Computing capital stock in the Belgian national accounts according to the ESA 2010

Methodological note - October 2014

Capital stock forms an integral part of the European System of National and Regional Accounts 2010 (ESA 2010).

Firstly, capital stock is one of the elements of the system's opening and closing balance sheets, as shown by table 1 which illustrates a balance sheet presentation. In this table, the variable "AN.11 Fixed assets" is equivalent to the capital stock.

The difference between the opening balance sheet and the closing balance sheet for fixed assets includes the gross fixed capital formation, other volume changes and nominal holding gains and losses. Given that Belgium does not produce balance sheets, no details will be provided on those last two items.

Secondly, besides being part of the balance sheets, capital stock is also used for estimating the consumption of fixed capital.

TABLE 1 BALANCE SHEET PRESENTATION IN ESA 2010

Assets	Liabilities
AN. Non-financial assets (AN.1+AN.2)	AF. Financial liabilities
AN.1 Produced non-financial assets	
AN.11 Fixed assets	
AN.12 Inventories	
AN.13 Valuables	
AN.2 Non-produced non-financial assets	
AN.21 Natural resources	
AN.22 Contracts, leases and licences	
AN.23 Purchases less sales of goodwill and marketing assets	
AF Financial assets	
	B.90 Net worth

Source : ESA 2010.

Indeed, ESA 2010 (as ESA 1995 used to do) indicates that the consumption of fixed capital[1] should be estimated on the basis of capital stock (§ 3.141). This is why capital stock has to be estimated when preparing national accounts. On the one hand, consumption of fixed capital is needed in order to estimate the production (and value added) of non-market sectors, because the latest is computed as the sum of costs, and, on the other hand, it allows to derive "net" aggregates from "gross" ones in the sequences of accounts of the various institutional sectors.

The methodology applied by Belgium to compute capital stock is described below.

1. Definition of capital stock

Capital stock is defined as being the total value of fixed assets at a given point in time and in a given area.

Although, at first glance, this definition seems clear-cut, some points need to be clarified. First of all, there is the definition of fixed assets. Secondly, the values at which the fixed assets are to be added together - the current market value[2] of the assets or the value which they should have if they were to be bought at this precise moment – are not specified. Moreover, the price at which the value of fixed assets is to be estimated (current or constant prices[3]) is not specified either.

1.1 Fixed assets

ESA 2010 defines[4] non-financial assets (AN.1) as outputs from production processes. The classification of produced non-financial assets (AN.1) is designed to distinguish among assets on the basis of their role in production. It consists of: fixed assets which are used repeatedly or continuously in production for more than one year (AN.11); inventories which are used up in production as intermediate consumption, sold or otherwise disposed of (AN.12); and valuables (AN.13)[5].

Fixed capital formation occurs when these fixed assets (AN.11) are bought by resident producers. It is fixed capital formation that is used when estimating capital stock and it includes acquisitions less disposals of the following assets[6]:

- AN.1110 Dwellings[7]
  AN.112 Other buildings and structures, broken down into the following two assets:
- AN.1121 Non-residential buildings
- AN.1122 Other buildings and structures
- **AN.1123 Land improvements:**
  This is a novelty in ESA 2010, where it must be separated from assets under dwellings and other buildings. It is however not yet estimated separately in the Belgian accounts[8]
- AN.1131 Transport equipment
- AN.1132 ICT equipment, which must be broken down into the following two assets:
- **AN.13121 Computer and hardware;**
  This category is new in ESA2010, and was formerly included in the sub-heading "Office machinery and hardware" in ESA 1995; this implies that office equipment other than computer and hardware has now been transferred to asset AN.1139 "Other machinery and equipment".
- AN.11322 Telecommunication equipment
- AN.1139 Other machinery and equipment
- **AN.1140 Weapons systems**
  AN.1140 is also a new asset in ESA 2010
  In ESA 1995, only the acquisition of those military structures and equipment which were

1 The term "depreciation" is synonymous with "consumption of fixed capital" which is the official ESA terminology.
2 This is the price that would be received if the existing asset was sold on the market.
3 Sometimes, the terms "current and constant replacement costs" are also used to refer to current and constant prices.
4 See ESA 2010 § 7.22 and 7.23
5 For the time being, there is no estimation for this item due to lack of data.
6 The classification mentionned here is the official one set in ESA 2010. As will be seen later, the National Accounts Institute (NAI) has adopted an harmonized 5 digits classification for all detailed items.
7 At first glance, it seems that the household dwellings are not used in processes of production, a necessary condition in order to appear in the fixed assets (cf. point 1). However, dwellings are used to produce dwelling services, which is indeed a process of production.
8 An accurate separate estimate of this item is not possible as long as there is no data for non produced asset AN.211 "Land". According to the ESA 2010 transmission program, the first transmisssion ot this asset is due in 2017; the NAI will thus work in the coming years to meet this new deadline. For the time being, it is considered that major improvements to land are included in the fixed asset that lies above it (AN.1110 or AN.112). Such an assumption is in fact in accordance with a practical approach that states that if improvement is impossible to separate from land itself, it has to be registered as a composite asset in category with highest value (source : Eurostat , «Training on general introduction to ESA 2010», Luxembourg, December 2013).

considered to have a civilian equivalent (such as airfields or hospitals) were to be recorded as capital formation. In ESA 2010, the boundary of military capital assets is extended to include military weapons and supporting systems, even if they have no equivalent civilian purpose. Vehicles and other equipment such as warships, submarines, military aircrafts, tanks, missile carriers and launchers are fixed assets, used continuously for more than one year in the production of defence services[1].

- AN.1151 Animal resources yielding repeat products
- AN.1152 Tree, crop and plant resources yielding repeat products
- **AN.1710 Research and development**
  This is the main new asset in ESA 2010.
  In ESA 1995, there was recognition of some so-called "intangible assets". IN ESA 2010, the former (produced) intangible fixed assets (mineral exploration, computer software, entertainment, literary and artistic originals and other intangible fixed assets) come under the new heading of "intellectual property products" (AN.117). ESA 2010 continued the expansion of the asset boundary by including results of research and development as intellectual property under the heading of produced assets. It recognises expenditures for both purchased and own-account R&D as fixed investment and the depreciation of these assets as consumption of fixed capital. This includes government R&D expenditure either protected via patents or made freely available to the public. Not only is there a change in concept leading to a significant change in important economic measures, the newly recognised output and assets are also particularly difficult to measure. In theory, the value of the output of R&D is equal to the value of discounted future benefits a corporation gets from their R&D investment. These future benefits are difficult to estimate. Furthermore, most R&D is produced on own-account. Therefore the sum of cost approach for valuation of output will usually be applied.
- AN.1720 Mineral exploration and evaluation
- AN.1730 Computer software and databases
- AN.1740 Entertainment, literary or artistic originals
- AN.1790 Other intellectual property products.

Note that costs associated with the transfer of ownership of both fixed assets and non-produced assets are supposed to be recorded as gross fixed capital formation by the new owner.

1.2 Gross and net stock

Gross capital stock is the value of all of the fixed assets at '*as new prices*', i.e. the prices which would have to be paid if the same fixed assets were bought at the current time.

By contrast, ***net*** capital stock is the gross capital stock less the cumulative value of consumption of fixed capital[2] at a given moment. The manner in which the consumption of fixed capital is estimated is explained in more detail in section 2.5.

1.3 Current and constant prices

Both gross and net capital stock can be valued at current prices or in volume[3].

Capital stock at current prices values the fixed assets at the prices for the period in question. For example, to estimate the capital stock for the year 2010, all of the fixed assets must first be valued at 2010 prices and then they must be added together in order to obtain the capital stock.

The capital stock at constant prices values the fixed assets at the prices of one year in particular; in the Belgian accounts, this is the year 2000. Like the other aggregates of the national accounts, it is however published in chain-linked volumes[4].

1 Single-use items, such as ammunition, missiles, rockets and bombs are treated as military inventories.
2 Consumption of fixed capital represents the decline in the value of fixed assets, in the course of a period, as a result of physical deterioration and foreseen obsolescence, including a provision for losses of fixed assets as a result of accidental damage which can be insured against.
3 Besides these two price types, capital stock may also be valued at historic prices (or acquisition prices). This is a concept which is used in particular in business accounting and which is not suited for the comparison with economic statistics expressed at current or constant prices. This is the reason why this evaluation method is not examined.
4 This has not yet been changed for technical reasons linked to the IT program used for the computing the PIM. Since 2006 however, in accordance with european practice,

2. Capital stock estimation method

Capital stock can be measured in two ways: (i) by direct observation (survey-based or other sources) of fixed assets or (ii) by using the Perpetual Inventory Method (PIM). As direct observation of the fixed assets is extremely time-consuming as well as expensive, the PIM is the most commonly used method of estimating capital stock. This is also the case in Belgium.

2.1 The Perpetual Inventory Method (PIM)[1]

The PIM is a method which enables the gross capital stock to be estimated based on historical series of gross fixed capital formation, the average service life of fixed assets and survival functions. If depreciation functions are also used, it is also possible to estimate net capital stock. In practical terms, the PIM is used to estimate the value of gross fixed capital formation made in the past and which 'survives' in the current period (i.e. which is still used in a process of production).

Using a simple example, we can illustrate how both the gross and net capital stock can be estimated with the help of the PIM.

Let us take the example of a machine which was bought for € 600 at the start of period 1. Let us then suppose that the average service life of the machine is three years and that the machine is depreciated on a straight-line basis throughout its service life and that there was no other gross fixed capital formation during these three years. In order to simplify matters, let us also assume that there is no change in price and that the machine is discarded at the end of the third year[2].

Under the PIM, the gross capital stock at the end of a period may be estimated as the gross fixed capital formation value surviving during this period. For period 1, the gross capital stock is therefore € 600. In period 2, there is no gross fixed capital formation so the gross capital stock is equal to the gross fixed capital formation value of the previous periods which survives during this period. Given that the machine survives in period 2, the gross capital stock is therefore equal to € 600. For the third period, the same reasoning is applied according to which the gross capital stock is still € 600. However, at the start of the fourth period, the machine is decommissioned and the gross capital stock therefore equals 0, since the fixed asset is no longer operational.

To estimate the net capital stock, the consumption of fixed capital must be taken into account. Based on the assumption that the machine is depreciated on a straight-line basis over its service life, the consumption of fixed capital for a period is equal to a third of the machine's value (since the average service life is three years). The net capital stock is equal to the gross capital stock minus the accumulated consumption of fixed capital of this gross fixed capital formation. In period 1, the net capital stock is therefore equal to € 600 - € 200 = € 400. In period 2, the net capital stock is equal to € 200 since the accumulated consumption of fixed capital (= € 400) is subtracted from the surviving gross fixed capital formation value. Following the same reasoning, the net capital stock becomes zero for periods 3 and 4.

TABLE 2 EXAMPLE OF ESTIMATING CAPITAL STOCK USING THE PIM

	Gross fixed capital formation	Gross capital stock	Consumption of fixed capital	Accumulated consumption of fixed capital	Net capital stock
	(1)	(2)	(3)	(4)	(5) = (2) - (4)
Period 1	600	600	200	200	400
Period 2	0	600	200	400	200
Period 3	0	600	200	600	0
Period 4	0	0	0	0	0

Source: NAI.

investments in volume are valued at previous year's prices in Belgian national accounts, and published in chain-linked volumes.

1 Annex 1 provides a more mathematical presentation of the PIM.

2 Under points 2.3, 2.4 and 2.5, more detailed comments are given on average service lives and the survival and depreciation functions.

2.2 Gross fixed capital formation – historical series

Historical series of gross fixed capital formation are used to estimate the capital stock in accordance with the PIM. For the model used by the National Accounts Institute (NAI), it is necessary to have series which are at least twice[1] as long as the average service life of the fixed assets. These must also conform to the ESA 2010 methodology.

To this end, backward calculations of gross fixed capital formation have been carried out mainly based on the following sources:

- gross fixed capital formation series of the national accounts estimated directly in accordance with ESA2010 (for the period from 2010 onwards);
- gross fixed capital formation series of the national accounts in accordance with ESA 1995 converted to ESA 2010 (for the period 1995-2009);
- evolution of gross fixed capital formation series prepared by the Federal Planning Bureau for previous estimates of capital stock, combined with specific sectorial estimates of NBB for branches that are present in public as well as private sector (for the period 1853-1994).

In this way, a gross fixed capital formation series has been estimated for the period 1853-2013, at 2000 prices, covering 38 branches of activity and 13 assets.

2.3 Average service lives

In addition to historical series regarding gross fixed capital formation, the PIM also uses the average service lives of fixed assets. On that basis is the longevity of fixed assets determined in the PIM, and therefore the period during which these assets contribute to the capital stock.

For these reasons, it is important that the service life is estimated as accurately as possible and in as much detail as possible.

In Belgium, average service lives are estimated by branch of activity (A*38) and by asset (AN.11).

These were initially based on a combination of previous service lives, used by the Federal Planning Bureau, and European 'best practice'. This 'best practice' is developed by the 'Centraal Bureau voor de Statistiek' (CBS) in the Netherlands. The average service lives obtained in this way were compared with international average service lives[2] by product and by branch. If the Belgian average service lives differ greatly from the international averages, they were adjusted[3].

For the assets that are new in ESA 2010, services lives have been determined as follows:

- for the "Computer hardware" sub-heading in ITC , average service live has been set to 5 years;
- for "Weapons systems", the following information has been given by the Ministry of Defence: 10 years for weapons and land vehicles, 15 years for ships and 20 years for aircrafts;
- for research and development, the default service live of 10 years recommended by Eurostat in the dedicated Taskforce on R&D manual is used.

Moreover, for the "Telecommunications equipment" sub-heading in ITC, average service live has been shortened to 11 years (against 15 to 25 years in ESA 1995).

Table 3 shows the service lives[4] by asset and by A*38 branches of activities used from 2014 on by the NAI in the national accounts.

1 This is due in particular to the characteristics of the probability density which is used to establish the survival function. More detailed explanations are given in Annex 1.
2 Cf. the OECD publication 'Methods Used by OECD Countries to Measure Stocks of Fixed Capital', from the 'National Accounts: Sources and Methods' series, 1993, Paris.
3 As was the case for the service lives of "metal products and machines" in industry.
4 Note that investments in dwellings appear in two branches only: 'financial institutions' and 'renting and trade in real estate'. The first branch (specifically insurance companies) is obliged under a European directive to invest a minimum amount in dwellings whereas the second branch includes investments in household dwellings.

TABLE 3 AVERAGE SERVICE LIVES (IN YEARS) BY A*38 BRANCH OF ACTIVITY AND BY FIXED ASSET (AN)[1 2]

A38	AN. 11110	AN. 11210 & 11220	AN. 11310	AN. 11321	AN. 11322	AN. 11390[3]	AN. 11400	AN 11510 & 11520	AN 11710	AN 11730	AN 11740
AA		37	12	5	11	15		3	10	3	7
BB		33	10	5	11	20		3	10	3	7
CA		34	10	5	11	20		3	10	3	7
CB		38	10	5	11	19		3	10	3	7
CC		45	10	5	11	19		3	10	3	7
CD		38	10	5	11	18		3	10	3	7
CE		34	10	5	11	18		3	10	3	7
CF		34	10	5	11	18		3	10	3	7
CG		30	10	5	11	19		3	10	3	7
CH		35	10	5	11	21		3	10	3	7
CI		35	10	5	11	19		3	10	3	7
CJ		35	10	5	11	19		3	10	3	7
CK		35	10	5	11	19		3	10	3	7
CL		35	10	5	11	18		3	10	3	7
CM		35	10	5	11	18		3	10	3	7
DD		42	10	5	11	25		3	10	3	7
EE (S13)		60	8	5	11	15		3	10	3	7
EE (others)[4]		40	8	5	11	15		3	10	3	7
FF		42	10	5	11	20		3	10	3	7
GG		40	8	5	11	15		3	10	3	7
HH (S13)[4]		(a)	8	5	11	15		3	10	3	7
HH (others)[4]		40	15	5	11	15		3	10	3	7
II		40	8	5	11	15		3	10	3	7
JA (S13)[4]		60	8	5	11	15		3	10	3	7
JA (others)[4]		40	8	5	11	15		3	10	3	7
JB		40	15	5	11	15		3	10	3	7
JC		40	8	5	11	15		3	10	3	7
KK	60	40	8	5	11	15		3	10	3	7
LL	60	40	8	5	11	15		3	10	3	7
MA		40	8	5	11	15		3	10	3	7
MB		40	8	5	11	15		3	10	3	7
MC		40	8	5	11	15		3	10	3	7
NN		40	8	5	11	15		3	10	3	7
OO		(a)	8	5	11	15	(b)	3	10	3	7
PP		60	8	5	11	15		3	10	3	7
QA		40	8	5	11	15		3	10	3	7
QB		40	8	5	11	15		3	10	3	7
RR		40	8	5	11	15		3	10	3	7
SS		40	8	5	11	15		3	10	3	7

Source : NAI.

(a) 55 years for roads, 70 years for shipping and inland waterway works, 60 years for other construction work1 See Annex 3 for the details of the various classifications.

(b) 10 years for weapons and land vehicles, 15 years for ships and 20 years for aircrafts (source: Ministry of Defence)

1 See Annex 3 for the details of the various classifications.

2 Since mineral exploration is only a marginal activity in Belgium, asset AN.11720 is not taken into account for estimating gross fixed capital formation and capital stock. AN.11790 is assumed to be negligeable and set to zero.

3 New reference values were set for "Other machinery and equipments" in industry for the February 2003 publication (then labelled "Pi2 -Metal products and machinery"). These new reference values gradually have an impact on estimates from 1985 onwards. This table shows the services lives appliable from 2003 onwards.

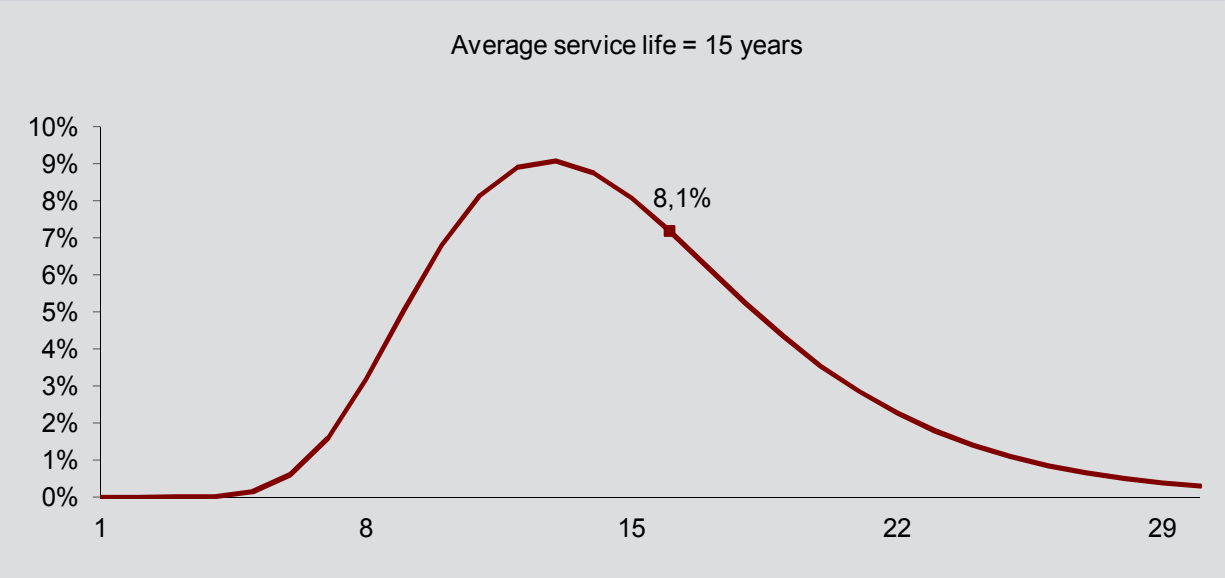
4 S.13 = Public sector ; others = other domestic institutional sectors (S.11, S.12. S.14 and S.15).

2.4 Survival function

Although the average service life of fixed assets is an important parameter of the PIM, it provides little information if the dispersion around the average is not known. In the example under 2.1, the average service life of the machine is three years and it is discarded after three years exactly. In reality, it is unlikely that the machine will be taken out of service after precisely three years. In fact, the machine will wear out more or less rapidly depending on the intensity with which it is used. However, it is possible that some machines will be subjected to exceptional conditions (high level of humidity, severe cold, etc.) or that they are not as well maintained as others. All of these factors influence the service life of machines, in such a way that they can be used for more, less or for exactly three years in the process of production. In order to characterise this dispersion around the average value, a bell-shaped probability density function is often used. This density indicates which part of the gross fixed capital formation realised previously has been discarded during a specific period.

In Belgium, the log-normal probability density function is used[1]. The choice of a log-normal density is dictated in particular by Eurostat's preference for this approach. The chart below shows an image of a log-normal density for a fixed asset with an average service life of 15 years.

CHART 1 LOG-NORMAL PROBABILITY DENSITY FUNCTION



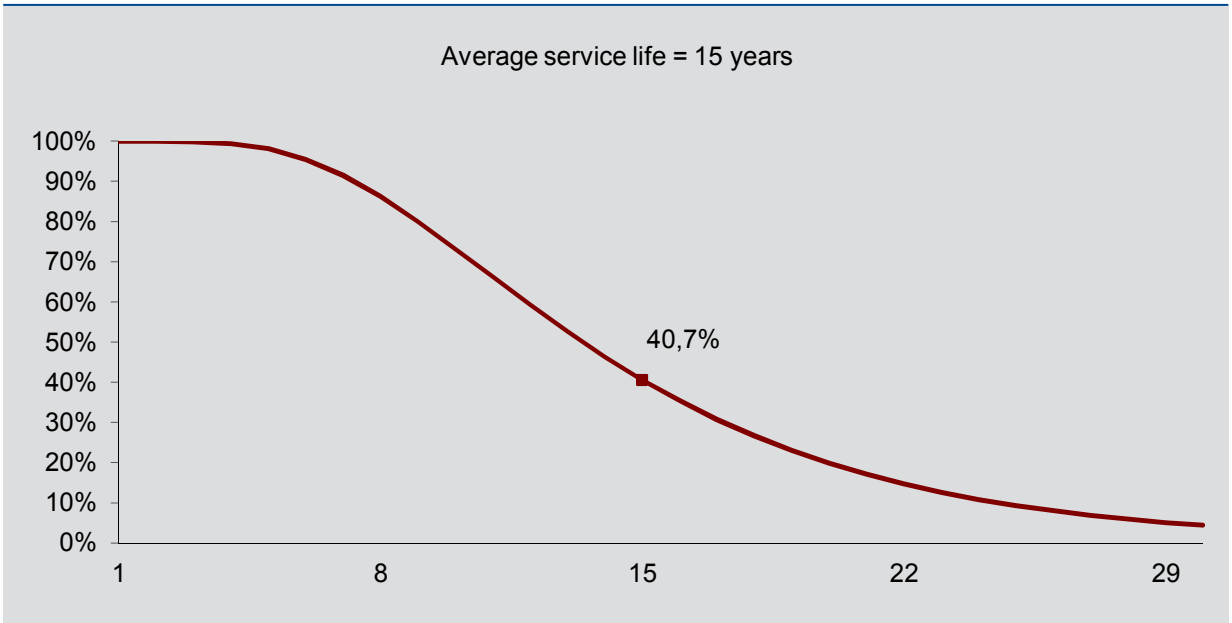
Source : NAI.

As Chart 1 shows, the log-normal density is asymmetrical but more right-sided. The interpretation of this is that during the fifteenth year of the life of fixed assets of the same type (with an average service life of 15 years), just over 8 p.c. of these fixed assets will be discarded.

Although the density indicates which part of the fixed assets is discarded during a specific period, it is essential, as regards the PIM, to know which part of the gross fixed capital formation, realised several periods previously, currently remains. It is measured by deducting from the total gross fixed capital formation for the first period, equal to 100 p.c., the part discarded for each subsequent period. In other words, a survival function must be estimated. The survival function is derived from the density (log-normal in Belgium) and takes the form of Chart 2.

1 A variable x is distributed as log-normal if ln(x) is distributed according to the normal law. Here there is a direct relationship between the normal and log-normal distribution. Moreover, a whole series of normal distribution characteristics applies to the log-normal. In fact, for a log-normal distribution, just as for a normal distribution, 95 p.c. of the probabilities lie within a two standard deviation interval around the median.

CHART 2 LOG-NORMAL SURVIVAL FUNCTION



Source: NAI.

Using the survival function described above, it is possible to determine which part of the gross fixed capital formation, produced during period 1, survives in each subsequent period. After 15 years, 40.7 p.c. of the fixed assets are therefore still being used[1].

Now that the gross fixed capital formation series, average service life and survival function are known, it is possible to estimate the gross capital stock with the PIM. To estimate the net capital stock, one element is still missing, namely the depreciation function of fixed assets.

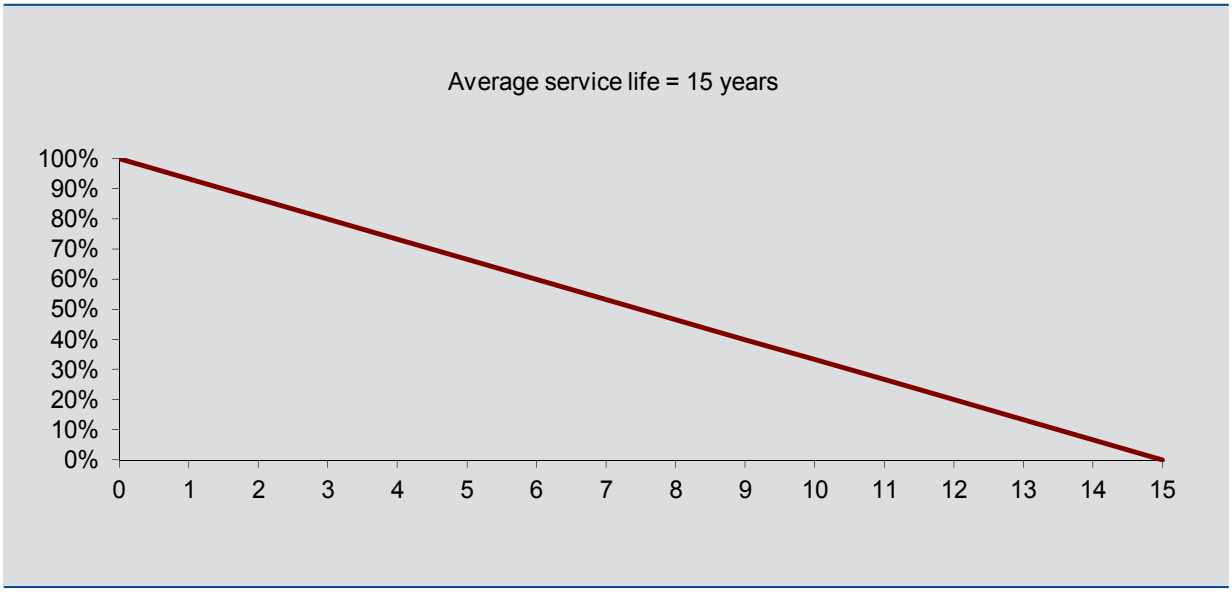
2.5 Depreciation function

The survival function determines which part of the gross fixed capital formation realised is still surviving.

However, the condition of this gross fixed capital formation is not known. It is highly likely that after a certain number of years of use, it will no longer be able to provide the same services as when it was bought and it will therefore lose value. For example, a lorry used for seven years will perhaps use more fuel than a new one. In order to illustrate the reduction over time of the services that the fixed assets can provide (and therefore their value too), the PIM uses a depreciation function. In accordance with paragraph 3.143 of ESA 2010, Belgium uses a 'straight line' function. As a result, the value of the fixed asset is written off at a constant rate over its service life. Chart 3 illustrates a 'straight line' depreciation function.

1 The asymmetrical form (tending to the right) of the corresponding probability density explains why, after 15 years, only 40.7 p.c. of the fixed assets are still used whereas the average service life is 15 years.

CHART 3 'STRAIGHT LINE' DEPRECIATION FUNCTION



Source : NAI.

Chart 3 shows the value of the fixed asset, expressed as a percentage of its as new value, for each period.

As mentioned previously, the net capital stock is estimated by introducing the depreciation function into the PIM.

Annex 1 - Estimating capital stock using the perpetual inventory method

1. Definition of capital stock

The gross capital stock (SDCB) for the year t is simply defined by the following expression:

(1) $$SDCB_t = SDCB_{t-1} + I_t - R_t$$

where:

I_t = gross fixed capital formation during year t

R_t = retirement of fixed capital during year t

The net capital stock (SDCN) for year t is given by:

(2) $$SDCN_t = SDCN_{t-1} + I_t - D_t$$

where:

I_t = gross fixed capital formation during year t

D_t = consumption of fixed capital during year t (this component also takes account of the retirement of fixed capital)

The difference between gross and net capital stock is found in the estimate of the age of the fixed assets. Gross capital stock treats fixed assets as if they were new and were still able to provide as much in the way of "capital services" (be as productive) as when they were bought. Net capital stock takes account of the age of fixed assets and only takes account of the capital services still to be provided by the fixed assets. To allow for this difference, the accumulated consumption of fixed capital for all of the preceding periods is corrected. In expression (2), the time concept for the variables "I" and "D" is therefore different. The variable "I" covers only gross fixed capital formation for the relevant period, while "D" represents the accumulated consumption of fixed capital (for all of the preceding periods).

In identities (1) and (2) the variables R_t (for gross capital stock) and D_t (for net capital stock) are not known. Capital stock cannot therefore be estimated on the basis of these two identities. It is for this reason that the PIM (Perpetual Inventory Method) is used in Belgium.

2. Perpetual inventory method

According to the PIM, capital stock is equal to the sum of the preceding gross fixed capital formation which survives into the current period, i.e. which is still in use in the current period. To estimate the capital stock using the PIM, the following basic details are essential:

– historical series of gross fixed capital formation (and the necessary price indices for expressing these according to different price concepts);
– details of the average service life of the fixed assets and of the distribution of the retirement of fixed assets around this average (i.e. the survival function);
– modelling of consumption of fixed capital as a function of gross fixed capital formation.

2.1 Gross capital stock

In the methodological note in point 1, capital stock is defined as: 'the total value of fixed assets at a given point in time and in a given area'. Capital stock can now be expressed by identity (1):

(3) $$SDCB_t = \sum_{j=0}^{L} I_{t-j} g_j$$

where:

I_{t-j} = gross fixed capital formation during year t-j

g_j = proportion of fixed assets purchased in t-j and still in use in t (i.e. after year j)

L = 2n = the maximum service life of the fixed assets[1]

n = the average service life of the fixed assets

The expression (3) treats the capital stock as the sum of the gross fixed capital formation previously realised and currently still in use. However, there is also an unknown in this expression, namely g_j. This variable describes the conditions for discarding fixed assets. To calculate g_j, a log-normal survival function calculated on the basis of a log-normal probability density is used. The log-normal[2] probability density function is given by:

(4) $$f(x) = \frac{1}{x\sigma\sqrt{2\pi}} e^{-\frac{(\ln(x)-\mu)^2}{2\sigma^2}}$$

where:

x = year 1, 2, …, n

σ = standard deviation for the log-normal distribution calculated as follows:

$$\sigma = \sqrt{\mathbf{h}\left(1+\left(\frac{s}{m}\right)^2\right)}$$

where:

m = average of the normal distribution[3] corresponding to ln(x)

s = standard deviation for the normal distribution corresponding to ln(x)

μ = average of the log-normal distribution calculated as follows:

$\mu = \ln(m) - 1/2\ \sigma^2$

1 Adding up to L rather than to + ∞ helps to prevent the fixed assets from remaining indefinitely within capital stock. In fact, the survival function used can come very close to 0, without ever reaching this value.
2 Cf. methodological comments under point 2.4 of Annex 1 for a representation in chart form of this density function.
3 Given that a variable x is distributed in accordance with a log-normal if ln(x) is distributed in accordance with a normal law.

It should be noted that m corresponds to the average service life of a fixed asset and that s is generally a value between m/2 and m/4 so as to obtain more or less flat functions. The factor on the basis of which m is distributed (between 2 and 4) is also referred to as the dispersion coefficient. In the Belgian context, a dispersion coefficient of 3 is used.

The survival function[1] of expression (4) is given by:

(5) $$F(x) = \int_0^x f(x)dx$$

Using expression (5), it is possible to calculate the values of gj and estimate gross capital stock.

2.2 Net capital stock

To estimate net capital stock, the reasoning is similar to that followed for estimating gross capital stock, but an additional variable must be introduced, namely consumption of fixed capital.

This produces the following expression:

(6) $$SDCN_t = \sum_{j=0}^{L} I_{t-j} g_j d_j$$

where:

d_j = percentage of the value of the fixed asset bought in t-j not depreciated in t

The value of d is derived from the depreciation functions selected. In Belgium, a 'straight line' depreciation function[2] is used with the following formula:

$$d_j = 1 - a_j$$

where

j = 1, …, n

a = 1 / n.

Given that all of the components of expressions (3) and (6) are known, both gross capital stock and net capital stock can be estimated.

2.3 Retirement and consumption of fixed capital

In the two preceding points, we have discussed the expressions which make it possible to estimate both gross and net capital stock. If one wishes then to calculate R and D directly from expressions (1) and (2), a new formulation must be derived.

1 Cf. methodological note under point 2.4 for a representation in chart form of this survival function.
2 Cf. methodological note under point 2.5 for a representation in chart form of this depreciation function.

The combination of expressions (1) and (3) gives:

(7) $$R_t = \sum_{j=0}^{L} (g_j - g_{j+1}) I_{t-(j+1)}$$

Hence:

$$R_t = I_t - \left[\sum_{j=0}^{L} I_{t-j} g_j - \sum_{j=0}^{L} I_{t-1-j} g_j \right] \Rightarrow$$

$$R_t = I_t - \left[I_t g_0 + I_{t-1} g_1 + \ldots + I_{t-L} g_L \right] + \left[I_{t-1} g_0 + I_{t-2} g_1 + \ldots + I_{t-(L+1)} g_L \right]$$

and since $g_0 = 1$ and $g_{L+1} = 0$,

expression (3) is obtained directly

Similarly, expressions (2) and (6) may be combined, giving:

(8) $$D_t = \sum_{j=0}^{L} (c_j - c_{j+1}) I_{t-(j+1)}$$

where:

$c = g_j d_j$

Annex 2 - Classifications

A2-a BRANCH OF ACTIVITY (A*38)

AA	Agriculture, forestry and fishing
BB	Mining and quarrying
CA	Manufacture of food products, beverages and tobacco products
CB	Manufacture of textiles, wearing apparel and leather products
CC	Manufacture of wood and paper products, and printing
CD	Manufacture of coke and refined petroleum products
CE	Manufacture of chemicals and chemical products
CF	Manufacture of basic pharmaceutical products and pharmaceutical preparations
CG	Manufacture of rubber and plastics products, and other non-metallic mineral products
CH	Manufacture of basic metals and fabricated metal products, except machinery and equipment
CI	Manufacture of computer, electronic and optical products
CJ	Manufacture of electrical equipment
CK	Manufacture of machinery and equipment n.e.c.
CL	Manufacture of transport equipment
CM	Manufacture of furniture; other manufacturing; repair and installation of machinery and equipment
DD	Electricity, gas, steam and air conditioning supply
EE	Water supply; sewerage, waste management and remediation activities
FF	Construction
GG	Wholesale and retail trade, repair of motor vehicles and motorcycles
HH	Transportation and storage
II	Accommodation and food service activities
JA	Publishing, audio-visual and broadcasting
JB	Telecomnunications
JC	Computer programming, consultancy and related activities; information service activities
KK	Financial and insurance activities
LL	Real estate activities
MA	Legal and accounting activities; activities of head offices; management consultancy activities; architecture and engineering activities; technical testing and analysis
MB	Scientific research and development
MC	Advertising and market research; other professional, scientific and technical activities; veterinary activities
NN	Administrative and support service activities
OO	Public administration and defence; compulsory social security
PP	Education
QA	Human health activities
QB	Social work activities
RR	Arts, entertainment and recreation
SS	Other service activities
TT	Activities of households as employers of domestic personnel and services production of households for own use

A2-b FIXED ASSETS (AN.11)[1]

AN11110	Dwellings
AN11210	Buildings other than dwellings
AN11220	Other structures
AN11230	*Land improvements*
AN11310	Transport equipment
AN11321	Computer & hardware
AN11322	Telecommunications equipment
AN11390	Other machinery and equipment
AN11400	Weapons systems
AN11510	Animal resources yielding repeat products
AN11520	Tree, crop and plant resources yielding repeat products
AN11710	Research and development
AN11720	*Mineral exploration and evaluation (= 0)*
AN11730	Computer software and databases
AN11740	Entertainment, literary or artistic originals
AN11790	*Other intellectual property products (= 0)*

A2-c INSTITUTIONAL SECTORS

S.1	Total economy
S.11	Non-financial corporations
S.12	Financial corporations
S.13	General government
S.14	Households
S.15	Non-profit institutions serving households

1 Based on the ESA 2010 AN.11 fixed assets classification (see ESA 2010 § 7.33), the NAI assets classication has been harmonised to a most detailed 5 digits sequence to facilitate the computation of all aggregated levels.

Annex 3 - Transmission program of capital stock according to ESA 2010

ESA Table 20 – Cross classification of fixed assets by industry and by asset (stocks) (from 2000 onwards, t+24 months)

Code	List of variables	Breakdown Industries[1]	Current replacement costs	Previous year's replacement costs
AN.11g	1. Fixed assets, gross		x	x
AN.111g	2. Dwellings, gross	A*21/A*38/A*64	x	x
AN.112g	3. Other buildings and structures, gross	A*21/A*38/A*64	x	x
AN.113g+AN.114g	4. Machinery and equipment, gross + weapon systems, gross	A*21/A*38/A*64	x	x
AN.1131g	5. Transport equipment, gross	A*21/A*38/A*64	x	x
AN.1132g	6. ICT equipment, gross		x	x
AN.11321g	7. Computer hardware, gross		x	x
AN.11322g	8. Telecommunications equipment, gross		x	x
AN.1139g +AN.114g	9. Other machinery and equipment, gross + weapon systems, gross		x	x
AN.115g	10. Cultivated biological resources, gross	A*21/A*38/A*64	x	x
AN.117g	11. Intellectual property products, gross		x	x
AN.1171g	12. R&D, gross (*)		x	x
AN.1173g	13. Computer software and databases, gross		x	x
AN.11n	14. Fixed assets, net		x	x
AN.111n	15. Dwellings, net	A*21/A*38/A*64	x	x
AN.112n	16. Other buildings and structures, net	A*21/A*38/A*64	x	x
AN.113n+AN.114n	17. Machinery and equipment, net + weapon systems, net	A*21/A*38/A*64	x	x
AN.1131n	18. Transport equipment, net	A*21/A*38/A*64	x	x
AN.1132n	19. ICT equipment, net		x	x
AN.11321n	20. Computer hardware, net		x	x
AN.11322n	21. Telecommunications equipment, net		x	x
AN.1139n+AN.114	22. Other machinery and equipment, net + weapon systems, net		x	x
AN.115n	23. Cultivated biological resources, net	A*21/A*38/A*64	x	x
AN.117n	24. Intellectual property products, net		x	x
AN.1171n	25. R&D, net[2]		x	x
AN.1173n	26. Computer software and databases, net		x	x

1 A*21 compulsory; A*38/A*64 on a voluntary basis. If no breakdown is indicated, that means total economy.

2 Added by Delegated Act of 12.08.2014

ESA Table 26– Balance sheets for non-financial (from 1995 onwards, t+24 months)

Code	List of variables	Breakdown
		Sectors
AN.1	1. Produced non-financial assets[3]	S.1, S.11, S.12, S.13, S.14 + S.15
AN.11+AN.12	2. Fixed assets + Inventories[1]	S.1, S.11(4), S.12(4), S.13[4], S.14 + S.15[4]
AN.11	3. Fixed assets[2]	S.1, S.11(4), S.12(4), S.13[4] S.14 + S.15[4]
AN.111	4. Dwellings	S.1, S.11, S.12, S.13, S.14 + S.15
AN.112	5. Other buildings and structures[2]	S.1, S.11, S.12, S.13, S.14 + S.15
AN.1121	6. Buildings other than dwellings[1]	S.1, S.11, S.12, S.13, S.14 + S.15
AN.1122	7. Other structures[1]	S.1, S.11, S.12, S.13, S.14 + S.15
AN.113+AN.114	8. Machinery and equipment + Weapons systems[2]	S.1, S.11, S.12, S.13, S.14 + S.15
AN.115	9. Cultivated biological resources[2]	S.1, S.11(4), S.12(4), S.13[4], S.14 + S.15[4]
AN.117	10. Intellectual property products[2]	S.1, S.11(4), S.12(4), S.13[4], S.14 + S.15[4]
AN.1171	11. Research and development[3]	S.1, S.11, S.12, S.13, S.14 + S.15
AN.1172	12. Mineral exploration and evaluation[3]	S.1, S.11, S.12, S.13, S.14 + S.15
AN.1173	13. Computer software and databases[3]	S.1, S.11, S.12, S.13, S.14 + S.15
AN.1174	14. Entertainment, literary or artistic originals[3]	S.1, S.11, S.12, S.13, S.14 + S.15
AN.1179	15. Other intellectual property products[3]	S.1, S.11, S.12, S.13, S.14 + S.15
AN.12	16. Inventories[1]	S.1, S.11, S.12, S.13, S.14 + S.15
AN.13	17. Valuables[3]	S.1, S.11, S.12, S.13, S.14 + S.15
AN.2	18. Non-produced non-financial assets[3]	S.1, S.11, S.12, S.13, S.14 + S.15
AN.21	19. Natural resources[3]	S.1, S.11, S.12, S.13, S.14 + S.15
AN.211	20. Land	S.1[3], S.11[3], S.12[3], S.13[3],S.14 + S.15[4]
AN.212	21. Mineral and energy reserves[3]	S.1, S.11, S.12, S.13, S.14 + S.15
AN.213 + AN.214	22. Non-cultivated biological resources and water resources[3]	S.1, S.11, S.12, S.13, S.14 + S.15
AN.215	23. Other natural resources[3]	S.1, S.11, S.12, S.13, S.14 + S.15
AN.22	24. Contracts, leases and licences[3]	S.1, S.11, S.12, S.13, S.14 + S.15
AN.23	25. Purchases less sales of goodwill and marketing assets[3]	S.1, S.11, S.12, S.13, S.14 + S.15

1 Data for reference years before 2012 to be transmitted on a voluntary basis. Transmission for reference years from 2012 onwards is compulsory.

2 Data for reference years before 2000 to be transmitted on a voluntary basis. Transmission of data for reference years 2000 to 2011 on is on a compulsory basis only for total economy. Transmission is compulsory for total economy and for institutional sectors for reference years from 2012 onwards.

3 On a voluntary basis.

4 First transmission in 2017