for IPP assets in general, which hold equally for R&D. Recommendation 14, in particular, relates to own-account production which is especially relevant for R&D and is restated below for comprehensiveness. This is consistent with the FM that also recommends the use of, and detailed advice on how to build, input-cost price indices. An alternative approach to a comprehensive input-cost price index is to use a single price index for one of the inputs. This approach is not uncommon for measuring the volume of output in the service sector where many countries typically use a measure of average earnings or equivalent for deflation. However, the cost structure of R&D, provided by R&D surveys, show that no single input represents more than 50% of output and so such an approach is generally not recommended for deflating R&D output.

Recommendation 21: In principle, output, or pseudo output, price indices should be derived for R&D. But at the present time no consensus has been reached on how such price indices could be derived. Until that time input-cost price indices should be used.

In practice the use of input-cost indices for R&D is likely to be widespread in the short to medium term at least, and so it is instructive to say a few additional words on the subject here.

Methods for deflating estimates of compensation of employees, an important input-cost, should ensure adequate splits of the quantity and price components. So, for example, average earnings per week indices, should be adjusted before use to ensure that changes in the compensation paid per hour are included in the price components but that changes in the index driven by changes in the number of hours worked, or say, qualifications/experience are included in the quantity component. It also follows that estimates of compensation of employees should be broken down as far as possible by employee-type, such that the disaggregation results in groups that are as homogeneous as possible. The FM for example breaks down R&D

personnel into three categories, Researchers, Technicians and equivalent staff, and other supporting staff. Ideally this split should serve as a minimum (with corresponding average compensation indices also available). The UK R&D satellite account uses hourly wage information for 12 detailed occupational groups from the Annual Survey of Hours and Earnings (Galino-Rueda 2007). Useful information on other national approaches is also available, for example: for the United States (Copeland, Medeiros and Robbins, 2007) and for Denmark (Gysting 2006).

19. Capital measures

Typically, researchers have derived estimates of R&D capital stock using econometric methods or the perpetual inventory method (PIM). The PIM method is most commonly used to derive capital stock estimates of fixed assets for national accounts purposes, and therefore has the advantages of being well understood and having computer systems in place to employ it. These are some of the reasons why, as described in Chapter I, the PIM method is the recommended approach for deriving capital measures for R&D.

The choice of PIM notwithstanding an important area where guidance is still required concerns the assumptions and/or sources that should be used to estimate depreciation rates and asset service lives for R&D. Two key approaches have generally been used in practice: the patent renewal method and econometric methods. While both approaches have serious shortcomings[24], they generally indicate that service lives lie between 10 and 20 years, but vary considerably between industries.

Given these shortcomings, the joint meeting of Canberra II and NESTI in 2006, encouraged the adoption of survey based approaches, particularly those that could target major R&D performers in various industries to test whether they were able to provide expectations of the service lives of R&D. In response, a number of statistical agencies (including Israel, Germany and the UK) undertook exploratory pilot surveys which are described below.

19.1 The pilot survey conducted by ICBS

The pilot survey conducted by ICBS (Israeli Central Bureau of Statistics) covered a small number of enterprises (about 30), operating in the most important industrial sectors engaged in R&D – 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 respondents were able to provide 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 similar types of R&D.

In almost all cases respondents explained that they undertook more than one kind of R&D, each with its own specific 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 in service lives between the two. 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 the length of service lives by type of R&D broken down by different stages in the R&D development/use process namely: 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 explained that the length of service lives has changed in recent years, and become shorter in some industries. This implies that data on the length of service lives need to be collected regularly (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 implementation takes 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 to questions on the lengths of the three stages.

The results of the pilot survey are presented in table 5, below, and given the size of the sample, are intended for illustrative purposes only.

Table 5 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.

Further summary information from the pilot survey is provided below:

- Inclusion of unsuccessful R&D: Respondents were aware of the rates of success, and the fact that R&D can be unsuccessful was taken into account in work programs. Respondents also stated that 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: reflected the uptake of newer R&D which replaced and improved upon the former R&D asset. In most cases the old R&D asset is entirely abandoned but in some cases it continues to be used in production on a minor scale if remaining benefits can be gained.

- 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 data collection: 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 should be R&D managers or, for R&D enterprises, Product Managers. For face to face interviews however, a combination of R&D managers and financial managers should be encouraged.

19.2 Pilot survey conducted in Germany

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 to gain information on service lives, on the share of R&D patented, and on the shares of types of R&D (with significantly different service lives), within total R&D expenditure. Results from all 12 respondents showed that it is possible to obtain answers to questions on the length of service lives. Most respondents also gave information concerning the different types of R&D and some separated product and process development. Those who differentiated between several types of R&D were mostly also able to estimate their shares in total R&D.

On the basis of this experience one can conclude that it is important to obtain service lives broken down by type of project within each industry, and to have estimates of the relative magnitudes of the values of the different types of project so that a weighted average of service lives can be derived for each industry (but separate mortality functions for the difference service lives of projects within an industry can also be calculated). In addition, the reported shares of relating to the patenting of R&D ranged from between 1.5 to 90 per cent, indicating very strongly that considerable care is needed when using patent data to estimate the service lives of R&D.

19.3 Pilot survey conducted in UK

The UK Office for National Statistics undertook a pilot survey of 19 enterprises (nine face-to-face and ten telephone interviews) across various industries, using the questionnaire developed by the Israeli CBS. Unlike the other two pilot surveys, the UK survey covered R&D and other non-technical activities. However, it was found that this approach did not work very well and that the two types needed to be conducted separately with different interviewees. For R&D it is crucial that a technical person, familiar with R&D projects, be asked to complete the questionnaire. Other findings are as follows:

- The response from companies was extremely positive, as the overriding feeling of interviewees was that the R&D agenda had been neglected.

- The questionnaire needs to be amended; clearer definitions given, more examples provided, geography and timeframe specified, and questions clarified - a second round of testing will be required.

- Most of the companies undertook applied and experimental development research rather than basic research.

- The sources and structures of R&D production and management varied across companies.

- The concept of a three stage service life was said to be simplistic although companies were able to provide service life estimates within this framework.

- Typical service life lengths are difficult for companies to estimate – therefore the different types of R&D should be clearly defined within the questionnaire.

- To improve estimates of service lives an expenditure weighting should be collected.

19.4 Japanese and Korean surveys

Two earlier instances of data collection on service lives were conducted by Japan and Korea. Although the data collected were not explicitly on R&D, and covered intangibles in general, the results demonstrated that it was possible to obtain data on service lives.

The Japanese survey was conducted 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 per se, unless R&D accounts for a large portion of innovation expenditures. However the number of responses to 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 the service lives of intangibles in full-scale regular surveys.

19.5 Conclusion

The outcomes of all three pilot surveys and indeed the earlier surveys conducted by the Japanese and the Koreans are very encouraging, and it appears that obtaining service lives by surveying respondents is viable, but an assessment of full blown surveys by several countries are required to confirm this is so.

Based on the outcomes of the three pilot surveys described above, the original CBS questionnaire has been modified a little – see below. Service life surveys could be conducted as either as part of the regular R&D surveys or conducted independently. The three countries who have undertaken pilot surveys favour undertaking a separate survey of a sub-sample of the regular R&D survey sample. By linking data from the two surveys at the unit record level, it should be possible to use GERD data from the regular R&D surveys to weight service life information to obtain industry averages. It is envisaged that surveys could be conducted by mail, personal interview or telephone. But whichever mode is used, it is clear that contacting a technical expert with first-hand knowledge of the R&D being undertaken by an enterprise is critical.

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

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

11 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

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

13 Data are now collected for the OECD based on the 2007 version of NABS (Nomenclature for the Analyses and Comparison of Scientific Programmes and Budgets). Previously, data were collected using Eurostat's 1992 version of NABS, see Eurostat: "Comparison between NABS 2007 and NABS 1992" October 2008.

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

15 Estimates of national income and output at factor cost exclude taxes less subsidies on production and were recommended measures in the 1968 SNA. However, they are not recommended measures in either the 1993 or 2008 SNA.

16 For the acquisition of services closely related to intramural R&D activities, the borderline between intramural and extramural expenditures is not always clear. If these services are separate R&D projects, the expenditures can in most cases be regarded as extramural R&D. If they are certain tasks (not necessarily R&D as such) necessary for the intramural R&D of the unit but contracted out, they can generally be regarded as intramural R&D expenditure (other current costs).

17 Refer to the OECD manual *Measuring Capital* for a full explanation.

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

19 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.

20 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.

21 Some countries show expenditure by government and NPISH directly as final consumption, others however reflect the transactions as IC, forming parts of the costs of output, and instead record under final consumption the output produced and consumed by these sectors.

22 See Quarterly National Accounts Manual IMF 2001..

23 OECD Software Task Force Report on Software Measurement in the National Accounts (2002).

24 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.

ANNEX B: QUESTIONS ON THE LENGTH OF THE SERVICE LIFE OF R&D

Recently the United Nations Statistical Commission approved the inclusion of expenditures on major parts of research and development (R&D) as fixed capital formation (i.e. investment) in the national accounts, after appropriate steps have been taken to ensure that the estimates are of acceptable quality.

One of the requirements is to record the value of the stock of R&D assets in the national balance sheet and another is to make estimates of the depreciation of these assets over time. In order to make such estimates, information on the length of the service life of R&D assets is required. You can help make this important improvement to national and international statistics by entering the required information in the following tables.

Please provide information on the average length of service life for the R&D assets you have developed yourself in Table 1 and those you have purchased in Table 2.

If you have different types of R&D assets with different average service lives, please describe the types and the service lives for each type. Please provide an approximate proportion of the expenditure on each type in total expenditure.

Table 1: 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	Expenditure % of total projects	
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			

Table 2: R&D purchased from others

[2]No.	Type of R&D	Details on stages in the "life" of R&D				Comments
		Stage	Information needed	Time in years	Expenditure % of total	
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			

ANNEX C: CONSOLIDATED SET OF QUESTIONS FOR R&D PERFORMERS[25]

Introduction

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

At various times in the meeting of the OECD Task Force on R&D and Other IPPs (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 that 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 it is hoped that this collection of questions will also serve to stimulate discussion and long-term data development on these intangibles.

I. Length of the service life of research and development

See Annex B

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

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 (NMPs) 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. How much of sales 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

Enterprises in the R&D sector are explicitly excluded as unless specific information says otherwise, expenditures on R&D by the sector are treated as intermediate consumption (IC).

These questions should be asked of non-market purchasers or funders, whether they are R&D producers 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 defence services, health services, policy development? If so, can you specify?

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 <u>payments</u> 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 <u>revenues</u> 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. *International R&D transactions with others outside your company*

   A. Would your company be able to report <u>payments</u> 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, 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

B. 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?

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

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 licences to 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 licensee 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 responsibility 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

    b. foreign sales

ANNEX D: ADDITIONAL DATA REQUIREMENTS

The following is a list sent by the Canberra II Group in 2005 to the OECD's NESTI Group.

Items to be estimated using data from R&D surveys

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.

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.

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

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.

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 E: POINTERS ON DATA DEVELOPMENT FOR INTERNATIONAL TRANSACTIONS IN R&D

A. International transactions between affiliated enterprises

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 IPPs 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 recognised 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 IPPs 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*).

D. Non-R&D testing services

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.[26] 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."[27] 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).

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 recognised 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[28] may be further developed to accommodate some of these issues.

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

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

28 http://www.bea.gov/surveys/pdf/be13.pdf.

CHAPTER III: MINERAL EXPLORATION AND EVALUATION

Introduction

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.

This treatment of mineral exploration has been retained in the 2008 SNA, albeit 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*.

20. International standards and mineral exploration and evaluation as an asset

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

20.1 1968 SNA

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 using the accounting conventions of the 1968 SNA. 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

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."

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.

20.2 System of Environmental and Economic Accounting (SEEA) 2003

The SEEA was developed with the purpose of developing sets of statistical accounts that measure interactions 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. This Handbook has made use of the 2003 SEEA content in a number of the issues discussed below.

20.3 International business accounting standards

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.

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.

20.4 Update of the 1993 SNA

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.

21. Definition and coverage of Mineral Exploration and Evaluation activity

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.

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 22: 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.

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. Only recording expenditures on mineral exploration and evaluation activities that resulted in finding sub-soil assets would lead, in practice, 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.

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 23: 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.

22. Valuation

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 (for market producers)
e. Other taxes (less subsidies) on production

23. Compiling estimates of GFCF

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.

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.

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 3.1). These vehicles cover all expenditure (capitalised and non-capitalised) 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.

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 24: 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.

24. Price and volume measures

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.

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.

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. Adjustments of this kind should be explicitly described in the associated metadata.

Recommendation 25: 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 could be made for productivity growth.

25. Capital measures

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 recognised 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.

As a consequence of recommendation 23, the service life of a mineral exploration and evaluation asset relates to all associated expenditures, whether successes or failures. But the mean service lives used should only be determined on the basis of successful mineral exploration and evaluation.

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. At the time of writing, the average service life is currently estimated to be 34 years.

Recommendation 26: 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.

25.1 Sub-soil assets

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

26. Ownership

26.1 Mineral exploration and evaluation

Exploration activities are usually funded by the extractor looking to discover sub-soil assets that they can then exploit. In some 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.

26.2 Sub-soil assets

In some 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 F: AUSTRALIAN MINERAL EXPLORATION AND EVALUATION SURVEYS

Australian Bureau of Statistics

Mineral Exploration
(excluding petroleum and water)
Quarter ending September 2008

MX

In correspondence, please quote this number

Please complete this form for the Australian-based activities of the business named on this label.

Please correct any errors on the label.

Purpose of Collection
This form collects information on expenditure and metres drilled by private businesses engaged in mineral exploration activity in Australia. The information will be used by analysts in both the private and public sectors.

Collection Authority
The information asked for is collected under the authority of the *Census and Statistics Act 1905*. Your co-operation is sought in completing and returning this form by the due date. The Act provides me with the power, if needed, to direct you to provide the information sought.

Confidentiality
Your completed form remains confidential to the Australian Bureau of Statistics.

Due Date
Please complete this form and return it in the reply paid envelope to the Australian Bureau of Statistics by **15 October 2008.**

Help Available
If you have problems in completing this form, or feel that you may have difficulties meeting the due date, please contact the Sydney Office of the Australian Bureau of Statistics by:

Telephone	**Facsimile**	**Mail**
1800 816 851	1800 220 822	GPO Box 796
Freecall (excluding mobile phones)	(02) 9268 4789	Sydney NSW 2001
(02) 9268 4533		

Brian Pink
Australian Statistician

Person we should contact if any queries arise regarding this form

Name		Telephone Number	
Signature		Facsimile Number	
		Date	/ /

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Australian Government Statistical Clearing House Approval Number: 00175-03

2 MX

Please read this first

- Report all expense items **exclusive of Goods and Services Tax (GST)** where this is recoverable as an input tax credit.
- If exact figures are not available, please provide careful estimates.
- Please report all monetary values in ***thousands of Australian dollars (A$,000)***. Where the value in this business's accounts is not expressed in thousands of dollars, round the value up or down to the nearest thousand dollars.
- You will need to report an estimate of time taken when you have completed this form.

1 Has this business sold or 'farmed out' any of its exploration leases?

No ☐

Yes ☐ ▶ Please give details of buyers or 'farminees'. If insufficient space, please attach a list.

Name

Address

2 Is this business engaged in any Joint Venture arrangements as a non-operator?

Note
- Report expenditure for all Joint Ventures for which this business is the managing operator.

No ☐

Yes ☐ ▶ Please report who the managing operator is in each case. If insufficient space, please attach a list.

Joint Venture

Managing operator

Address

3 Did this business have any expenditure on exploration in Australia during this quarter?

Note
- Exploration expenditure is all expenditure (capitalised and non-capitalised) during the exploratory or evaluation stages up to the point where mine development for purposes of production takes place.
- Expenditure activity includes exploration, determination of recoverable reserves, engineering and economic feasibility studies, gaining access to reserves and construction costs of pilot plants.
- Examples of costs include airborne surveys, map preparation, satellite imagery, procurement of finance, geologist inspections, land access and legal costs, licence fees, payments to employees and contractors and any other costs (including technical and administrative overheads) directly associated with the activities above.

No ☐ ▶ Go to Question **8**

Yes ☐

3 MX

4 Please provide total exploration expenditure for this business by deposit type by State/Territory

Including
- All Joint Venture exploration expenditure if this business is a managing operator

Excluding
- All Joint Venture exploration expenditure if this business is a participant only

Definitions
- Exploration on **Existing deposits** is exploration that is delineating or proving up an existing deposit, including extensions and infill, which has been classified as an Inferred Mineral Resource or higher.
- **New deposits** are previously unknown mineralisations or known mineralisations yet to be classified as an Inferred Mineral Resource or higher. They include:
  - Exploration resulting in finding mineralisation that was previously unknown.
  - Exploration on previously known mineralisation that has not been subjected to modern exploration.
  - Exploration within an existing mining tenement for the purpose of finding new sources of mineralisation that have not already been classified as at least an Inferred Mineral Resource.

	$,000						
	NSW	Vic.	Qld	SA	WA	Tas.	NT
Exploration expenditure on existing deposits … … …							
Exploration expenditure for new deposits … … … …							
Total exploration expenditure							

5 Please report exploration expenditure for this business in the following table by type of mineral sought and State/Territory

Note
- Expenditure for each exploration project should be allocated wholly to one of the categories listed below, according to the principal mineral or group of minerals explored for on each project.
- The total expenditure in this table should equal that already reported in Question 4.

Type of Mineral	$,000						
	NSW	Vic.	Qld	SA	WA	Tas.	NT
Copper … … … … … … … … … …							
Silver-lead-zinc … … … … … … …							
Nickel and cobalt … … … … … … …							
Gold … … … … … … … … … … …							
Iron Ore … … … … … … … … … …							
Mineral Sands … … … … … … … …							
Tin, Tungsten, Scheelite and Wolfram … … … … … … … …							
Uranium … … … … … … … … … …							
Other metallic minerals Specify							
Coal … … … … … … … … … … …							
Construction materials … … … …							
Diamonds … … … … … … … … … …							
Other non-metallic minerals Specify							

4 MX

6 Please show the number of metres drilled on exploration during this quarter — Number of metres

Metres drilled on existing deposits .... [ ]

Metres drilled on new deposits .... [ ]

Total metres drilled .... [ ]

7 Has exploration expenditure or metres drilled by this business been significantly affected by any of the following during this quarter? — **Tick appropriate box(es)**

Bad weather .... [ ]

Mineral prices .... [ ]

Lack of funds .... [ ]

Land access .... [ ]

Other (please specify) .... [ ]

[ ]

Go to Question **10**

8 Will this business be exploring next quarter?

No [ ]

Yes [ ] ▶ Go to Question **10**

9 On what date does this business expect to recommence exploration? .... [/ /]

10 Please provide comments

- on any information you have supplied on this form (e.g. related to unusual movements or other factors)
- on any difficulties you had providing the information, or suggested improvements to this form
  (Please use BLOCK letters)

[ ]

11 Please provide an estimate of the time taken to complete this form

Including
- The time actually spent reading the instructions, working on the questions and obtaining the information
- The time spent by all employees in collecting and providing this information

[hrs mins]

Thank you for completing this form

Australian Bureau of Statistics

PX

Petroleum Exploration
(excluding oil shale)
Quarter ending September 2008

In correspondence, please quote this number ▼

Please complete this form for the Australian-based activities of the business named on this label

Please correct any errors on the label

Purpose of Collection
This form collects information on expenditure by private businesses engaged in petroleum exploration activity in Australia. The information will be used by analysts in both the private and public sectors.

Collection Authority
The information asked for is collected under the authority of the *Census and Statistics Act 1905*. Your co-operation is sought in completing and returning this form by the due date. The Act provides me with the power, if needed, to direct you to provide the information sought.

Confidentiality
Your completed form remains confidential to the Australian Bureau of Statistics.

Due Date
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Brian Pink
Australian Statistician

Person we should contact if any queries arise regarding this form

Name		Telephone Number	
Signature		Facsimile Number	
		Date	/ /

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Australian Government Statistical Clearing House Approval Number: 00175-04

2 PX

Please read this first

- **Important:** This form will be read using electronic equipment.
- Use **only black ball point pen** when completing this form.
- Keep each number, letter or tick within the data entry boxes provided, for example

  2 8 5 or ✓

- Leave answer boxes blank where you have no response or data to enter, for example
- Do not use 'nil', 'n/a' or draw a line in the data entry boxes.
- Information reported on this form should comply with the Australian equivalents to International Financial Reporting Standards (AIFRS).
- Report on an accruals basis as recorded in this business's Income Statement and Balance Sheet.
- If a mistake is made, cross out the incorrect answer and either write the answer in the remaining boxes, for example

  NSW

  $ 7 3 ~~3 6~~ ,000

  or if not enough space is left, write next to the relevant item, for example

  NSW

  3 5 2 7 $ ~~2 8 4 5~~ ,000

- Only the Australian-based activities (including imports and exports) of the business shown on the label should be included on this form. Include details of the business's participation in any unincorporated joint ventures.
- Report all income items **exclusive of Goods and Services Tax (GST)**.
- Report all expense items **exclusive of Goods and Services Tax (GST)** where this is recoverable as an input tax credit.
- If exact figures are not available, please provide careful estimates.
- Please report all monetary values in ***thousands of Australian dollars (A$,000)***. Where the value in this business's accounts is not expressed in thousands of dollars, round the value up or down to the nearest thousand dollars.
- The items listed under ***Including*** and ***Excluding*** are examples and should not be taken as a complete list of items to be included or excluded.
- You will need to report an estimate of time taken when you have completed this form.

1 Has this business sold or 'farmed out' any of its exploration leases?

No ☐

Yes ☐ Please give details of buyers or 'farminees'.
If insufficient space, please attach a list.
(Please use BLOCK letters)

Name

Address

3 PX

2 Is this business engaged in any Joint Venture arrangements as a non-operator?

Note
- Report expenditure for all Joint Ventures for which this business is the managing operator.

No ☐

Yes ☐ ▶ Please report who the managing operator is in each case.
If insufficient space, please attach a list.
(Please use BLOCK letters)

Joint Venture

Managing operator

Address

3 Did this business have any expenditure on exploration in Australia during this quarter?

Note
- Exploration expenditure is all expenditure (capitalised and non-capitalised) during the exploratory or evaluation stages up to the point where wellhead development for production purposes takes place.
- Expenditure activity includes exploration, determination of recoverable reserves, engineering and economic feasibility studies, gaining access to reserves and construction costs of pilot plants.
- Examples of costs include rig hire, map preparation, satellite imagery, payments to employees and contractors and cash bids for offshore petroleum exploration permits, procurement of finance and any other costs (including technical and administrative overheads) directly associated with the activities above.

No ☐

Yes ☐ ▶ Go to Question **6**

4 PX

4 Will this business be exploring next quarter?

No ☐

Yes ☐ ▶ Go to Question **9**

5 On what date does this business expect to recommence exploration?

☐☐/☐☐/☐☐☐☐ ▶ Go to Question **9**

6 Please report the breakdown of exploration expenditure for this business by the following lease types and locations in the Timor Sea and Indian Ocean

Note
- Please **exclude** Australian offshore and onshore expenditure to be reported in **Question 7.**

	Timor Sea Joint Petroleum Development Area	Territory of Ashmore and Cartier Islands
(a) Production leases		
- Drilling	$,000	$,000
- Other	$,000	$,000
(b) All other areas		
- Drilling	$,000	$,000
- Other	$,000	$,000

5 PX

7 Please allocate exploration expenditure for this business by type of expenditure

Note
- Please **exclude** details of expenditure for exploration as already provided in **Question 6.**
- Offshore commences from the low water mark.

(a) Production leases

Onshore Drilling

NSW	Vic.	Qld	SA
$,000	$,000	$,000	$,000
WA	**Tas.**	**NT**	
$,000	$,000	$,000	

Onshore Other

NSW	Vic.	Qld	SA
$,000	$,000	$,000	$,000
WA	**Tas.**	**NT**	
$,000	$,000	$,000	

Offshore Drilling

NSW	Vic.	Qld	SA
$,000	$,000	$,000	$,000
WA	**Tas.**	**NT**	
$,000	$,000	$,000	

Offshore Other

NSW	Vic.	Qld	SA
$,000	$,000	$,000	$,000
WA	**Tas.**	**NT**	
$,000	$,000	$,000	

6 PX

7 Please allocate exploration expenditure for this business by type of expenditure – *(continued)*

(b) All other areas

Onshore Drilling

NSW	Vic.	Qld	SA
$,000	$,000	$,000	$,000

WA	Tas.	NT
$,000	$,000	$,000

Onshore Other

NSW	Vic.	Qld	SA
$,000	$,000	$,000	$,000

WA	Tas.	NT
$,000	$,000	$,000

Offshore Drilling

NSW	Vic.	Qld	SA
$,000	$,000	$,000	$,000

WA	Tas.	NT
$,000	$,000	$,000

Offshore Other

NSW	Vic.	Qld	SA
$,000	$,000	$,000	$,000

WA	Tas.	NT
$,000	$,000	$,000

(c) Total (Sum of (a) and (b))

NSW	Vic.	Qld	SA
$,000	$,000	$,000	$,000

WA	Tas.	NT
$,000	$,000	$,000

7 PX

8 Has exploration expenditure by this business been significantly affected by any of the following during this quarter?

Tick all that apply

(a) Bad weather ☐

(b) Mineral prices ☐

(c) Lack of funds ☐

(d) Land access ☐

(e) Other (please specify in BLOCK letters) ☐

9 Please provide comments

– on any information you have supplied on this form (e.g. related to unusual movements or other factors)
(Please use BLOCK letters)

– on any difficulties you had providing the information, or suggested improvements to this form
(Please use BLOCK letters)

10 Please provide an estimate of the time taken to complete this form

Including
- The time actually spent reading the instructions, working on the questions and obtaining the information
- The time spent by all employees in collecting and providing this information

hrs mins

Thank you for completing this form

CHAPTER IV: SOFTWARE AND DATABASES

Introduction

Of the three new fixed asset categories introduced in the 1993 SNA 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.

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 indices for deflating software and what might constitute best practice.

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 indices to derive volume estimates of software GFCF.

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

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 database management system (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.

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 takes a stronger view on the meaning of 'intention' and states 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).

The guidelines provided in this handbook largely reflect the recommendations made by the OECD Task Force in its report to the 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.

27. Software

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.

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.

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

27.1 Definition and scope

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 IPP. 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.

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.

27.2 Licences to use and reproduce

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.

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.

The acquisition of a licence-to-use or a licence-to-reproduce may be recorded as either GFCF or intermediate consumption, depending on the circumstances – see section 1.3. 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.

27.3 Bundled/embedded software

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.

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.

27.4 Maintenance and repairs

The 2008 SNA draws a distinction between ordinary, regular maintenance and repairs of a fixed asset on the one hand and major renovations on the other. Ordinary, regular maintenance and repairs should be recorded as intermediate consumption. But major renovations that are undertaken at a time not dictated by the condition of the asset and 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).

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.

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.

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?

Taking account of both practical matters and conceptual principles, it is best to follow recommendation 2: IPPs 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.

27.5 Upgrades and outright sales of original software

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 upgraded software is equal to the GFCF plus the depreciated value of the software before the upgrade.

Recommendation 28: 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.

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 29: 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.

27.6 Measurement of software GFCF

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.

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. As discussed in Chapter I, the different approaches have their strengths and weaknesses, and recommendations 6 and 7 should be followed, *i.e.* all the approaches should be used and confronted with each other.

In 2008 another software survey of OECD member countries was conducted. It was designed to determine what changes had taken place in country practices since the 2001-02 survey and the subsequent release of the report of the OECD Software Task Force. The major difference between the findings of the 2002 and 2008 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.

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 other three 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.

An important matter concerns the measurement of GFCF of software licences to use and the need to discriminate between those licences purchased by production units that meet the criteria of an asset and

those that do not. Essentially, the issue boils down to whether a licence to use is for more than a year (recorded as GFCF) or less (recorded as intermediate consumption). When the demand-side approach is used it is simply a matter of asking respondents to separately report their expenditures on licences of more than a year and those of a year or less. The supply-side approach, however, 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 30: It is very important to distinguish between licences to use for more than a year and licences to use for a year or less. Expenditures on the former, purchased by production units and not embodied and sold on within other products, are recorded as GFCF, while expenditures on all other licences to use are recorded as consumption. Whatever approach is used it is vital that the accurate discrimination between the two should be central to measurement.

Demand-side approach

The demand-side approach for software follows the generic demand-side approach outlined in Chapter I of the Handbook. This section covers those aspects that are specific to software.

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.

Purchased software

Software purchases come in a number of different forms, but it is necessary to distinguish between packaged, or ready-made, software and customised 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.

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 customised software for own use. They should comprise all external costs of developing customised 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 the 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 a year or less.

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.

Own-account production of software

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.

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.

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

The calculation of total labour costs and other costs within stages 2-6, follows the rules described in Chapter I, and should be derived as follows:

Total labour costs (the product of (a) (b) and (c) below):

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 (the sum of (d), (e) and (f):

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 expenditures on software development.

Supply-side approach

The main difficulty in applying the supply-side approach to software (apart from discriminating between licences of different durations) is to avoid double-counting 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.

Purchased software

General principles

The recommended commodity flow method for estimating GFCF in purchased software can be outlined as follows:

Estimated total gross fixed capital formation of purchased software
equals
Value of domestic output 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
Other software purchases by production units that do not qualify as GFCF
minus
Household consumption of games and other packaged software

minus
Exports
minus
Maintenance expenditures

Step-by-step implementation

The starting 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 these data to obtain sales data of software products. When implementing a supply-side approach from industry sales data, all sales of software products should be taken into account, in other words including sales of 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.

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

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

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 customised 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 customised.

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

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 32: 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, including relevant businesses not classified under the category "computer services".

Step 2: inclusion of imports to obtain total resources

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.

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.

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.

In the case of 2(b), the terms of the contract between the software owner in country A and the wholesaler/distributor in country B could take several forms. The wholesaler may be paid a fee by the software owner to distribute copies and the owner receives the remainder of the sale receipts. Alternatively, the wholesaler may make payments to the software owner for a licence-to-reproduce, and it is the wholesaler that receives all or most of the sale receipts. The 2008 SNA recommends that in the first case the payments made by the owner should be recorded as IC. In the second case, the payments made by the wholesaler should be recorded as IC 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.

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, at present, 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. The forthcoming changes to the EBOPS classification system, outlined in section 5, should greatly improve matters in the future.

Table 6: Imports and exports of software in Canada, 1998

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

Recommendation 33: In the supply approach, import and export 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

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

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

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 G reflect these changes and strategies need to be developed to take account of them.

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

Exclusion of subcontracting

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 G). 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 capitalised.

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

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 Software Task Force suggested that it be assumed to be 50%.

Exclusion of own-account production of software

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. Customised 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 customised software. Hence double counting can be avoided by excluding customised software production from the estimates of own-account GFCF.

Recommendation 34: 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

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.

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. Therefore, there is also the need to estimate external costs of maintenance.

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.

Regarding the European case, (CPA 2008), the situation is much the same.

Recommendation 35: 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

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

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.

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.

Data obtained from Australia and USA seem to converge to an amount of 4 to 5% of total supply being assigned to household consumption. 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 36: 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

A previous paragraph has already discussed issues regarding external flows.

Summary of recommendations for implementation of the supply approach for purchased software

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

Table 7: 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

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

Appendix 3 in annex G 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.

Own-account original software

General principles

The OECD Software 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 (depreciation only for non-market producers)

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

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 by 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 Microsoft's Windows corresponds to software to be used internally. Only reproductions of Windows are sold, not the original.

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.

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

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).

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 Software 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.

A more recent consultation of key firms and institutions in the software industry by the United Kingdom's Office for National Statistics (ONS) 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.

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 Software Task Force.

Table 8: 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

The recommendations of the 2002 OECD Software 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 28-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 Table 9. The categories that are classified as software investment are in bold italics.

Boehm identified 43% of the time spent by programmers and systems analysts was on development, but for national accounts purposes some of the items he identified as maintenance (shown in bold in the table) should be recorded as development, which brings the total to 62%.Nevertheless, 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 pre-packaged software. So far, no recent study on the matter has been identified. The 50% deduction rule is also adopted in Canada, France and Italy.

Table 9: Time spent on software development and maintenance costs by programmers and systems analysts in the US

Development	***43 per cent***
Maintenance	
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

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 37: If a country does not have reliable data on the share of time spent on the various tasks of computer professionals, the share should be assumed to be no more than 50% in calculating the labour cost of own-account software production.

Non-labour costs

As direct data on non-labour costs of own-account software production are hardly available, they have 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 varying availability of data on the 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 industries as a whole.

It is reasonable to assume that the cost structure of own-account software production is similar to the custom software development or contract software programming industries. These industries tend to be more labour intensive than service industries 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. 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

The cost of the capital services provided by 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 section 2.2

Sales adjustment

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.

In the US, a sales adjustment of 2/(proportion of software professionals to total employment x 100) is made in the custom software industry.

Multiplicative model

The additive model described above for deriving macro 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.

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

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 Software Task Force report and after the UK study described above. As such the OECD Software Task Force recommended that all costs associated with software R&D should be included in estimates of own-account software GFCF, and recommended that they should be capitalised as they occurred. With the recognition of R&D as assets however only the capital services provided by R&D should be included in these costs. This matter is addressed in section 1.4 and recommendation 3 and in the R&D chapter.

Further adjustments ensuring consistency of national accounts

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 capitalised by businesses. In order to compile this difference, surveys should continue to monitor capitalised software investment as they are recorded in business accounts.

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.

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 capitalised by business since sometimes this software, even bought separately from hardware, is included as hardware. That is why the built-in capitalised 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.

28. Databases

The 1993 SNA described the treatment and measurement of databases as a special case of software and recommended that only large databases should be capitalised. 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.

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.

28.1 Definition and treatment

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 **Databases 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.*

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.

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.

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 to deterioration, and the cost of updating a database that qualifies as a fixed asset should be recorded as GFCF.

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 capitalised, however, if it was stored elsewhere, *e.g.* on paper files, it would not be capitalised. 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.

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 38: 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.

28.2 Measurement

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.

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.

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.

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.

Demand-side approach

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 capitalised databases, if any.

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.

Costs of in-house database creation

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.

Supply-side approach

The method to be used is the same as that for own-account original software (see above). 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.

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%.

29. International trade in software and databases

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

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.

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.

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 noted 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 customised 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 BPM6 guidelines, or possibly to purchase of assets depending on the nature of the transaction.

f. Software may be traded internationally online and in such a case it will by default not be counted in Customs reports. BPM6 recommends 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 may be 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.

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.

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

29.1 Concepts and classification issues

As described in chapter I the product "computer software" is not currently well identified in current international trade codes or balance of payments (BOP) items, although BPM6 and the 2010 IMTS and EBOPS classifications will improve this situation somewhat. Rather than repeat the discussion of software in chapter I, this sub section focuses on issues related to international trade in software not covered earlier.

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 customised 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.

For online delivery of standard (*i.e.* packaged, not customised) 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.

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 (as per BPM5) 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 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 in GFCF. This difference is remedied in BPM6.

29.2 Conclusions and recommendations

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.

That said the improvement to classification systems in BPM6, the 2010 IMTS and EBOPS classifications should lead to improvements in this area.. Changes to the HS system are also welcome however and the development of a standard international grouping of HS codes that represents trade in software goods (HS96 codes 8524.31; 8524.40; 8524.91 and 8524.99) to improve international comparability is encouraged. .

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 codes mentioned above.

30. Prices and volumes

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 indices. 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 indices for packaged software may be used to construct price indices for the other two software components if more appropriate price indices are unavailable. Fourth, volume estimates of the items are useful indicators in their own right.

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 indices 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 indices. 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.

The 2002 OECD Software 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 indices and used the price indices of other goods and services as proxies. Partly as a result of the OECD Software 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 indices 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 indices for these products in practice.

One thing that is clear is that the 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.

There are two particular features of software GFCF that make the derivation of suitable price indices challenging. First, there are rapid quality and specification changes, and, second, price data are only readily available for purchases of packaged software. This section describes how price indices for software and databases should or could be compiled. It distinguishes between packaged software, customised software, own-account software and databases. When the most desirable way of compiling price indices may only be possible in the long term, then second-best, short-term solutions are given.

30.1 Constructing price indices for software and databases

Packaged software deflators

Generally, all OECD member countries should develop price indices 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.

The US has been the leader in developing price indices 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.

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 indices, 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 indices 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.

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.

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.

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).

Customised software deflators

The standard price index techniques referred to above cannot be applied to customised software, at least not in a straightforward way, because each product is unique. Methods for constructing price indices 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.

For customised and own-account software the PPI Manual suggests function point analysis as a potential means of constructing price indices. 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 are 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).

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

The US derives its price index for customised software as a weighted average of its packaged software index and an input price index based on the costs of producing software (wage rate indices, 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 customised 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.

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

Own-account software deflators

In the long term, when price indices for customised 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 customised software.

Database deflators

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.

31. Capital measures

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 these measures are discussed in chapter I and are also the subject of the new edition of the OECD manual *Measuring Capital*. Note should be taken of recommendation 15: 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.

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.

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 following section addresses the matter of setting values for these parameters for software and databases.

31.1 Service lives

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

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, customised 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.

Surveying software suppliers

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

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.

31.2 Country practices

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 10 below presents the results.

Table 10: Estimating the capital stock of software, PIM parameters
Responses to Questionnaire, 2002

Country	Service lives: Own-acc't & Customised	Service lives: Pre-recorded/ packaged	Age-efficiency or age-price function	Retirement distribution function
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	4.5	Straight line	Lognormal
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 (c)	3		One hoss shay for age-efficiency function	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; as of 2008.

With the exception of Sweden, most respondent countries reported service lives of approximately 5 years. A few countries specify service lives for customised and own-account separately from packaged, and invariably specify a shorter life for the latter. Given the high cost and specialised nature of customised 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.

Australia uses a hyperbolic age-efficiency function and derives corresponding age-price function by assuming a real 4% per annum discount rate. The Netherlands (as of 2008) follow a similar procedure but assume a one-hoss shay age-efficiency function. 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.

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

Another survey of OECD countries was conducted in 2008, and the results are shown in table 11 below. This survey only sought service life information.

Table 11: Software service lives, 2008

	own account & customized	purchased	total
Austria			30% depreciation rate
Belgium			3
Canada	5	3	
Czech Republic			4.5
Denmark	6	4	
Hungary			5
Israel	5	3	
Japan			5
Netherlands			3
New Zealand			4
Poland			8
Slovak Republic			5
Spain			4
USA	5	3	

For those countries that reported service lives in both surveys there has been no change between 2002 and 2008.

ANNEX G: 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 - with some closing comments concerning the difficulties, notwithstanding these recommendations, in identifying software in business accounts in practice.

The US Generally Accepted Accounting Principles

The forerunner for 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 did not cover software developed in-house, for internal use, the statement provided clear guidance on the treatment of software to be sold or leased (including "originals" produced for reproduction), and explicitly stated that all costs of software to be sold or leased during the research and development stage should be expensed until the point in time that the software becomes technologically feasible, when costs should be capitalised and treated as a master copy with subsequent costs capitalised 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. This stated that the costs of such software should also be capitalised 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

Statement # 38 of the International Financial Reporting Standards (IFRS) stipulates 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 capitalised if the enterprise can demonstrate all of the following requirements: technical feasibility; intention and ability to complete the asset for use or for sale; ability to use or sell the asset; expectation of future economic benefits; 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 into 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 the costs incurred in stages (ii) to (vi) should be included in the valuation of in-house software.

Identification of software costs in business accounts

Proper identification of software costs in business accounts is complicated by the accepted ways in which accounting information is reported in business accounts. For capitalised 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 H: SOFTWARE-RELATED CLASSIFICATIONS

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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 licensed 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 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 capitalised	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 "customised" software purchased to be sold-on to another user/client.)	IC
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	

Table 1a – Purchases of Software (continued)		
CPA 2008 Code	Product Description	Intermediate or Investment
	◆ 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 licensed 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[30]
	◆ 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 <u>not include</u> these costs if they are directly capitalised	GFCF
	- If the software is purchased by a final-user for inclusion in an own-account "original" the expenditure may also be treated as <u>intermediate consumption</u> as long as its value <u>is included</u> in own-account production	IC
	◆ Software expected to be used in production for less than one year. (This includes "customised" software purchased to be sold-on to another user/client.)	IC
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*	

Appendix 1: CPA 2008 Detailed description list (continued)		
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 relations management 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	

Appendix 1: CPA 2008 Detailed description list (continued)		
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*	

Appendix 1: CPA 2008 Detailed description list (continued)		
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	

Appendix 1: CPA 2008 Detailed description list (continued)		
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.)*	

Appendix 1: CPA 2008 Detailed description list (continued)		
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 between 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

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

30 Unless purchased by games arcades, game rental companies, etc

CHAPTER V: ENTERTAINMENT, LITERARY AND ARTISTIC ORIGINALS

Introduction

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 (EU 2003) 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.

The recommendations of the OECD Task Force on IPPs and the earlier EU Task Force are consistent with two exceptions, both of which reflect changes made in the 2008 SNA: (i) that concerning licences to use and reproduce and (ii) that concerning the measurement of GFCF when summing costs. In addition, the report of the EU task force did not address the derivation of volume estimates, but they are addressed here.

32. Definition and scope

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 recognised 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.

Although the definition and scope have not changed from the 1993 SNA, the measurement of GFCF is affected by other changes in the SNA, as noted above.

33. Coverage of entertainment, literary and artistic originals

33.1 Introduction to coverage

This section considers a wide range of products that could potentially be categorized as originals. Four criteria to assist in determining whether they should be treated as originals or not are postulated below. They are then used in an assessment of the main components of entertainment, literary and artistic originals, 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.

33.2 Criteria for inclusion

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 2008 SNA requirement 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 capitalised 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.

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 I contains the summary results of this investigation.

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 recognised 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 be better not to draw attention to it. Entertainment, literary and artistic originals, on the other hand, have value only because they are able to be copied and/or distributed, and so legal protection is vital.

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.

The following sections discuss each potential original, whether it satisfies the criteria above and some special cases for which the EU task force provided guidance.

33.3 Films

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.

Residence of the film producing company[31] 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.

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.

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 of being 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.

33.4 Television and radio programmes

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.

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.

Both industries categorize programmes as either "stock" or "flow". Stock includes documentaries, drama, music, arts, history and education programmes. . 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.

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.

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 reflects the fact that the rights to broadcasting sporting events, while often very valuable initially, usually decline very quickly in value even if highlights from the events themselves are subsequently re-broadcast.

Advertisements are a further special case. Although advertisements probably satisfy the criterion of primary artistic intent, they would generally be used for less than one year as part of an advertising campaign and hence should be excluded from entertainment originals.

33.5 Literary Works

All published works with separate copyright should be included in this category as long as they satisfy the inclusion criteria.

All complete works, regardless of subject or style should be included; including preferably audio books and multimedia versions (e.g. e-books) of literary works. However, there would need to be separate licences for different media for the same asset, otherwise the addition of new media would not contribute to the value of the original.

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 in itself in the same way as a film script discussed above. However, like film scripts, music scores should not be recorded separately under music.

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. (Individual copies may become valuables.)

33.6 Musical Works (including music videos)

As with most IPPs, 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, 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.

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.

It is suggested that all music regardless of the intended medium should be included as an original. Therefore, music videos should be included. All advertising jingles, scores, etc. should be excluded in parallel with the treatment of advertisements on television or radio.

33.7 Slogans and brand names

Slogans and brand names are legally protected under "Trade Mark" and should not be considered as originals.

Table 12: Coverage of Entertainment, literary and artistic originals

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	

33.8 Technical and Architectural Drawings

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 production 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.

33.9 Models

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.

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.

Similarly, a model used in the same way as architectural drawings does not satisfy the primary artistic intent criterion and should therefore be excluded.

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.

33.10 Paintings, sculptures, antiques, fine art and jewellery

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.

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.

Portraits and pictures should be treated in the same way as paintings and therefore they fail the fourth criterion as they are covered elsewhere in the national accounts, *i.e.* as valuables.

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.

Images and reproductions, along with photographs, are covered below.

33.11 Photographs and Images (reproductions or copies from books)

Photographs could potentially satisfy the main criteria as they can be highly valuable and are often very marketable. Photographs can be covered by copyright and can be reproduced and used repeatedly: the image may be used in newspapers, magazines, on posters, in books or on television for example. 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.

33.12 Maps

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 39: Entertainment, literary and artistic originals should be defined to include at 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.

34. Conceptual issues

34.1 Nature of originals

Originals have three features which warrant particular attention.

Embedded originals

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.

Consider the following example, which arises because of different valuation methods for different originals (which are discussed later).

Example

A film company pays royalties to a musician to use their music in a film. The music original is valued using royalty flows, and the film is valued using production costs.

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.

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.

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.

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.

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 13 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

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.

Double counting can occur if assets are valued by summing costs and the same costs are used to value different assets. This should be avoided (see recommendation 3). 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.

Divisible rights

As described in annex I, 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.

Originals and copies

Many of the artistic creations in originals are subject to copying for distribution to final users. If the proportion of artistic originals legally copied for further productive use is relatively small (perhaps limited to prints of films for distribution), they can be ignored.

35. Valuation of entertainment, literary and artistic originals

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.

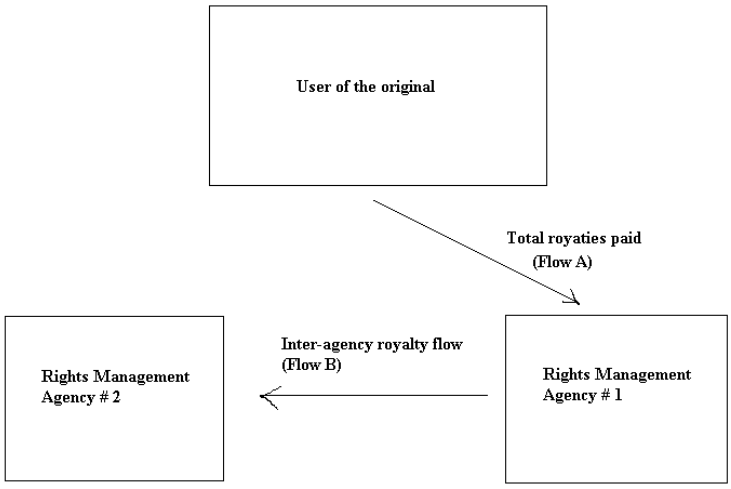
d) The discounted net present value of future receipts.

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 unlikely to be "similar originals" for reliable valuations. This leaves options (c) and (d) as the only viable options for valuing non-traded originals.

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.

The EU task force concluded that the production cost approach would be most appropriate for films and TV/Radio productions.

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 recognise 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. The value of the original is determined by the income received by the author from the Right's Management Agency # 2.



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[32] ; used by several countries in Europe:

$$W_j = H_j * (1+r_j-i_j) \qquad (1)$$

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 nominal growth rate of royalties compared with the previous year and i_j is the nominal 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. It is important to note that the royalties in this context are not restricted to those received by the author, musician etc. They can include revenues earned by other institutional units that have rights related to the original, such as production companies and publishers.

Recommendation 40: 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 41: The value of literature, music and photographic/image originals should be measured by modelling royalty flows (from whatever source), using a formula $W_j = H_j * (1+r_j-i_j)$, with the nominal rates r_j and i_j 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 can be estimated from a single year or by a moving average over up to five years.

36. Royalties and rights for entertainment, artistic and literary originals

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.

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 (. It is of course always possible that the seller, such as an artist, retains a significant proportion of their rights but these rights will be worth less if certain rights of exploitation have already been sold.

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.

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).

36.1 Domestic flows

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.

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.

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 <u>domestic</u> rights management agencies, and

c) Royalty payments paid and received to/from <u>non-resident</u> rights management agencies.

A corrigendum has been issued for this page. See: http://www.oecd.org/dataoecd/61/61/44756265.pdf

36.2 International flows

In terms of *cross-border flows*, the 2002 MSITS introduced specific categories in the EBOPs categories for "other royalties and licence fees", for "audio-visual services", and a memorandum item for "audiovisual transactions". Moreover, as described in chapter I, the 2010 MSITS and EBOP classification categories include changes that will further improve the situation in the following areas:

- A separate category, *Licenses to reproduce and/or distribute audiovisual and related services*, within *Charges for the use of intellectual property.*
- A breakdown of *Audiovisual services* into *Audiovisual products* and *Other audiovisual services,* with a further *of-which* item for the former, reflecting *Audiovisual originals.*
- The inclusion of a supplementary item *Audiovisual transactions*
- The inclusion of a further supplementary item *Licenses to use audiovisual products.*

Given that existing, centralised data collection mechanisms do not currently meet the requirements, it will be necessary for statistical offices to collect data directly from enterprises and organisations in the industries.

Recommendation 42: 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.

37. Prices and volumes

The EU task force made no recommendations concerning volume measurement and so what follows are the recommendations of the OECD Task Force on IPP responsible for developing this handbook.

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

With the exception of (c), and possibly (b), all of these factors are difficult to quantify. This makes it very difficult, if not impossible, to measure change in the market price of originals.

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 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

$$H_j = \qquad (2)$$

A corrigendum has been issued for this page. See: http://www.oecd.org/dataoecd/61/61/44756265.pdf

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

$$W_j = \qquad * (1+r_j-i_j) \qquad (3)$$

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.

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.

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.

The only other option is to measure the price change of originals as the price change in the inputs.

Recommendation 43: 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 entertainment, literary and artistic originals. Otherwise, suitably weighted input price indices should be used.

38. Capital measures

As for other forms of IPPs, 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. Ideally the service lives should be based on empirical data such as the discounted present values of royalties.

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.

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.

Given this, and recommendation 15, (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 entertainment, literary and artistic originals.

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31 If the film is produced by a joint venture then ownership is allocated to the respective countries.

32 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.

ANNEX I: 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 are:

- Reproduction
- Modification
- Distribution
- Public Performance
- Public Display

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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Handbook on Deriving Capital Measures of Intellectual Property Products

The latest System of National Accounts (the 2008 SNA) explicitly recognises, for the first time, that expenditures on research and experimental development (R&D) should be recorded as capital formation. This is a natural extension to the 1993 SNA, which recommends recording many acquisitions of software and databases, mineral exploration, and entertainment, artistic and literary originals as capital formation, too. These products have a common characteristic, namely that their value reflects the underlying intellectual property they embody, which is why they are referred to collectively in this publication as intellectual property products (IPPs). But they also share another important characteristic: their measurement is not straightforward, and in the absence of clear guidance it is highly likely that estimates will not be comparable between countries. This *Handbook* is designed to provide that guidance by considering IPPs collectively, based on their common characteristics, by type, based on any specificities, such as data availability, and by detailed transaction – for example the valuation of IPPs that have been produced for internal use by their developers, the valuation of unsuccessful IPPs, and the production of IPPs produced and made freely available by government.

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