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EUROSTAT

Directorate C: Macro-economic statistics

DMES Task Force on fixed assets and estimation of consumption of fixed capital under ESA 2010 (TF FIXCAP)

Final report – May 2023

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1. Introduction

The Task Force was established in August 2020 by the Directors of Macroeconomic Statistics (DMES) with a two year mandate to improve the availability and the quality of fixed assets data reported under the ESA 2010 transmission programme, in particular the comparability of stocks of fixed assets and estimation of consumption of fixed capital and associated metadata (see Annex 1). The Task Force met seven times, with its final meeting in October 2022, and the list of participants can be found in Annex 2.

The Task Force presented an interim report to the DMES in June 2021, which focused on the development of practical recommendations for the compilation of stocks of fixed capital and consumption of fixed capital (CFC). This final report complements the recommendations presented in that interim report, which were already generally accepted by the DMES in December 2022.

The analysis and harmonisation efforts of the Task Force concentrated mainly on the Perpetual Inventory Method (PIM), which is the most common method used to calculate capital stocks and CFC (or in other words depreciation) for national accounts purposes. In the PIM, capital stocks are calculated by cumulating flows of gross fixed capital formation (GFCF), corrected for retirements and CFC. ESA 2010 paragraph 3.141 says that the PIM is applied whenever direct information on the stock of fixed assets is missing.

The theory and application of the PIM is described in detail in the OECD Manual Measuring Capital from 2009. However, in order to implement the PIM, compilers have to make choices regarding the key assumptions of the method, in particular:

- Type of retirement and depreciation functions
- Key parameters of these functions, such as average and maximum service lives, and depreciation rates
- Estimating initial capital stocks
- Recording of other changes in the volume of assets (e.g. natural disasters, unforeseen obsolescence, classification changes)
- Price indices for capital stocks and CFC

For each of these there is a range of plausible assumptions, and the choices made can have significant impacts on the estimates of stocks and consumption of fixed capital. Given the substantial observed diversity of assumptions made across Member States, and the strong policy interest in statistics relating to fixed assets, it is necessary to further harmonise the assumptions used across countries.

This does not mean that all countries should use identical assumptions. Both institutional and natural (climate, geography) factors may influence the depreciation of assets in different ways. The goal is to avoid arbitrary differences without removing justifiable differences. For example, for service life assumptions, the aim is to agree on narrow ranges of acceptable values (interval

estimates, or point estimates in some cases) where there is no other available recent empirical evidence[1] at national level, together with a list of factors to take into account when making choices within these ranges.

Significant changes to PIM assumptions are usually made only periodically (often at the time of benchmark revisions), as they can potentially change long fixed capital stock and CFC time series, and (through the measurement of non-market output by sum of costs) key macroeconomic indicators such as Government Final Consumption Expenditure and GDP.

Given this, it is expected that Member States will implement improvements – as necessary – to their statistics, based on the recommendations in this report, during the next EU harmonised benchmark revisions of national accounts, scheduled for 2024.

The recommendations are presented through the report by topic, and are brought together in Annex 3.

Throughout the Task Force's work, an important emphasis has been placed on the availability of suitable metadata on statistical sources and methods used for compiling capital stocks. Few countries publish sufficient information for users on these sources and methods, and a major effort had to be made to collect such information to support the Task Force's work[2]. Nevertheless, this information remains incomplete in places, and further work – led by Eurostat – will be needed to complete it and make the metadata available at national and European levels.

In addition, the report considers (in section 9) the work undertaken by the OECD and Vienna Institute for International Economic Studies (hereafter "the Vienna Institute") to investigate the comparability of capital stock statistics across countries. This is a difficult task because the cumulative impacts of different assumptions on the aggregate results are hard to disentangle, and apparent outliers can (sometimes) be found to be justified by country circumstances. The work of the OECD has been described in an OECD Statistics Working Paper published in January 2023[3], while the data collection of combined retirement/depreciation profiles for countries not covered in this study is expected to continue throughout the year. The work by the Vienna Institute is still ongoing. The Task Force acknowledges the importance of country engagement with both projects in the coming months.

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[1] The issue of empirical evidence, and how it may be gathered, is discussed in Annex 4 of this report, as it is a horizontal aspect which is relevant for a number of assumptions to be made.

[2] A Confluence wiki has been established to collect and store detailed information on the assumptions used by countries in their PIM approaches and also to collect useful materials for practitioners.

[3] Pionnier, P., M. Zinni and K. Baret (2023), Sensitivity of capital and MFP measurement to asset depreciation patterns and initial capital stock estimates, OECD Statistics Working Papers, No. 2023/01, OECD Publishing, Paris

2. Choice of retirement function

Chapter 13 of Measuring Capital describes different kinds of retirement functions[4]. In this manual, the concepts “retirement” or “discard” denote the removal of an asset from the capital stock, with the asset being exported, sold for scrap, dismantled, pulled down or simply abandoned. The concepts are used interchangeably. Retirements are distinguished from “disposals” which also include sales of assets as second-hand goods for continued use in production.

The most common ones for use in the PIM are bell-shaped. With a bell-shaped function, retirements start gradually some time after the year of installation, build up to a peak around the average service life and then taper off in a similar gradual fashion some years after the average. Various mathematical functions are available to produce bell-shaped retirement patterns. The shape of the functions is determined by the choice of different parameters.

Retirement functions used in the EU/EFTA

Various functions are used in the EU/EFTA countries for which information is available (countries that use cohort geometric depreciation usually do not use an explicit retirement function). Six different bell-shaped functions are in use (log normal, normal, truncated normal, Weibull, quasi-logistic, and gamma). The three that are not bell shaped are simultaneous exit, linear and delayed linear, and these are used by four countries. Only one country (CZ) uses more than one retirement profile for the various assets. Most countries use the same functional form (but with different parameters) for all asset types.

Retirement functions used by country

Lognormal	**7**	BE, FR, HR, IE, LU, LV, CZ (partly), CY
Normal	**3**	HU, CZ (partly)
Weibull	**3**	EE, FI, NL
Truncated-normal	**2**	ES, IT
Quasi-logistic	**2**	LT, MT
Gamma	**1**	DE
Linear	**1**	RO, SK
Delayed linear	**1**	PT
Simultaneous exit	**2**	SI, CZ (partly)
Geometric	**1**	AT

[4] This report does not enter into the mathematical details of the functions, as these are well described in Measuring Capital, and the underlying research literature is accessible (see for example see Jorgenson’s 1995 ‘Productivity’ and 1996 ‘Depreciation’ publications, amongst others).

There is not much advice available on the choice of retirement functions in the literature, but bell-shaped retirement functions seem more plausible than simultaneous exit and delayed linear functions (see chapter 13.2 of the OECD Manual Measuring Capital). The different bell-shaped functions are challenging to compare, since the exact shape depends on the choice of parameters.

Recommendation 1

A bell-shaped retirement function should be used (without preferring a specific bell-shaped function).

3. Choice of depreciation function

ESA 2010 paragraph 3.139 defines consumption of fixed capital as ‘the decline in value of fixed assets owned, as a result of normal wear and tear and obsolescence.’ Paragraph 3.143 recommends the ‘straight line’ or linear depreciation method for calculating consumption of fixed capital, but paragraph 3.144 mentions the possibility of using the geometric depreciation method ‘when the pattern of decline in the efficiency of a fixed asset requires it.’

The difference between the linear and the geometric depreciation method may be significant for an individual asset, but the distinction is blurred when we consider a cohort of assets, i.e. all the assets of a particular type that are acquired in a specific year. We can assume that assets in a cohort will retire at different times, following a retirement function. Most EU Member States that use the linear depreciation method do so in combination with a bell-shaped retirement function.

The OECD Manual Measuring Capital from 2009 discusses in detail the different assumptions for asset retirement patterns, age-efficiency profiles and age-price profiles, and explains in chapters 4 and 5 how they are combined into depreciation patterns for cohorts of assets. An important result is explained in a box in chapter 4.3: ‘Even when depreciation profiles for a single asset are linear, depreciation profiles for an entire cohort turn out to be of convex shape. Reasoning in terms of a single asset is thus not a good guide to the depreciation profile of a whole cohort.’

The geometric depreciation function has a convex shape, and it is a simple function with important practical advantages for the PIM calculation. Based on these considerations, the OECD Manual Measuring Capital (on page 12) ‘recommends the use of geometric patterns for depreciation because they tend to be empirically supported, conceptually correct and easy to implement.’

One important factor to consider is that geometric depreciation functions usually combine two joint processes: the retirement and the depreciation of individual assets in a cohort. In this case, they generally cannot be used to calculate gross capital stocks (which are required in the ESA Transmission Programme).

According to the Eurostat/OECD survey from 2019, which has since then been updated by some countries, 18 EU/EFTA countries use linear depreciation for most individual assets, in

combination with a (mostly) bell-shaped retirement function. Eight of these countries use geometric depreciation in a minority of assets. Sixteen countries use geometric depreciation for cohorts of assets, while 7 of them also together with linear deprecation for some assets.

One country derives the depreciation function from the age-efficiency function with the present value method, as explained in chapter 3.2 of the OECD Manual 'Measuring Capital.

According to a Eurostat-OECD survey of structures from 2015, among non-EU countries, the US, Canada and Japan use geometric depreciation for cohorts of assets in their national accounts. Australia and Korea derive depreciation from age-efficiency functions.

Depreciation functions used by EU/EFTA countries

Linear (1)	**18**	BE, CZ, DE, EE, ES, FI, FR, HR, HU, IT, LU, LT, LV, MT, PT, RO, SI, SK
Geometric (2)	**16**	AT, BG, DK, EE, EL, ES, FI, IE, IS, IT, LT, LV, NO, PT, SE, SI
Based on Age-efficiency	**1**	NL

(1) In combination with a retirement function
(2) For cohorts of assets

More details per country and per asset can be found in the Confluence wiki pages for retirement and depreciation functions sections. Most countries tend to use the same functional form (possibly with asset-specific parameters) to model the depreciation throughout all assets. An exception is for R&D and other intellectual property products where more countries use geometric depreciation, in line with recommendations in the Joint Eurostat – OECD Task Force on Land and other non-financial assets - Report on Intellectual Property Products.

Recommendation 2

Within the context set by ESA2010 regarding depreciation functions, the recommendation is limited to using a convex cohort depreciation function.

4. Average service lives

Comparative studies have shown that the assumptions for average service lives can have significant impacts on capital stocks and CFC over time[5]. But many Member States do not have direct evidence for setting service life assumptions (Annex 4 describes some of the potential

[5] For example see a study from CBS Netherlands.

sources for this evidence and some international experience). In the absence of such evidence at national level, a harmonisation of assumptions across countries can improve comparability.

The following sections provide recommendations of the Task Force for average service lives (ASL) for each asset type, often including a range above and below. The range is usually 5 years above and below the recommended ASL, or less in the case of short ASLs. Some asset types that can be assumed to be more homogenous have no range. The recommendations are based on observed service lives and existing guidance, informed by discussion in the Task Force. Cumulatively, the average service life recommendations are **Recommendation 3** of the Task Force and are summarised in a table in Annex 3.

Many of the asset categories are heterogeneous. In this case, it is suggested that the service lives should vary within the broad asset category, by more detailed asset breakdowns. If this data is not available, differentiation by industry using the asset is an alternative.

Criteria for selecting within the range of service lives are mentioned as well for many types of assets. The ASL of an asset class is expected to be influenced by its composition (i.e. by the weight of the different components/products, new assets or upgrades etc.) and by the intensity of their use. These factors may vary by country, industry and sector, as well as over time.

Service lives may change over time, so it is important to review the service life assumptions on a regular basis. It is recommended that the review takes place at least **every 5 years** (in particular for such assets that have a considerable weight in the total assets), in connection with the harmonised benchmark revision of national accounts.

If it is decided to change ASL, the next step is to decide whether to revise the time series backwards. It is important to avoid unjustified breaks in time series when new ASLs are introduced, and implementation during a benchmark revision allows for an informed choice. If a revised ASL is also applicable to the past, then a revised time series should be estimated.

ASLs should not vary over the business cycle. Unexpected changes in the capital stock should be recorded as other changes in volume, see section 6. This would also apply, for example, to assets (e.g. aircrafts, cruise ships etc.) permanently taken out of use earlier than expected because of crises such as the COVID-19 pandemic.

Geometric depreciation function and ASLs

If the geometric depreciation function is used, the ASLs have to be converted to geometric depreciation rates. The OECD Manual Measuring Capital explains in Chapter 5.5.2 and 12.1 how this can be achieved with the so-called ‘declining balance method’.

The formula is $\delta = R/ASL$, where δ is the cohort geometric depreciation rate and R is a declining-balance rate (DBR). Several EU and EFTA countries use an assumption of R=2, which is called the double declining balance method. At the same time, there are no broad-based empirical results that would generally support a DBR of 2, and non-EU countries such as

the US and Canada use declining balance rates above or below 2, based on their own assessments.

It is recommended that countries using declining-balance rates collect empirical evidence at national level on the appropriate rates to apply by asset (see Annex 4).

Recommendation 3

The following average service lives are recommended. In some cases, a range is specified. Member States that use an ASL outside the range should support their decision by evidence.

Dwellings (AN.111)

This asset type covers buildings that are used entirely or primarily as residences, including any associated structures, such as garages, and all permanent fixtures customarily installed in residences. Average service lives for dwellings vary from 45 to 90 years across countries, with most between 60 to 80 years.

Part of the investment in dwellings is renovation and upgrades rather than new buildings. Ideally, these should be accounted for separately, with a shorter asset life than new buildings. If this is not possible in practice, the asset life chosen should reflect a combination of new buildings and upgrades.

The costs of ownership transfer should also ideally have shorter service lives, reflecting the time between ownership changes.

The recommendation for average service life (ASL):

Asset	ASL years	Range
Dwellings	70	65 - 75

Factors influencing the choice of ASL: Relative shares of new buildings, upgrades (comprehensive maintenance and modernisation measures) and costs of ownership transfer in GFCF. High share of upgrades and transfer costs point to lower ASL.

Buildings other than dwellings (AN.1121)

This asset type contains a wide range of buildings, e.g. warehouse and industrial buildings, commercial buildings, buildings for public entertainment, hotels, restaurants, educational buildings, health buildings.

This heterogeneity in building types implies a wide range of asset lives used in the PIM, both within and across countries. These range from 12 to 150 years across countries, with most countries between 30 and 60 years. It is therefore useful to differentiate some more detailed asset types with different service lives. A differentiation by industry could serve a similar purpose.

Warehouse and industrial buildings often have shorter lives than commercial buildings.

Part of the investment in buildings is renovation and upgrades rather than new buildings. Ideally, these should be accounted for separately, with a shorter asset life than new buildings. If this is not possible in practice, the asset life chosen should reflect a combination of new buildings and upgrades.

The costs of ownership transfer should also ideally have shorter service lives, reflecting the time between ownership changes.

Recommendation for average service is to differentiate between at least these groups:

Asset	ASL years	Range
Warehouse and industrial buildings	30	25 - 35
Commercial buildings	50	45 - 55
Educational buildings	50	45 - 55
Health buildings	50	45 - 55
Buildings and structures for military use	50	45 - 55
Other buildings	50	45 - 55

Factors influencing the choice of ASL: Relative shares of new buildings, upgrades, and costs of ownership transfer in GFCF. High share of upgrades and transfer costs point to lower ASLs.

Note: The difference in recommended ASLs for dwellings (65 to 75 years) and other buildings may seem large. However, the design, construction methods and the level of wear usually differs between the two asset categories, i.e. the use of simple prefabricated buildings for warehouses and industrial buildings, and higher intensity of use and faster economic obsolescence for commercial buildings.

Other structures (AN.1122)

This asset type contains a wide range of structures. Examples include highways, streets, roads, railways and airfield runways; bridges, elevated highways, tunnels and subways; waterways, harbours, dams and other waterworks; long-distance pipelines, communication and power lines; local pipelines and cables, ancillary works; constructions for mining and manufacture; and constructions for sport and recreation.

This heterogeneity in asset types implies a wide range of asset lives used in the PIM, both within and across countries (between 25 and 150 years, with most countries between 30 and 70 years).

For roads and bridges, a recommendation exists. ESA 95 expanded the scope of consumption of fixed capital (CFC) to include this kind of infrastructure. In 2002, the (then) GNP Committee set up a Task Force on the consumption of fixed capital on roads, bridges, etc. The mandate included to examine and evaluate current practice in Member States regarding the estimation of

CFC on roads, bridges, dams, etc., and make proposals aimed at improving the comparability of estimates across Member States.

The Task Force (TF) made recommendations[6] on service lives and depreciation and retirement functions for these asset types. The ideal approach would be to distinguish the main components of infrastructure assets in the PIM (earthworks, foundations, bridges and tunnels, surface layers for roads, etc.) and to use separate assumptions for each component. It was recognised that this would be difficult in practice, so the TF made recommendations for a simplified method, based on a weighted average over the different main components. The recommendation was to use an average lifetime estimate of 55 years, with a range from 50 to 60 years.

The suggestion is to keep this recommendation for all assets in this “Other structures” category, as there is no evidence that the situation has changed to such an extent that the recommendation made at that time has lost its validity.

Part of the investment in structures is renovation and upgrades rather than new structures. Ideally, these should be accounted for separately, with a shorter asset life than new structures. If this is not possible in practice, the asset life chosen should reflect a combination of new structures and upgrades.

Recommendation for average service life (ASL):

Asset	ASL years	Range
Other structures	55	50 - 60

Factors influencing the choice of ASL: Relative share of the main components and upgrades / renovations.

Land improvements (AN.1123)

Examples of land improvements include the increase in asset value arising from land clearance, land contouring, creation of wells and watering holes. Many countries include AN.1123 in buildings and structures, and some others use similar service lives as for AN.1122 Other structures.

The recommendation is therefore to use the same service lives as AN.1122 Other structures.

Transport equipment (AN.1131)

This asset type contains a wide range of assets and include equipment for moving people and objects. Many countries differentiate service lives by detailed asset types or industry. Ranges of service lives are recommended for types of equipment which may have more varied use

[6] GNIC 497/Rev. 1, available on CIRCABC in the group GNI Expert Group, GNI/GNP Committee (Restricted)

intensity or differentiation (e.g. ships and vehicles), whereas a point estimate of service life would be more suitable for other types.

A differentiation by detailed asset is preferable. If this information is not available, differentiation by industry is an alternative.

Upgrades can be important, e.g. for aircraft, ships and trains.

The recommendation for average service lives is to differentiate between at least the following groups:

Asset	ASL years	Range
Aircraft	20	
Trains	25	
Ships	25	20 – 30
Vehicles (possible differentiation e.g. trucks, trailers, buses, cars)	10	8 – 12

Factors influencing the choice of ASL: Use intensity for vehicles may vary by industry (e.g. higher in the transport industry) or, for example, the wear and tear of ships may be different depending on whether the ships are on high seas or inland waterways. Share of upgrades in GFCF.

Computer hardware (AN.11321)

Examples are shorter-lived hardware (such as laptop computers) as well as longer-lived hardware (such as servers). Most countries' ASLs are between 5 and 8 years. There is little differentiation by asset type or industry. The range reflects the balance of shorter-lived hardware (such as laptop computers) with longer-lived hardware (such as servers). It is reasonable to assume that the ASL for computers has been changing over time, with changes in technology[7]. This means that this ASL especially needs regular review.

Recommendation:

Asset	ASL years	Range
Computer hardware	6	5-7

[7] See e.g. Evolution of Product Lifespan and Implications for Environmental Assessment and Management: A Case Study of Personal Computers in Higher Education, by Babbitt et al. (2009)

Telecommunications equipment (AN.11322)

Examples are mobile phones and telecom network routing equipment. Most countries' ASL is between 5 and 15 years. There is little differentiation by asset type or industry. The ASL is likely to change over time, with changes in technology. This means that this ASL needs regular review.

Recommendation for average service life:

Asset	ASL years	Range
Telecommunications equipment	5	4 – 7

Factors influencing the choice of ASL: Shares of different types of equipment. In particular the share of mobile telephones is expected to be a significant factor, and an evidence-based specific service life – where possible to separately identify these telephones – may usefully be applied to them.

Other machinery and equipment (AN.1139)

This asset type contains a wide range of equipment. According to ESA 2010: "Examples include products other than parts, installation, repair and maintenance services included in CPA[8] division 26: computer, electronic and optical products (except groups 26.1 and 26.2), division 27: electrical equipment, division 28: machinery and equipment n.e.c., division 31: furniture, and division 32: other manufactured goods."

This is reflected in the wide range of asset lives used in the PIM, both within and across countries. (The range is 3 to 43 years, with most countries in the 10 to 30 years range). It seems useful to differentiate some more detailed asset types with different service lives. This information may not be available in all countries. In that case, differentiation by industry is a second best option.

A good starting point for differentiation would be the CPA groups mentioned in the definition above. Even with these groups, further differentiation by NACE may be useful. CPA 28 is a broad group, for example. Information on this level should be available in Supply-Use tables, including price indices. Industries' GFCF will consist of different combinations of the products. If this detailed information is not available, an ASL for each industry can be derived as a weighted average of the ASLs for the products. The weights may be based on information from other countries, if necessary.

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[8] Classification of products by activity: Commission Regulation (EU) No 1209/2014 of 29 October 2014 amending Regulation (EC) No 451/2008 of the European Parliament and of the Council establishing a new statistical classification of products by activity (CPA) and repealing Council Regulation (EEC) No 3696/93.

The recommendation is to differentiate based on products, with differentiation by industry as a second best option:

Asset	ASL years	Range
CPA 26: computer, electronic and optical products (except groups 261 and 262)	10	8 - 12
CPA 27: electrical equipment	15	12 - 18
CPA 28: machinery and equipment n.e.c.	20	15 - 25
CPA 31: furniture	15	12 - 18
CPA 32: other manufactured goods	10	8 - 12

Factors influencing the choice of ASL: Shares of different types of equipment.

Weapon systems (AN.114)

An overview of the service lives used for weapon systems in EU Member States is given in the GNI Committee document GNIC/499 – Final report on CCCs: Weapon systems (Transition item 4).

Countries that reported a point estimate of the service life for all types of weapon systems use average lifetimes between 5 and 25 years (with a median value of ca. 20 years). The other countries varied the service lives by type of weapon system, such as tanks, ships, and aircraft.

Upgrades can be important (e.g. for aircraft, ships and tanks). Ideally, these should be accounted for separately, with a shorter asset life than new equipment. If this is not possible in practice, the asset life chosen should reflect a combination of new equipment and upgrades.

It is recommended to have ranges for two types of weapons systems (aircraft and other assets), leaving point estimates of ASLs for other types of system. As with all the recommended ASLs in the report, recent evidence at national level will be helpful to set ASLs for these other types.

The recommendation is to differentiate between at least the following groups:

Asset	ASL years	Range
Aircraft	25	20 - 30
Ships	25	
Tanks	20	
Armoured vehicles	20	
Electronic equipment	10	
Other	15	5 - 25

Factors influencing the choice of ASL: Share of upgrades in GFCF.

For the “Other” category there needs to be a distinction made between shorter life weapons (e.g. hand-held weapons) and longer lived weapons (e.g., missile systems).

Cultivated biological resources (AN.115)

According to ESA 2010 paragraph 3.140 CFC is not to be calculated for animals, so for this asset, CFC applies to tree, crop and plant resources yielding repeat products. Common examples are vineyards, orchards, groves, asparagus or hop cultivation. For animals, ASL may nevertheless be used to calculate the gross stock with the PIM.

Recommendation for average service lives:

Asset	ASL years	Range
Animal resources yielding repeat products (no CFC)	10	
Tree, crop and plant resources yielding repeat products	15	10 - 20

Factors influencing the choice of ASL: Type of plants cultivated (natural conditions).

Research and Development (AN.1171)

The Joint Eurostat – OECD Task Force on Land and other non-financial assets – Report on Intellectual Property Products from 2020 discusses the estimation of net stocks of R&D in chapter 2.6. The recommendations for service life and depreciation function are:

“15. Countries should regularly re-examine the service lives of the different types of R&D assets. In the absence of direct information, using a service life of 10 years is acceptable until further reliable information becomes available.

16. In measuring net capital stock of R&D, the geometric depreciation approach is preferred unless there are conceptual or practical objections.”

The report also recommends not to include consumption of fixed capital on R&D assets in the sum of cost method for estimating own account capital formation for IPP for industries other than NACE 72. In a dynamic model, this has implications on the overall level of consumption of fixed capital (P.51c).

The Eurostat Manual on measuring Research and Development in ESA 2010 from 2014 gives similar recommendations. Paragraph 6.9 says:

“As a last resort, where no reliable evidence is available for the activity in which the R&D product is used, a service life of 10 years is as acceptable until further reliable information becomes available. The depreciation function can be any currently used in the standard PIM models, including straight-line depreciation, although the geometric one is recommended.”

Most countries use the 10 year ASL assumption, some others use a range around 10. Differentiation by type (e.g. basic research, applied research and development) and/or industry is recommended if the information is available.

Recommendation for average service life:

Asset	ASL years	Range
Research and development	10	8 - 12

Factors influencing the choice of ASL: Types of R&D undertaken.

Mineral exploration and evaluation (AN.1172)

The OECD Handbook on Deriving Capital Measures of Intellectual Property Products from 2010 discusses capital measures for mineral exploration and evaluation in section 25. Recommendation 26 says that:

"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."

Mineral exploration and evaluation is not relevant in all countries, but those that calculate it use ASL that vary from 2 to 50 years.

Recommendation for average service life:

Asset	ASL years	Range
Mineral exploration and evaluation	30	20 - 40

Factors influencing the choice of ASL: Type of sub-soil assets involved and their longevity.

Computer software and databases (AN.1173)

Examples of computer software are computer programs, program descriptions and supporting materials for both systems and applications software, while databases are files of data organised to permit resource-effective access and use of the data.

Some guidance on the service life of software is given in the report[9] of the GNP Committee Task Force Software Measurement from 2002, see paragraph 6.8:

"The average service life for software should probably be between 3 to 5 years."

The Joint Eurostat – OECD Task Force on Land and other non-financial assets - Report on Intellectual Property Products from 2020 discusses the estimation of net stocks of software and databases in chapter 3.7. Recommendation 33 says:

[9] Document CPNB/313, available on CIRCABC in the group GNI Expert Group, GNI/GNP Committee (Restricted)

“In measuring net capital stock of software and databases, the geometric depreciation approach is preferred unless there are conceptual or practical objections.”

No explicit recommendation for service life is given, but it is mentioned in paragraph 94 that “…most countries apply an average service life of 5 years (in line with the Eurostat and OECD recommendations in case information is lacking) although a few countries apply significantly longer service lives (i.e. 9 or 10 years).”

Some countries use different ASL for purchased and own-account software (a bit shorter for purchased than for own-account). This is recommended if the information is available. The share of software being sold by subscriptions is increasing. These should be recorded as intermediate consumption and not GFCF.

Recommendation for average service life:

Asset	ASL years	Range
Computer software and databases	5	

Entertainment, literary or artistic originals (AN.1174)

Examples are original films, sound recordings, manuscripts, tapes, models, etc., on which drama performances, radio and television programmes, musical performances, sporting events, literary and artistic output, etc. are recorded or embodied.

Some guidance on the service life and depreciation function of originals is given in the GNI Committee document GNIC/475[10], which is based on the report of GNI Committee Task Force on Entertainment, Literary and Artistic Originals from 2003. Recommendation 6 says that:

“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.”

The OECD Handbook on Deriving Capital Measures of Intellectual Property Products from 2010 refers to this, and adds in section 38 that “the case for using the geometric model seems particularly strong for entertainment, literary and artistic originals.”

Most countries use an ASL in the range of 5 to 10 years.

Recommendation for average service life:

Asset	ASL years	Range
Originals	7	5 - 10

Factors influencing the choice of ASL: Types of originals.

[10] Available on CIRCABC in the group GNI Expert Group, GNI/GNP Committee (Restricted)

Other intellectual property products (AN.1179)

Very few countries report CFC on this, so no recommendation is made.

5. Estimating the initial capital stock

The PIM model assumes that a sufficiently long time series of GFCF data is available for each asset. For long-lived capital goods (notably buildings and structures), this may however not be the case, and a second-best approach has to be taken. There are several methods to deal with this situation (see the work by the OECD[11]), and it is helpful to use more than one method and then to compare the results.

A first method is to construct a benchmark estimate on the basis of other sources. The Measuring Capital OECD Manual 2009 mentions several possibilities in Chapter 15.7:

- Wealth surveys (i.e. specific surveys of capital goods)
- Population censuses (e.g. number of dwellings of different types)
- Fire insurance records (should give net capital values, but may be incomplete)
- Company accounts (e.g. asset values at depreciated historic costs)
- Administrative property records (e.g. buildings at revalued historic prices)
- Share valuations (may include values that are not fixed assets in national accounts)

Specific surveys of capital goods for statistical purposes are available in only a few countries (e.g. Canada, Japan) and are not common in the EU. The other sources mentioned here are based on direct information related to the capital stock, such as administrative records and company accounts, and will require a number of assumptions in order to estimate capital stock values suitable for use in national accounts (notably in terms of valuation and coverage). The results will be approximations, but the importance of errors introduced into the stock figures will diminish over time as the base period is left further behind.

A second method, commonly used across countries and in the economic literature, is to rely on stationarity assumptions either about the growth rate of GFCF or the capital stock to output ratios. The first approach consists in extrapolating the (volume) GFCF series backwards, using

[11] See Pionnier, P., M. Zinni and K. Baret (2023), "Sensitivity of capital and MFP measurement to asset depreciation patterns and initial capital stock estimates", OECD Statistics Working Papers, No. 2023/01, OECD Publishing, Paris,

– where the usual source data for GFCF are not available[12] – the growth rate of related variables observed at national level or the growth rate of the GFCF over a more recent period for which GFCF data are available. The estimated backward time series must be long enough in relation to the service life of the asset concerned – if the longest service life of a given asset is T and capital stocks need to be published from date t onwards, the corresponding GFCF series should start at date t-T (at least). In the second approach, it is assumed that the capital stock-to-output ratio is constant over time, in which case the initial capital stock can be derived using the capital stock to output ratio estimated for a recent date together with the value of output (GDP) at the initial date.

When relying on stationarity assumptions about the growth rate of GFCF, it is important to investigate (and test) whether the growth rate of GFCF is stable over time or, when using the growth rate of related variables to extend GFCF series backwards, whether there is a stable relationship between these and the observed GFCF series. When applying stationarity assumptions about the capital stock to output ratios, it is important to carefully assess whether there is a stable relationship between the GDP and the estimated capital stocks.

In both cases, it is important to make adjustments for other changes in the volume of assets that may have occurred in the past, i.e. increases or reductions in the capital stock that are not included in GFCF (see section 6).

The results of these backward extrapolation methods are sensitive to the assumptions used. A useful pragmatic approach is to back-estimate a few years more than are actually needed, then verify in detail the results (e.g. the ratio of CFC in relation to capital stocks) for the first few years after the published initial capital stock estimate.

Recommendation 4a

Where there is no obviously best method available to estimate an initial capital stock (reliable valuations at a suitable point in time), two (or more) different methods may be tried, and the results cross-checked.

Recommendation 4b

A two step approach is recommended when initial capital stocks must be estimated:

- Backcasting GFCF series for as long as possible. Ideally, if the longest service life of a given asset is T and capital stocks need to be published from date t onwards, the corresponding GFCF series should start at date t-T (at least). This backcasting exercise should be based on national data sources such as historical vintages of national accounts, company accounts, censuses and other relevant administrative sources.

[12] Clearly the best approach would be to calculate a longer GFCF time series from the same or equivalent data sources used for more recent GFCF data, even if complete national accounts have not been compiled for those earlier years.

- If additional assumptions are needed, finding a stable relationship with a reliable indicator which leads to converging results. A useful pragmatic approach is to back-estimate a few years more than are actually needed, then verify in detail the results (e.g. the ratio of CFC in relation to capital stock) for the first few years after the published initial capital stock estimate.

6. Other changes in the volume of assets

Other changes in the volume of assets have to be taken into account in the PIM model. They account for changes in the volume of the capital stock that are not included in GFCF or CFC. For fixed assets, examples of other changes in volume include (see ESA 2010 para. 6.01-6.25):

- Economic appearance of historic monuments, when their value is first recognised in the balance sheet. (K.1 in ESA)
- Catastrophic losses caused by natural disasters, war, major accidents, etc. (K.3)
- Uncompensated seizures. (K.4)
- Damage and degradation not accounted for in CFC, and not large enough to be considered catastrophic. (K.5)
- Unforeseen obsolescence. (K.5)
- Abandonment of production facilities before completion or use. (K.5)
- Reclassifying an institutional unit from one sector to another. (K.6)
- Changes in the classification of assets, such as conversions of dwellings to commercial use. (K.6)

These are the only cases on which other changes in volume of assets should be recorded, and other rationales for recording should be avoided. In the case of classification-related other changes in volume, these do not relate to restructuring of balance sheets between existing units (GFCF transactions should be recorded in this case when the restructuring is between domestic sectors or across borders). Other changes in volume should not be used for balancing purposes to reconcile stocks and flows.

Wherever other changes in volume of assets are recorded, it is helpful to inform users of the reasons and amounts involved, so that they can fully reconcile stocks and flows.

The procedure for taking into account other changes in volume, where a geometric cohort depreciation function in used, can follow the simplified process set out in the OECD's Measuring Capital manual.

Recommendation 5a

Other changes in volume of assets are only recorded for situations enumerated in ESA 2010 para. 6.01-6.25, with transactions in GFCF or CFC being recorded for other situations. Where there are significant amounts of other changes in volume of assets, it is helpful to clearly inform users through appropriate metadata.

Recommendation 5b

If a geometric cohort depreciation function is used, Member States should follow the OECD Manual on Measuring Capital.

Member States should avoid using “other changes in volume” if there is no clear conceptual rationale for doing so.

Changes in classification and structure should be used only for statistical re-classifications, not for organizational restructuring (e.g. in the case of restructuring of balance sheets between existing units).

Other changes in volume should not be recorded as a “balancing item” when reconciling stock and flow measures.

7. Price indices

In the PIM model all variables are valued at average prices of a reference period, which may be the previous year, the current year or another year. In a second step, the price index of the asset class under consideration is used to calculate CFC and capital stock in current prices and/or previous year prices, depending on the reference year chosen.

The price index for the asset class is the same as the price index for the gross fixed capital formation (GFCF) of the asset.

Guidance on price indices for GFCF can be found in the Eurostat Handbook on price and volume measures in national accounts from 2016, see chapter 3.6. Some of the main points in the Handbook are:

- GFCF covers a large range of different products, many of which can be unique.
- The large range of different products calls for methods to be applied at a detailed product level to ensure good quality estimates of GFCF in volume terms.
- Valuation is an important issue when considering the suitability of price indices for the deflation of GFCF. For price indices to be entirely appropriate they should measure changes in the purchasers' price of the particular products, including any non-deductible VAT included in the price.

- Another important consideration is that some goods recorded as GFCF will have been imported. This creates the need to ensure a consistent approach to the deflation of products within imports and GFCF, taking account of any difference in price, for example due to taxes and subsidies on imports.

Ideally, the Supply and Use framework should be used for deflation. During the SUT balancing process, the deflators for GFCF should be checked for plausibility.

The Task Force discussed the use of price indices specifically for Dwellings, and then for other assets. It was observed that there was ongoing work – led by Eurostat – on the quality of prices and volumes in national accounts, and capital stock compilers would need to be aware of improvement actions for price indices used in PIM models. The Task Force further noted the usefulness of **periodic cross-country comparisons of price indices**, at least for some assets.

With respect to **Dwellings**, the Task Force recalled that buildings should be separated from the land underlying them, and therefore that the price indices used in the PIM should focus on the buildings[13]. Given the general principle that the price index for an asset class should be the same as the price index for the gross fixed capital formation (GFCF), the Task Force considered construction price indices (relating to new dwellings and major renovations), however it also looked at the House Price Index (HPI) and the sub-component for acquisition of dwellings of the Owner-Occupied Housing Price Index.

The Task Force agreed ideal price index for using in the PIM for dwelling assets should have the following characteristics:

- It focuses on newly built assets (since the PIM needs a deflator for investment flows)
- It includes changes in price of major renovations
- It takes full account of quality changes in the dwellings

The Task Force concluded that the overall HPI is unsuitable for PIM purposes, because it is based on transactions of new and existing dwellings, includes changes in the price of land, and does not take account of major renovations.

The Task Force considered the subcomponent “O.1.1 Acquisition of dwellings” of the Owner-Occupied Housing Price Index (OOHPI) to broadly have the desired characteristics. In principle, the OOHPI includes only acquisitions of dwellings for the purpose of owner-occupation, though in practice the price index is based on all transactions (adjustments are made only for the weights). Two potential drawbacks were however identified – the index only considers purchases by households, and the value of underlying land is included.

[13] This is an important aspect in some countries, notably in cities, where it is observed that prices of land underlying buildings may increase much faster than prices of the buildings themselves.

The Task Force noted that a construction price index is already widely used by countries for PIM purposes. It has the desired focus on new dwellings (separate from underlying land), but it is not clear if in every country this index includes major renovations, or if in some countries quality developments (both in terms of composition changes in dwellings and quality changes in each type of dwellings) are taken into account (since the indices are sometimes named "construction cost indices" in metadata).

The Task Force recalled that the Eurostat Handbook on price and volume measures in national accounts recommends to avoid (as "C methods") the use of input prices to deflate output, as well as the use of physical indicators such as cubic metres of construction. Three methods are described in the Handbook to develop output prices:

- The "actual prices" (sometimes called "repeat sales") method which uses prices from real comparable projects;
- The "model prices" method which asks construction experts to estimate prices based on a set of model project specifications;
- The "hedonic" method which uses a model-based approach to identify the key characteristics which influence prices.

The Task Force also noted that the underlying valuation basis is important, taking into account all factors which impact on the purchase prices of dwellings (for example taxes on the purchase of houses and other transaction costs).

With respect to Other assets, the Task Force underlined the heterogeneity of some asset classes, and therefore the importance of both using price indices at the most detailed level possible, and also of publishing metadata for users on the sources and methods used.

Whilst examining descriptions of country practices, it was noted that some "C methods" continue to be used in some countries, and that the earliest opportunity should be taken to replace them with better methods. In particular, some countries continue to use a general CPI, or to use unadjusted Producer Price Indices, for some assets.

The Task Force noted substantial differences across countries in the development of (implied) price indexes over recent years and linked them to the need for improvements being identified by ongoing general work on prices and volumes in national accounts. One example discussed was ICT equipment, which is an asset type where significant differences in measured price changes can be observed across countries (most countries show substantial falls in prices whilst others show stable or even rising prices), even if these assets are widely traded and often produced in non-EU countries.

Recommendation 6a

Ideally, the Supply and Use framework should be used for deflation. During the SUT balancing process, the price indices for GFCF should be checked for plausibility.

It will be useful to make periodic cross-country comparisons of price indices, at least for some assets. An example could be ICT equipment, which is an asset type where significant differences in measured price changes have been observed in the past.

Recommendation 6b

With regard to the use of price indices for dwellings (separated from land):

- If possible, Member States should use a construction price index (provided it has suitable coverage and takes account of quality changes), or – as a second best – the “Acquisition of dwellings” component of the OOHPI.
- Member States should review how quality change is taken into account for dwellings, either in their price indices or PIM approach. It is important that the ‘volume’ element of dwellings (i.e. both the impact of composition changes in dwellings and quality changes in each type of dwellings) is clearly separated from the price (revaluation) effect.
- Member States should consider if the PIM approach should distinguish between different components of dwelling stocks when conducting revaluation, and if all of these components (major renovations, costs of ownership transfer etc) are covered.
- Use of headline HPI should be avoided.

Recommendation 6c

For other asset types than dwellings:

- PIM experts should be informed at national level of the ongoing work to improve prices and volumes in national accounts through the general prices and volumes project, and possible impacts on their work.
- Application of price indices should be at the most detailed product level possible.
- Member States should improve their metadata describing how price indices are applied.
- Some remaining ‘C methods’ identified in Member States for price indices for GFCF should be replaced with better methods.
- Some implicit price deflators in some countries should be investigated, where strong divergence is observed from development of prices of internationally-traded assets or unusually strong movements over period; notably for ICT assets for some countries.

8. Harmonisation of data

The Task Force examined several aspects of capital stock compilation which are not directly linked to the PIM, but which have an impact on published data (and are noticed by users) and could therefore usefully be further harmonised.

Coverage of asset categories

The Task Force noted that there is no detailed international correspondence table between asset categories and product categories (CPC/CPA), however the 2008 SNA (Chapter 10) and

the ESA 2010 (Annex 7.1) provide some overall guidance (in the form of examples) by asset category. This leads to the possibility that different countries could include different products – at the detailed level – in a given asset category. This will not necessarily impact the overall results from the PIM, provided that the assumptions for that asset category (e.g. service lives) relate to the products included within it, however the comparability across countries of the breakdown of stocks by asset is impacted.

One specific example of this discussed in the Task Force relates to telecommunications equipment. The Task Force discussed the appropriate coverage of this asset category, and in particular whether it largely covers mobile telephones, or also includes other (longer lived) assets such as mobile telephone phone masts and network equipment.

ESA 2010 does not include a definition of this asset, but the aggregate AN.1132 ICT equipment is defined as follows in Annex 7.1:

“Information and communication technologies (ICT) equipment: devices using electronic controls and the electronic components used in the devices. Examples are products within CPA 2014 groups 26.1: electronic equipment and boards, and 26.2 computers and peripheral equipment.”

CPA also has a group called 26.3 Communication equipment, which includes radio or television transmission apparatus, television cameras and telephones. This should be included in AN.11322.

The 2008 SNA contains the following text (with CPC category 472 including mobile telephones):

10.85 Information, computer and telecommunications (ICT) equipment consists of devices using electronic controls and also the electronic components forming part of these devices. Examples are products within CPC 2.0 categories 452 and 472.

Communication lines and cables are included in the definition of other structures (AN.1122), which indicates that they (and other types of structures, such as mobile phone masts) should not be included in AN.11322.

Eurostat was asked by the Task Force to work towards a clarification of asset/product correspondence, that Member States could check (and possibly update) their own correspondences. This work is ongoing and will be shared with Member States in the coming months.

Cross-classification of assets by industry

The Task Force discussed a cross-country analysis of asset categories by industry, which showed some substantial variations in the industries to which assets are allocated. This was particularly noticeable for some categories (such as dwellings and cultivated biological assets), where some countries allocate all of these assets to one industry, some countries allocate these

assets to a small number of industries, and a few countries allocate assets across many industries.

The Task Force recognised that country specificities can lead to observed differences in the allocation of assets by industry, but also the risk that in some cases there may be a mechanical allocation of assets to industries (which should be avoided).

The general principle to follow is that an asset is allocated according to the unit which economically owns it. The Task Force also noted the importance of consistency in allocation of assets and their related transactions within the same industry (i.e. assets should not be re-allocated without their related transactions), to ensure that productivity analysis can be undertaken properly.

In particular, for dwellings, a large proportion of the dwelling stock is usually owned by households or real estate developers, and therefore it is expected that NACE L (specifically NACE L68A for dwelling stock owned by households) will have a large share of dwelling assets, or even that all dwelling assets are allocated there by convention (as is seen in many countries). However, it could also be possible – based on supporting evidence – that some dwellings are recorded in NACE F if construction companies are building dwellings on their own account, or NACE K if financial institutions directly own dwellings as an investment diversification.

For the case of cultivated biological resources, the Task Force noted that this asset would be mostly allocated to NACE A with possibly some small allocation to other NACE divisions (often covering secondary production).

Transmission practices

The ESA Transmission Programme Tables for capital stocks data are detailed and complex, which means that their transmission protocols are particularly important to ensure that Member State data are presented correctly in the Eurostat database, and that compilation of European aggregates is facilitated.

As some heterogeneity was noted when analysing countries transmission patterns, Eurostat presented good transmission practices to the Task Force which make appropriate use of SDMX transmission protocols, notably with respect to using a correct and consistent distinction of zero from the transmissions of values as “not-a-number” (NaN) combined with “data cannot exist” (M) and “data exist but were not collected” (L) flags.

Based on the SDMX guidance on the use of flags, and some recommendations already reflected in the ESA 2010 Handbook on Data Validation and further harmonisation guidance on flags presented to DMES[14], it is recommended to clearly distinguish the following cases:

- Notably, flag M for “data cannot exist” should normally only be used in few and specific cases, e.g. if values do not exist for methodological/concept/legal/institutional reasons. Examples for asset stocks by industry could be values for industry U, or specific combinations of assets and industries that are not applicable, like explained above for dwellings or biological assets.
- On the other hand, a zero should clearly be used if the value could also be a number different from zero (but is equal or very close to zero for the specific period). SDMX also allows to associate the transmission of zero with OBS_STATUS = N, i.e. “Not significant” to indicate a value which is not a "real" zero but a very small number (e.g. a result of 0.0004 rounded to zero).
- However, since the distinction between uses of “not-a-number” (NaN) with M flag and zero values can sometimes be “philosophical”, and the use of zero has practical advantages for users and producers for direct use in calculations, the use of zero instead of “not-a-number” (NaN) with M flag cases is also acceptable, especially if it is consistently done across ESA tables and in line with national publications, as “not-a-number” (NaN) with M flag values are in any case interpreted as zero for aggregation and additivity checks.
- Finally, it is very important that all values that are “data exist but were not collected”, but represent values that can be different from zero, are transmitted as “not-a-number” (NaN) with L flag, independently of legal transmission requirements. Especially, voluntary breakdowns should not generally be transmitted as “not-a-number” (NaN) with M flag, as it currently the case by some countries.

NSIs are invited to review their coding practices in relation to the provided guidance and contact Eurostat in case of doubt. Eurostat is also proceeding with further analysis in the context of setting up European estimates and may contact countries to clarify and/or review specific practices, also in view of better preventing unacceptable coding practices with fine-tuned checks in the pre-validation service CONVAL.

Recommendation 7

Member States should review and, if necessary, improve their estimates in view of harmonization of:

- Composition of asset categories (by product), based on further clarifications by Eurostat.

[14] DMES 2021/12/14: Updated recommendations on harmonised use of flags for ESA 2010 data

- Combinations of NACE x Asset breakdowns, avoiding assumed pro-rata distributions across industries (notably for dwellings (N1111) and cultivated biological assets (N115)), and ensure consistent treatment across tables of related estimates (GFCF, GVA, EMP).
- Transmission of data and use of flags, especially reviewing of the use of zero values versus missing values ("not-a-number" NaN with M flag "data cannot exist" or and L flag "data exist but were not collected") values, respecting SDMX definitions and recommended practices.

9. Comparative work

The OECD and the Vienna Institute have acted as valuable participants in the Task Force, and will remain important partners in the follow-up to the Task Force's work.

The OECD has been cooperating with some Member States (and countries outside the EU) in its ongoing exercise on the comparison of combined depreciation/retirement patterns. Participant countries have found the exercise useful and not burdensome, and OECD remains open to participation of further Member States, if they wish to join.

The use of different functional forms and parameters influences CFC and net stocks in different ways. In order to be able to go in greater detail and make more accurate statements about the resulting effects, however, would require further empirical testing to be made. One way of comparing different PIM models is to derive a geometric approximation of the combined age-price/retirement profiles. An example, based on data from France[15], has presented by the OECD as Item 4 of the second meeting of the Task Force. Other examples of these geometric approximations are presented in the annex of the OECD Statistics Working Paper published in January 2023[16]. The OECD approach consists of inserting the geometric approximation of the cohort depreciation rates of other G7 countries (Canada, France, Germany, Italy and the United Kingdom) into the US PIM to analyse how the US CFC, net investment and GDP are modified.. This work explores how the use of different depreciation and retirement patterns and initial capital stock estimates affect capital and multifactor productivity (MFP) measurement.

The Vienna Institute – under contract with Eurostat – has been working on cross-country comparisons of capital stock and flow data, using analytical ratios to identify unusual pattern that would warrant further investigation. The emerging results of the exercise were presented to the Task Force at its last meeting for two asset types (dwellings and telecommunication), and Task Force members' feedback has been taken on board to produce analytical reports for all

[15] This INSEE paper provides geometric approximations for the combined retirement and depreciation profiles of individual assets in the French national accounts.

[16] Pionnier, P., M. Zinni and K. Baret (2023), "Sensitivity of capital and MFP measurement to asset depreciation patterns and initial capital stock estimates", OECD Statistics Working Papers, No. 2023/01, OECD Publishing, Paris.

asset types. The first results of the Vienna Institute's analysis have been uploaded to CIRCABC so that Member States consult the results.

The work will continue, taking into account comments received from Member States and through bilateral contacts as relevant. The expected deliverables will include detailed comparisons of various methodologies and compilation practices across European countries as well as guidance for improvement in estimates. The Vienna Institute will be acting as methodological helpdesk for Member States, until April 2024, as a support in the implementation of improvement in the benchmark revision.

Annex 1 – Task Force Mandate (August 2020)

Mandate of the Task Force on fixed assets and estimation of consumption of fixed capital under ESA 2010

Background

There is a need to improve the availability and the quality of fixed assets data as well as associated metadata, which is reported under the ESA 2010 transmission programme. In particular, recording of stocks of fixed assets and estimation of consumption of fixed capital should be enhanced in terms of comparability between EU Member States.

There are two reasons to make further effort to improve the quality of this data.

Firstly, since the introduction of ESA 2010, work has been undertaken on non-financial assets. Observation of data still shows considerable gaps and discussion with colleagues responsible for their compilation reveals difficulties inherent to the estimation work. This translates in potential problems with the reliability of this data and their comparability between countries.

Eurostat organised a seminar on non-financial assets in February 2020 with the objective to discuss data sources necessary for compiling non-financial assets, share experiences in estimation methods for compiling capital stocks by asset and for aggregating by industry and by institutional sector, as well as best practices to collect and present metadata. The main conclusion of the seminar is that work is needed to further enhance the quality of the data. Among other ideas, it was suggested to develop additional guidelines and to establish a Task Force to discuss problems related with compilation of this data.

Secondly, in the context of the review of the effectiveness of the EU economic surveillance framework, the Commission is committed to prioritising higher public investment, both as part of the recovery from the current crisis and to facilitate the necessary green and digital transitions. The main option that the Commission is examining is to re-design and expand the scope of the investment clause, with a view to reorienting it towards net capital formation.

It is therefore important that data on the consumption of fixed capital by general government and its subsectors are compiled under comparable conditions and harmonised assumptions in order to ensure equal and fair treatment of Member States under a possible new investment clause. These data need to be consistently measured across all Member States and be subject to enhanced quality assurance by Eurostat. This is why Eurostat and Member States need to further harmonise the approaches to the assumptions and the conditions to enhance comparability of data.

For the above reasons, a Task Force on fixed assets and estimation of consumption of fixed capital under ESA 2010 should be set up rapidly within the European Statistical System (ESS)

and conducts the necessary work. The Task Force will discuss statistical issues relevant to ESA 2010 and the EU policy agenda and ensure that a cross-domain approach is applied and user requirements in ESA 2010, GNI OR and EDP/GFS contexts are met.

Link to other Task Forces and work streams

In 2012, the Eurostat-OECD Task Force on land and other non-financial assets was established to study possible sources and methods that will enable Member States to compile estimates for the different balance sheet items. This Task Force was asked to prepare a set of papers to describe available sources, methodologies and calculation methods. At the start of the mandate, priorities were defined as follows:

- Firstly, work on variable AN.211 Land for the combined institutional sectors S.14+S.15 households and non-profit institutions serving households by 2017;

- Secondly, work on institutional sector breakdowns for mandatory for transmission since 2017 items AN 115 Cultivated biological resources and AN.117 Intellectual property products; and,

- Finally, study of other non-financial balance sheet items.

The Eurostat-OECD Task Force on land and other non-financial assets had prepared guidelines on land estimation (2015) and inventories (2017) and a report with recommendations on the intellectual property products (2019). The task force is not active currently, as new priorities in line with the mandate should be defined. While there is a need to harmonize the EU guidance on estimation of consumption of fixed capital urgently, some methodological questions may need to be addressed internationally and may require more time in order to be elaborated properly. Therefore, the work on stocks of fixed assets and consumption of fixed capital should be planned while phasing the work and delineating what actions should be pursued within the ESS and internationally.

Based on the 2019 Eurostat-OECD questionnaire on the methodology underlying capital stock data, other information and further discussions with countries, the Task Force on fixed assets and estimation of consumption of fixed capital under ESA 2010 will assess the heterogeneity of compilation practices across EU countries, and identify examples to follow and practices to discourage. The 2009 OECD Manual on Measuring Capital will be used as a theoretical benchmark for this exercise. The Task Force on fixed assets and estimation of consumption of fixed capital under ESA 2010 will also identify areas where more research is needed in order to further harmonise compilation methodologies (e.g. in relation to asset depreciation patterns and service lives).

The Eurostat-OECD Task Force on land and other non-financial assets will tackle these research questions from Spring 2021 onwards, with the aim of releasing international compilation guidelines at a later stage, with a clear practical focus to complement the 2009 OECD Manual on Measuring Capital. The examples of the 2015 Eurostat-OECD compilation

guide on land estimation and the 2017 Eurostat-OECD compilation guide on inventories 2017 edition will be used. The Eurostat-OECD Task Force on land and other non-financial assets may also consider how the technical assumptions for the estimation of consumption of fixed capital and capital stocks affects capital services and multifactor productivity estimates.

In addition, Eurostat and EU Member States are collaborating within the Task Force on Productivity Indicators that aims at publishing capital productivity indicators by the end of 2021. While there are links between this project and the work on non-financial assets, the main difference comes from who compiles the data. The work that needs to be pursued relates to national data reported to Eurostat as part of ESA 2010 data transmission programme. In contrast, capital productivity indicators are to be derived by Eurostat from data transmitted by the countries.

The Task Force on fixed assets and estimation of consumption of fixed capital will focus only on data in the scope of ESA 2010 Transmission programme reported on a mandatory basis. Regarding capital services and productivity it will be appropriate to reflect how to share experiences internationally when the current objectives of the Growth and Productivity Accounts project are met.

Main tasks

The Task Force on fixed assets and estimation of consumption of fixed capital will have the following main objectives:

1. To assess the heterogeneity of compilation practices across EU countries for the consumption of fixed capital and capital stocks, and to identify examples to follow and practices to discourage. This will form the basis to draft a set of recommendations for the estimation of stocks of fixed assets and consumption of fixed capital;

2. To address data quality issues of data on stocks of fixed assets and consumption of fixed capital with a focus on methodological soundness, coherence and comparability, including issues from data transmission and validation, the use of appropriate data flags and metadata;

3. To ensure that progress is achieved in terms of cross-country coherence and comparability under ESA 2010;

4. To develop and publish relevant metadata;

5. To put forward a platform to share experiences and knowledge;

6. To identify areas where more research is needed internationally in order to further harmonise compilation methodologies (e.g. in relation to asset depreciation patterns and service lives).

An indicative list (not exhaustive) of topics (tasks) that might be relevant is:

1. Draft a report with recommendations on depreciation methods for fixed assets in line with document C1/NAWG/2020/CN 1063. Eurostat suggests this to be the first topic of the work programme of the Task Force and be given absolute priority in order to have a complete draft ready by the end of 2020. (Note that within this timeframe, some research questions will be handed over to the Eurostat-OECD Task Force on land and other non-financial assets);

2. Complete the stocktaking of current activities including data availability and compilation practices for stocks of fixed assets and consumption of fixed capital;

3. Develop metadata for stocks of fixed assets and consumption of fixed capital taking into account, when possible and appropriate, country information available from other sources, such as the GNI inventories;

4. Assess the adherence to the recommendations including harmonisation of assumptions applied in the models as well as implications for associated validation checks in the ESA 2010 validation handbook and, where necessary, checks implemented in the pre-validation service CONVAL;

5. Prepare a final report on the progress achieved in terms of cross-country comparability under ESA 2010.

The report with recommendations on depreciation methods will be presented to the Eurostat-OECD Task Force on land and other non-financial assets as a basis for elaboration of international compilation guidelines on fixed assets. These guidelines will be practically oriented and describe the good sources and compilation techniques, and if necessary mathematical methods and assumptions for stocks for different assets, NACE industries and institutional sectors. Eurostat and the OECD will aim that the international compilation guidelines are published in 2022.

The Task Force on fixed assets and estimation of consumption of fixed capital under ESA 2010 will address only data in the scope of the ESA 2010 transmission programme (i.e. reported in tables 2/25, 3, 8/801, 20, 22 and 26). Its work should cover the whole economy and the various breakdowns (e.g. institutional sectors, industries, assets). The consistency between institutional sectors is very important.

Composition

The Task Force will be mainly composed of national experts from organisations compiling fixed assets and consumption of fixed capital. All EU countries, as well as Iceland, Norway and Switzerland are invited to nominate members of the task force. Each country could nominate up to two experts to cover appropriately the datasets required under the ESA 2010 transmission programme.

Interested Commission services (notably DG ECFIN and the JRC) as well as the OECD, the ECB and the IMF will also be invited to participate in the Task Force.

Working arrangements and timetable

Given the impossibility to hold physical meetings at present, the Task Force will work through virtual meetings until physical meetings are possible again. It is expected that virtual meetings will be the main way of work at least until end 2020.

Given the urgency of the work of the Task Force, it will start working immediately after its establishment by the DMES and will work more intensively until the end of 2020 at a rhythm of one (virtual) meeting per month. Eurostat will organise the meetings.

Given the relevant policy needs, a first milestone for the Task Force to produce a draft report with recommendations for consumption of fixed capital is set by the end of 2020 (topic 1 of the list above). Topic 2 on stocktaking is to be addressed in parallel with topic 1 for fixed assets. Topic 3 on metadata and topic 4 on quality assurance and adherence to recommendations are to be addressed together and are expected to be developed starting from January 2021 with high peak effort during the two following years. Topics 5 on cross-country comparability will be addressed when topics 3 and 4 are more mature, i.e. starting in 2022. The task force will identify the areas for research at international level by spring 2021. The Task Force mandate will end in December 2022.

It is considered that a two-day meeting twice per year would be adequate in 2021 and 2022. If and when appropriate, physical meetings can be complemented with virtual meetings.

The Task Force will report to the NAWG and the EDPSWG and will be formally established under the DMES to ensure that the cross-domain approach is applied. The GNI expert group will be regularly informed about the progress of the work.

Annex 2 – Task Force participants

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Organisations Name of participant

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ESTAT.C2	Hakam Jayyousi
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Annex 3 – Task Force recommendations

This annex groups the recommendations of the Task Force, which were endorsed by the DMES at its December 2022 meeting. The intention is that Member States address the recommendations at the latest by the 2024 harmonised national accounts benchmark revisions. It may be generally noted that the availability of suitable metadata for users is very important, even if this is mentioned explicitly in only one recommendation.

Choice of retirement and depreciation functions

Recommendation 1

A bell-shaped retirement function should be used (without preferring a specific bell-shaped function).

Recommendation 2

Within the context set by ESA2010 regarding depreciation functions, the recommendation is limited to using a convex cohort depreciation function.

Average service lives

Recommendation 3

The following average service lives (ASLs) are recommended. In some cases a range is specified. Member States that use an ASL outside the range should support their decision by evidence.

Asset code	**Asset**	**ASL years**	**Range**
AN.111	Dwellings	70	65 - 75
AN.1121	Buildings other than dwellings		
	Warehouse and industrial buildings	30	25 - 35
	Commercial buildings	50	45 - 55
	Educational buildings	50	45 - 55
	Health buildings	50	45 - 55
	Buildings and structures for military use	50	45 - 55
	Other buildings	50	45 - 55
AN.1122	Other structures	55	50 - 60

Asset code	Asset	ASL years	Range
AN.1123	Land improvements	55	50 - 60
AN.1131	Transport equipment		
	Aircraft	20	
	Trains	25	
	Ships	25	20 - 30
	Vehicles (possible differentiation e.g. trucks, trailers, buses, cars)	10	8 - 12
AN.11321	Computer hardware	6	5 - 7
AN.11322	Telecommunications equipment	5	4 - 7
AN.1139	Other machinery and equipment		
	CPA 26: computer, electronic and optical products (except groups 261 and 262)	10	8 - 12
	CPA 27: electrical equipment	15	12 - 18
	CPA 28: machinery and equipment n.e.c.	20	15 - 25
	CPA 31: furniture	15	12 - 18
	CPA 32: other manufactured goods	10	8 - 12
AN.114	Weapons systems		
	Aircraft	25	20 - 30
	Ships	25	
	Tanks	20	
	Armoured vehicles	20	
	Electronic equipment	10	
	Other	15	5 - 25
AN.1151	Animal resources yielding repeat products (no CFC)	10	
AN.1152	Tree, crop and plant resources yielding repeat products	15	10 - 20
AN.1171	Research and development	10	8 - 12
AN.1172	Mineral exploration and evaluation	30	20 - 40
AN.1173	Computer software and databases	5	
AN.1174	Originals	7	5 - 10
AN.1179	Other intellectual property products	No recommend-ation	

It is recommended that the review of assumed asset service lives take place every 5 years (in particular for such assets that have a considerable weight in the total assets), in connection with the harmonised benchmark revision of national accounts. This review may take into account such factors as technical progress and the impacts of climate change[17].

Estimating the initial capital stock

Recommendation 4a

Where there is no obviously best method available to estimate an initial capital stock (reliable valuations at a suitable point in time), two (or more) different methods may be tried, and the results cross-checked.

Recommendation 4b

A two step approach is recommended when initial capital stocks must be estimated:

- Backcasting GFCF series for as long as possible. Ideally, if the longest service life of a given asset is T and capital stocks need to be published from date t onwards, the corresponding GFCF series should start at date t-T (at least). This back casting exercise should be based on national data sources such as historical vintages of national accounts, company accounts, censuses and other relevant administrative sources.
- If additional assumptions are needed, finding a stable relationship with a reliable indicator which leads to converging results. A useful pragmatic approach is to back-estimate a few years more than are actually needed, then verify in detail the results (e.g. the ratio of CFC in relation to capital stock) for the first few years after the published initial capital stock estimate.

Other changes in the volume of assets

Recommendation 5a

Other changes in volume of assets are only recorded for situations enumerated in ESA 2010 para. 6.01-6.25, with transactions in GFCF or CFC being recorded for other situations. Where there are significant amounts of other changes in volume of assets, it is helpful to clearly inform users through appropriate metadata.

[17] Since technological change can potentially increase asset service lives, whereas adverse climate change may have the opposite effect.

Recommendation 5b

If a geometric cohort depreciation function is used, Member States should follow the OECD Manual Measuring Capital.

Member States should avoid using “other changes in volume” if there is no clear conceptual rationale for doing so.

Changes in classification and structure should be used only for statistical re-classifications, not for organizational restructuring (e.g. in the case of restructuring of balance sheets between existing units).

Other changes in volume should not be recorded as a “balancing item” when reconciling stock and flow measures.

Price indices

Recommendation 6a

Ideally, the Supply and Use framework should be used for deflation. During the SUT balancing process, the price indices for GFCF should be checked for plausibility.

It will be useful to make periodic cross-country comparisons of price indices, at least for some assets. An example could be ICT equipment, which is an asset type where significant differences in measured price changes have been observed in the past.

Recommendation 6b

With regard to the use of price indices for dwellings (separated from land):

- If possible, Member States should use a construction price index (provided it has suitable coverage and takes account of quality changes), or – as a second best - the “Acquisition of dwellings” component of the OOHPI.
- Member States should review how quality change is taken into account for dwellings, either in their price indices or PIM approach. It is important that the ‘volume’ element of dwellings (i.e. both the impact of composition changes in dwellings and quality changes in each type of dwellings) is clearly separated from the price (revaluation) effect.
- Member States should consider if the PIM approach should distinguish between different components of dwelling stocks when conducting revaluation, and if all of these components (major renovations, costs of ownership transfer etc) are covered.
- Use of headline HPI should be avoided.

Recommendation 6c

For other asset types than dwellings:

- PIM experts should be informed at national level of the ongoing work to improve prices and volumes in national accounts through the general prices and volumes project, and possible impacts on their work.
- Application of price indices should be at the most detailed product level possible.
- Member States should improve their metadata describing how price indices are applied.
- Some remaining ‘C methods’ identified in Member States for price indices for GFCF should be replaced with better methods.
- Some implicit price deflators in some countries should be investigated, where strong divergence is observed from development of prices of internationally-traded assets or unusually strong movements over period; notably for ICT assets for some countries.

Harmonisation of data

Recommendation 7

Member States should review and, if necessary, improve their estimates in view of harmonization of:

- Composition of asset categories (by product), based on further clarifications by Eurostat.

- Combinations of NACE x Asset breakdowns, avoiding assumed pro-rata distributions across industries (notably for dwellings (N1111) and cultivated biological assets (N115)), and ensure consistent treatment across tables of related estimates (GFCF, GVA, EMP).

- Transmission of data and use of flags, especially reviewing of the use of zero values versus missing values (“not-a-number” NaN with M flag “data cannot exist” or and L flag “data exist but were not collected”) values, respecting SDMX definitions and recommended practices.

Annex 4 – Empirical evidence for PIM assumptions

The Task Force discussed the importance of obtaining empirical evidence for setting PIM assumptions. It is clear that in many European countries there is a lack of such evidence at national level. In some cases the evidence available is not recent, or is taken from another country (for example the US or Canada).

The OECD Manual on Measuring Capital describes in Chapter 12 the ways in which information may be gathered to determine age-price and depreciation profiles, and the debate around how this information can be interpreted. The following main sources have been used by some countries in practice:

Surveys by statisticians

Questions on asset acquisition, use and asset disposals (by type of asset) may be introduced into regular or periodic business surveys, including information on disposal prices (see below).

Used asset prices

Collection of used asset prices (whether from business surveys or from dealers in used assets) may provide a relation between age and efficiency as expressed through prices. There is however a debate about the proper interpretation of these prices, in particular if they can be considered representative and the extent to which they take account of quality change.

The accounting profession

Given that enterprises' financial statements include depreciation, which is based on similar types of assumptions to those used in national accounts, the accounting profession at national level may provide suitable evidence of assumptions used and the basis for these. It is however important to distinguish between depreciation assumptions used in relation to accounting standards for financial statements, and those used for taxation-related purposes (which may be different, as they are often influenced more by economic policy considerations than by actual asset lives).

Valuation professionals

These professionals have the responsibility to value larger assets such as buildings, and operate to a strict set of harmonised guidelines. Their input can therefore be useful for certain types of assets.

When looking to international evidence, many European countries examine the work undertaken in the US (Bureau of Economic Analysis) and Canada (Statistics Canada). Whilst the assumptions used in the US are based on rather old evidence – often dating back to the

early 1980s – the work in Canada is more recent; the 2015 report of the latest work can be found here:

An Update on Depreciation Rates for the Canadian Productivity Accounts (statcan.gc.ca)

This describes how Statistics Canada used data from its annual Capital and Repair Expenditures Survey to re-estimate its depreciation rates, and is very instructive in its discussion of the practical issues encountered[18].

Some Member States believe that, as the assets involved may be rather similar to those in Europe (especially internationally-traded assets like machinery and transport equipment), the depreciation rates from non-European countries can be 'imported' into European estimates. This belief of course depends on the similarity of the assets and the practices of those who use the assets, and the large differences between the assumptions used in the US and Canada indicate that even in North America this may not be correct. Thus, whilst it is instructive to look at international practice, the existence of national-level evidence is still important.

It is understood that the level of resources required to conduct this type of evidence gathering at national level is substantial, but nevertheless – as explained above – **it is appropriate to try to do so at least every five years**, so that PIM assumptions can be reviewed (commonly as part of a benchmark revision process) alongside recent evidence.

[18] Statistics Canada kindly made a presentation to the Task Force about its work.