ASSOFOND
ASSOCIAZIONE ITALIANA FONDERIE

ASSOFOND INDEXES
READING GUIDELINES

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November 2021

Objectives and areas of application

This guideline maps out the tools provided by Assofond to document the evolution of the main production inputs used to make a casting, while also suggesting a possible methodological approach for their understanding and possible application.

The sole purpose of the proposed system is to determine a measure, as objective as possible, of the value of the casting over time, such as to configure constant profitability in real economic terms, assuming constant physical volumes and the real value of the invested capital.

The method is not a commercial negotiation tool, but is intended to be a starting point and a basis for sharing on which foundries and their counterparts can effectively compare with each other.

Assofond tools: main features and functions

As foundry products (technically called **castings**) are mostly made to the customer's drawings, they cannot be priced as standard catalogue products or commodities. Their prices depend, to a great extent, on the geometry of the piece, which can affect productivity, the core content (*part of the shape required to obtain the cavities inside the casting*), the size, the quality level and many other factors. However, even with these distinctive details and differences, the elements that determine the overall value are essentially the same whether it is a complex piece or a geometrically simple product.

In order to measure the trend in the costs of the main production factors, since the 1970s, i.e. for over half a century, Assofond has developed a series of indices summarised in specific tables commonly referred to as "*tabelle della formazione indicativa*" or more simply "*Assofond's tables*" (*see Appendix A*) with the intention of helping to better understand the cost breakdown of a foundry casting.

Over the years, in addition to the actual ***indexes***, there has been an increasing integration of information and data to foster greater insights into commodities and their markets. So-called "***price books***" were created (integration of analyses, market notes, data and information on commodities).

As is typical in many organisations, the **Association's economic commission** helps to represent companies' needs and prefigure the reports to be managed in the interests of members, while the **Study Centre** handles their development, write-up and maintenance:

- updates the database
- checks the consistency and availability of data sources and reference drivers
- represents critical issues and proposes solutions where necessary

The database is based on a unique definition of the "source data" and its accurate input into tables. The reports are the outcome of operations on the data, performed through defined aggregate patterns.

The **quality of the input data** is a fundamental requirement on which the Study Centre has always paid the utmost attention, favouring **information sources with the following requisites:**

- **authority**
- **independence**
- **official capacity (expression of regulated markets, legally recognised public bodies, or accredited platforms, etc.)**
- **transparency**
- **accessibility**

Most of the input data fulfils these conditions, however, as we shall see below, there are a few isolated difficulties for typical elements of the foundry process for which, to date, there are no official prices and/or references in the above sense.

In order to fill this information gap, the Study Centre responds with direct monthly surveys, questioning commercial units and users of the raw material being researched. Established prices are averaged and recorded using a *range*

consisting of a minimum and maximum average price. Thanks to these surveys, an inflationary measure can also be estimated for these production inputs which, as mentioned, are not reflected in official price lists but whose costs are subject to substantial fluctuations because they are influenced by energy costs and the development of maritime freight rates. We will return to this point and the specific cost items below.

In summary, the task of the Assofond Study Centre is to follow and document the cost trends of the main production inputs used in the foundry process and to support the activities of companies with *outputs* that may consist of:

- **Indexes** (elementary or aggregated in composite benchmarks): statistical tools designed to provide an objective measure of changes over time in the prices of a set of production inputs that are deemed representative of the complexity of components that contribute to making a casting. This means that although we have tried to characterise the main cost items within the indices, these are still benchmarks, conceptually far from a company's bill of materials that shows a much wider range of elements and raw materials used in the production process with specific inflationary dynamics.
- **Total cost breakdown indexes** (formazione indicativa tables): tables showing the breakdown of cost in terms of percentages of the value, calculated for a variety of cases deemed representative of the different types of ferrous castings (grey and ductile cast iron, steel and investment casting) (see Appendix A).
- **Price books** (simple tabular reports, market notes, comments): weekly, fortnightly or monthly analysis tools that document the price trends of the most important metal and energy commodities (taken from official reference sources for national and international markets), in order to offer the user additional information and data to understand the phases of the up and down cycles of prices. The sources used are regulated markets (e.g. the London Metal Exchange (LME) for metals or the official stock exchange circuits for electrical powerity and natural gas) or other private platforms for raw materials that do not have official prices, such as Fast Markets (Metal Bulletin), Argus Metal, but which have authority and are taken as international references by the main market players.

All of the above publications are systematically checked to ensure that they reflect actual market trends and, whenever considered appropriate, are subject to review to keep them consistent with market changes and developments.
The preparatory activity for the review is always very intense and demanding, involving the top experts in the field from within the Association organisation and from the group of external consultants who contribute with analyses and simulations to define not only the most appropriate drivers but also the most consistent aggregate patterns to the technical-operational reality of the companies in the foundry industry.

The new methodological approach to breaking down the casting value

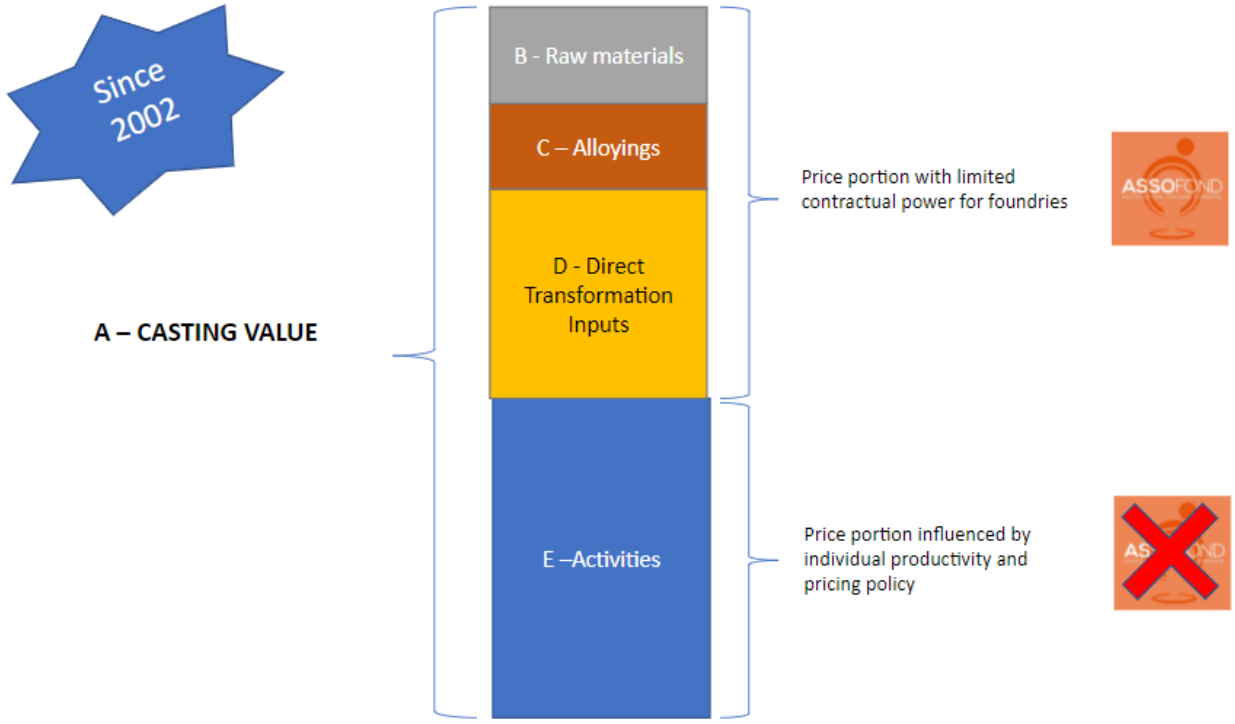
Since 2002, the foundry process has been characterised by a high level of cost inflation, mainly caused by the growth in global metal and energy prices. 2002 marked a divide between two different patterns of price development. After two decades of price reductions and stability, prices began to rise in the second half of 2001, with an exponential upward trend that manifested itself in full force in 2007/2008.

Noting that the scenario that was emerging would be a permanent factor in the international economic system and that the economic factors for forming the cost of the metal charge were completely uncontrollable by the foundries, Assofond decided to intervene, to support its members who were experiencing an immensely critical period, by monitoring the phenomenon through the publication of a new class of indexes that was a development of the previous "Indicative formation" indexes, which still apply and are still used today.

The basic idea was to sterilise the total value of a casting with respect to the cost component of ferrous raw materials, as had already been done for some time in other European countries (such as the German MTZ, etc.) and in Italy in other sectors, such as aluminium castings or the steel industry.

Hence a different methodological approach was opted for compared to the criteria used with the forerunners of the historical "Indicative formation" tables.

Under the new approach, the **casting value can be conventionally broken down into 4 main components (B, C, D, E):**



The first three components **B**, **C** and **D** are the production inputs transformed in the foundry process to obtain a casting and represent that part of the costs over which companies have no control, apart from that small negotiating power based on the volumes purchased, payment or contractual conditions. This is a price portion with limited contractual power for foundries. The evolution of these cost factors depends on the logic of the markets and their international dynamics.

Assofond contributes to documenting and explaining the dynamics of these components with specific *indexes* and *price books*.

Item **E**, the remaining part net of the three components **B, C, D**, represents the value of the activities carried out by the foundry and by any external suppliers. It's the price portion influenced by individual productivity and pricing policy. By its very definition on balance, the sum remains for the following components:

- external services, excluding energy consumption
- work,
- ecological/environmental
- financing charges
- amortisation/depreciation/
- use of third-party assets …….
- **Gross Operating Margin**

This **expresses the true pricing policy that each company will evaluate in accordance with its business objectives** and determines the **competitive capacity of the individual company.**

The Association cannot comment on this component and therefore does not provide any kind of support tool.

Map of tool availability by sector

The tools provided by Assofond are published on the Association's website (www.assofond.it) and can be consulted by registering on the portal. They are regularly updated with special posts under the following "*sections*" of the Thematic sections *economic studies*:

Assofond's Indexes
click here

- Indexes (also in English)
- Cost breakdown indexes

Raw materials click here

- Price Book

FOLLOW

You can be notified of regular updates of the individual sections of interest by pressing the continue button under each section.

The chart below shows the availability of tools for each cost component for the 4 segments represented by Assofond: Cast Iron, Steel, Precision Casting and Non-Ferrous Metals.

Components	Iron castings			Steel castings			Investment castings			Non ferrous castings		
	Indexes	Price book	Indicative breakdown cost	Indexes	Price book	Indicative breakdown cost	Indexes	Price book	Indicative breakdown cost	Indexes	Price book	Indicative breakdown cost
B - RAW MATERIALS	RMEC - Raw Material Extra § Grey Iron § Ductile Iron	Ferrous metal		RMEC - Raw Material Extra § Steel	Ferrous metal			Ferrous metal			Non ferrous metal	
C – ALLOYINGS		Extra Alloy Ferroalloys			Extra Alloy Ferroalloys			Extra Alloy Ferroalloys				
D – DIRECT TRANSFORMATION INPUTS	DTI - Direct Transformation Inputs: § ductile iron electrical furnace § ductile iron cupola furnace	Foundry coke Electrical power Natural gas			Electrical power Natural gas			Electrical power Natural gas			Electrical power Natural gas	
E - ACTIVITIES	NA			NA			NA			NA		
A - CASTING VALUE			Indicative breakdown cost % § grey Iron § ductile Iron			Indicative breakdown cost % § carbon steel castings § 18/8 CrNi steel castings § 11/13 Cr steel castings			Indicative breakdown cost % § Non-alloyed steel castings § inox steel castings § cobalt-based superalloys castings			

- Raw material extra charge indexes are available for grey cast iron, ductile cast iron and steel castings.
- Direct transformation input indexes are available for ductile cast iron castings produced with an electrical power or cupola furnace.
- Indicative breakdown cost indexes are available for grey cast iron, ductile cast iron, steel castings and precision casting.
- Price books for ferrous metals, alloy and ferro alloys extra charge are available for grey cast iron, ductile cast iron, steel castings and precision castings.
- Non-ferrous metal price books are available for non-ferrous castings.
- Coke price books are available for cast iron castings made with a cupola furnace.
- Price books for electrical power and natural gas cover all sectors.

Assofond tools that can be used for certain cost components

Item B - Raw materials - Raw material extra charge (QEMP)

The **QEMP** index monitors the monthly development of the costs of pig iron and scrap and is defined using the official surveys of the Milan Chamber of Commerce, Industry, Crafts and Agriculture (hereafter C.C.I.A.A.). The value, expressed in euro/ton, refers to the different kinds of metal: grey cast iron, ductile cast iron and steel castings.

Information on the method

- **Grey cast iron**: *the value is made up of hematite pig iron (50%) (chapter 431 item 310 Milan C.C.I.A.A.) and bales/packages 30X30 cm of deep drawing (50%) (chapter 431 item 226 Milan C.C.I.A.A.)*
- **Ductile cast iron**: *the value is made up of pig iron for ductile iron (50%) (chapter 431 item 320 Milan C.C.I.A.A.) and bales/packages 30X30 cm of deep drawing (50%) (chapter 431 item 226 Milan C.C.I.A.A.)*
- **Steel castings:** the value is made up of new scrap sheet for electrical furnace (chapter 431 item 225 Milan C.C.I.A.A.)

The breakdown of the metal charge is entirely conventional. The combination (50%) was chosen with the intention of making it easy to illustrate, so it can be considered plausible and is given as an example only. Each foundry is, of course, free to parameterise the process and product by entering the values corresponding to its own company's details.

See the FAQ (Click here) for operation of the Milan CCIAA Metal Prices Commission, surveys and more

Each month, two types of data are provided:

- line 7 = average monthly price, source Milan CCIAA
- line 8 = Maximum value trend of the last fortnightly survey by the Milan CCIAA

Calculation of the melt loss on the raw material extra charge

The raw material extra charge table does not take into account the melt loss that each foundry will have to define according to its specific production.

As an example, here below is a calculation based on the difference between the weight of the raw materials purchased and the castings sold. It is assumed that for the most common types of castings, the melt loss is 10%: a value which has been repeatedly supported and recognised from a tax point of view as well.

Ductile cast iron castings:
Cost of the raw material on castings including melt loss
= 310.00X100/(100-10) = 344.44

Possible use of the QEMP

- Determine the value of the raw material for the initial period from when inflation is to be calculated (QEMP) in €/t
- record any increase or decrease in changes, as documented by the monthly value in line 7 expressed in €/t (applying any melt loss).

ATTENTION!

The update frequencies and algorithms will be those that each foundry has agreed with its customer.

Even the benchmark conventionally proposed in the QEMP can easily be recalculated and customised by the foundry based on its own charge mix (percentage of scrap and pig iron used).

Item C - Alloy Elements - Price book for Alloy and Ferro Alloys extra charge

Assofond does not provide specific indices for the valuation of alloy elements, but documents their evolution through official surveys from the LME (Nickel and Copper) and from Fastmarkets, which are conveniently summarised in two **price books** published monthly containing the following items:

- Cobalt
- Chromium
- Ferro-chrome
- Ferro-Manganese
- Ferro-Molybdenum
- (Ferro-Silicon) (*attention! included in the auxiliary materials in the DTI index*)
- Ferro Silicon Manganese (currently not available)
- Ferro-Vanadium
- Nickel
- Copper

Possible use of the price book

Foundries making castings which require, in addition to the basic metal charge, an input of alloy elements, must:

- declare the standard alloy extra charge analysis, the total percentage of alloy extra charge
- determine the value of the alloy element for the initial period from when inflation is to be calculated
- alter the starting value according to the €/t changes in the price book
- multiply by the declared analysis percentage

Item D - Direct Transformation Inputs (DTI)

The DTI has been formulated by reproducing the hypothetical breakdown of case A of the indicative formation cleaned of pig iron and scrap included in component **B** of the cost and of other inputs such as: cost of money, sand disposal and labour included in item **E** (Activity).

% breakdown of the cost of ductile iron castings

Pig iron for ductile iron	**13,0**
Steel scrap	**4,5**
Recarburising graphite	**1,0**
FeSiMg	**3,0**
Other materials (FeSi)	**2,5**
Electrical power	**5,5**
Natural Gas	**1,0**
Foundry Coke	**5,5**
Filters & exothermic sleeves	**3,0**
French sand	**5,0**
Core binders	**3,0**
Green sand binders	**1,3**
Other costs (money cost)	**6,7**
Disposal sand cost	**5,0**
Labour cost	**35,0**
Other consumables (consumer prices index)	**5,0**
TOTAL	**100,0**

In 2007 the DTI was launched for foundries using an electric furnace, and then in 2009 the version for those using a cupola furnace was added.

The two indexes, electrical furnace and cupola furnace, differ only in the aggregate of energy consumption which, in the first case, takes into account electricity and natural gas, while in the second case, introduces foundry coke as the main fuel and attributes a lower incidence to electricity and gas.

Breakdown of the Index (*Direct Transformation Inputs*)

electric furnace

Recarburising graphite	2.67
FeSiMg	8.00
Other materials (FeSi)	6.67
Metallic charge excluding pig iron & steel scraps	17.34
Electrical power	29.33
Natural Gas	2.67
Foundry Coke	0.00
Energies	32.00
Filters & exothermic sleeves	8.00
French sand	13.33
Core binders	8.00
Green sand binders	3.47
Other consumables (consumer prices index)	17.86
Auxiliary materials	50.66
Direct transformation inputs	100.00

cupola furnace

Recarburising graphite	2.67
FeSiMg	8.00
Other materials (FeSi)	6.67
Metallic charge excluding pig iron & steel scraps	17.34
Electrical power	15.76
Natural Gas	1.43
Foundry Coke	14.81
Energies	32.00
Filters & exothermic sleeves	8.00
French sand	13.33
Core binders	8.00
Green sand binders	3.47
Other consumables (consumer prices index)	17.86
Auxiliary materials	50.66
Direct transformation inputs	100.00

There are 11 cost elements considered for these indexes which are monitored monthly from the base year 2002.

To simplify and facilitate the use of the indexes, the 11 cost elements have been combined into 3 benchmark indexes:

- **Metallic charge excluding pig iron and steel scraps**
- **Energies**
- **Auxiliary materials**

And then merged into a single summary index, the DTI.

The tables above calculate the index for item D, with average base year 2002 = 100 and use relative weights for the various typical commodities for an average casting of ductile cast iron produced in an electrical furnace and a cupola furnace.

Through publication of the summarised “benchmarks or aggregate indexes” for demonstration purposes and the separate publication of the elementary indexes for each component of the aggregate index, it is Assofond’s intention to allow the individual company to customise how the overall cost of its inputs is monitored, either through its product cycle or separately for each family or, in the most detailed case, for the individual casting.

DTI Indexes - Electrical Furnace and Cupola Furnace

Metallic charge excluding pig iron and steel scrap

The **metallic charge excluding pig iron and steel scrap** aggregate takes into account the materials used to process alloys, excluding basic materials used in the charge such as pig iron and scrap and alloy elements (metallic elements and/or ferro alloys). Alloy elements are: manganese, copper, tin for *pearlitic cast iron*, copper, nickel, molybdenum, manganese, chromium, etc. for *alloyed cast iron* added to the charge or afterwards.
This index includes, among other elements, FeSi and FeSiMg, which, although classed as ferro alloys, have a more generalised use than alloy elements, as they are used for the production of both common and special cast irons due to their inoculant and ductile properties.
Specifically, the inclusion of the FeSiMg is justified by the fact that the DTIs were created on the basis of a ductile cast iron casting whose production process requires the use of this charge element.
In this index, apart from the FeSi which can rely on Fastmarkets surveys (see source Appendix), the FeSiMg and carburising graphite, which do not have official prices, are monitored on the basis of ad hoc surveys conducted at the premises of main suppliers and users.
As regards the inflation of these commodities, the changes recorded throughout the year are affected by the typical nature of the contracts, which are mainly every six months or yearly, which is why they are often not responsive during the year to the inflation that materials receive on spot transactions. As a result, changes in these cost factors are perceptible at the beginning of the year or at the beginning of the six months.

Energies

The **energies** index is what differentiates the electrical furnace DTI from the cupola furnace DTI. The impact of energy consumption on the total DTI index in the base year is the same for both (**32%**); only in the first case the benchmark

is split between electricity and natural gas, setting coke at zero, while in the second case the introduction of coke as the main fuel imposes a reduction of the weights attributed to the other two energy sources.
Energy indexes have been the most turbulent over the last 20 years. The reviews were necessary in order to adapt the calculation mechanism to the new market references, e.g. switching from the old Ct (production cost of electricity from fossil sources) to the PUN (Italian National Single Price) for electricity; the same applies to the natural gas or coke index, which has incorporated several changes to the breakdown of the benchmark, and to the reference sources.

Electrical power index

The electrical power index is based on the total cost of energy, hence taking into account the commodity and charges.

Both components are calculated for a utility profile in medium voltage based on national statistical processing of energy data of iron foundries (non-energy intensive), which takes into account the average parameters measured on the sample surveyed for: annual and monthly consumption, plant power, etc.

In order to monitor the trend of the raw material, the PUN (Italian National Single Price) was chosen, i.e. the reference price of electrical power on the Italian Power Exchange (IPEX).

The monthly PUN values can be downloaded at the following link on the GME (Gestore Mercati Energetici [Italian Energy Markets Manager]) website.

PUN6, six-month moving average of the monthly PUN average, is used for the index. Under "normal" market conditions, the six-month moving average appeared to be the most appropriate frequency to ensure relative stability in the price of electricity by buffering a certain degree of monthly volatility.

As a result of the algorithms chosen, which calm down the monthly fluctuations of the commodity, it is possible that, at times of high volatility, the index is somewhat slow to absorb current market movements, which it will tend to reflect with a delay of 6 months.

The "charges" are calculated taking into account the different fees (fixed, power, energy) of all the charges that make up the electricity bill as well as the network blackouts as published with resolutions of the Italian Regulatory Authority for Energy, Networks and Environment - **ARERA** on the website at the following link.

Natural gas index

The structure of the natural gas index takes into account both the cost of the commodity published by the **GME** (Italian Energy Markets Manager) and the fiscal and parafiscal charges (transport, distribution and other charges) as published with resolutions of the Italian Regulatory Authority for Energy, Networks and Environment - **ARERA** on the website at the following link.

To monitor the trend of the raw material, **PB-GAS** (Balancing platform managed by the GME) now **MGS** (Market Organised for the Trading of Stored Gas) was chosen, as PB-GAS was the only platform that published data free of charge at the time of the index (2007). The historical series of the PB-GAS has an evolutionary agreement with the most widespread and recognised references in the trading environment, namely the prices of the PSV (Virtual Trading Point) and the TTF (Title Transfer Facility) taken respectively at the Italian and Dutch hubs.

The **3-month moving average** of the monthly MGS values is used for the index.
The three-month moving average appeared to be the most appropriate frequency to ensure relative stability in the price of gas by buffering a certain degree of monthly volatility.
The MGS values can be downloaded at the following link.

Coke index

Coke can be found in the "Raw Material Extra Charge + Coke" metal charge benchmark (**table 5bis**) and under energy consumption in the DTI index for foundries using a cupola furnace.

The Coke index was introduced in January 2007.

It was based initially and until December 2008 on prices of 80 mm Chinese Foundry coke published in the monthly "Coke Market report", which was deemed as the most reliable official source at the time, also considering the high propensity to the consumption of Chinese coke. Since January 2009, the reopening of the Milan Chamber of Commerce's activity with timely surveys of domestic, European and Chinese foundry coke has led to this information source being used as the official driver until December 2019, when it had to revert back to using the Coke Market Report due to the suspension of the Chamber of Commerce's activity for solid fuels.

With effect from January 2020, after extensive research, Assofond has provided for the use of the **Coke Market Report - Analysis of the Global Metallurgical Coke & Coal**.

The new reference is the "**Foundry Coke, 90/250mm, 10.0% Ash (Delivered) cfr northern Europe**".

Following the switch to the new driver, and so as not to produce a discontinuity in the series, the conventionally defined benchmark has stayed the same in absolute value, while quarterly inflation occurs using the €/t delta of the "Foundry coke, 90/250 mm, 10% Ash (delivered) cfr northern Europe" prices which does not separate national from foreign coke.

In particular, the first price list for the quarter values coke for the whole quarter similarly to previous chamber price lists.

Example

The €/ton delta between the price list issued in January (first month of the first quarter) and the price list issued in October (first month of the previous quarter) is applied for the valuation of the whole quarter: January-February-March.

Auxiliary materials

The so-called **Auxiliary Materials** contain an extensive amount of article codes, differentiated by size, quantities used, highly dependent on casting geometries and thicknesses and on the required final quality of the individual product.
The cost items included in this index (binders for sands, binders and catalysts for cores, sands, filters and exothermic sleeves, etc.) are typical elements of the foundry process for which, until now, there are no prices on official price lists issued by public bodies, stock exchange circuits or private platforms (Fastmarkets, Argusmetal, etc.) accredited to survey raw materials traded over the counter.

In order to fill this information gap and be able to constantly monitor these cost elements, Assofond conducts monthly ad hoc surveys at the premises of main suppliers and users. The monthly trend of these indexes is the result of the outcome of these surveys.

Also added to this aggregate is the "miscellaneous consumables" component which includes, for example, costs linked to packaging, transport, and freight, which in some market phases can experience inflation much higher than the consumer price dynamics to which they have been indexed.

The simplifying choice of indexing miscellaneous consumables to the general consumer price index (source ISTAT), on the one hand makes the index more official and transparent, since it is the country's general inflation, and therefore the most used tool for calculating the current value of goods and services, but on the other hand underestimates the inflationary trend of these cost components, whose trend is strongly linked to energy commodities and transport costs.

Possible use of the DTI

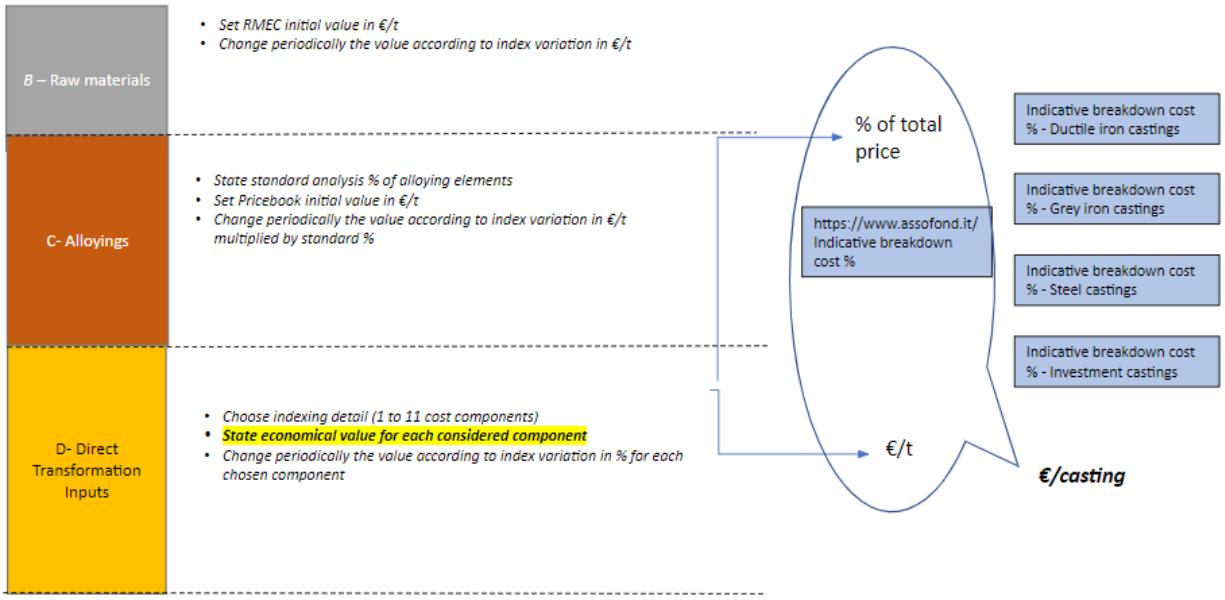
DTI can be used:

- as summary indices (total DTI) to inflate component D of the transformation cost, taking into account all breakdown assumptions that have been made to develop the aggregate benchmark
- as sub-indexes (3 benchmarks) up to a maximum detail using 11 elements. In the latter case, the procedure becomes more complex because for each cost element identified, the initial economic value and the usage

percentages of each one must be declared, which leads to a greater intrusion into the company's production process.

- the initial value expressed in €/t must be declared
- to apply the inflations recorded by the index(es) to the initial value
- Alternatively, a reference value expressed as a percentage of the casting sales value can be used.

Example of possible indexing methods



Benefit of Assofond's Tools

Assofond's tools, if used properly, represent valid starting documentation on which foundries can compare themselves with their customers when negotiating and updating their sales price lists.

The Raw Material Extra Charge indexes are easy and open to share, as these raw materials are regularly listed by the Chambers of Commerce.

The same applies to electricity and natural gas, commodities that are directly purchased to some extent by all industrial companies.

There is, of course, the largest consensus on the inflation index for miscellaneous consumables, since it is the country's general inflation, and thus the most commonly used tool for calculating the current value of goods and services.

There is some difficulty in sharing the index of auxiliary materials and auxiliary materials, as the underlying benchmarks contain items typical of the foundry process such as carburising graphite, ferro alloys, sands, binders for cores and sands, filters and exothermic sleeves, miscellaneous consumables.

There are no sharing problems for price books since they are created on the basis of official data or in any case taken from platforms recognised as valid market references.

Appendix A

Indicative breakdown cost

Until 2002, the **"indicative breakdown cost"** were the only cost indexes developed by Assofond to monitor the total production cost of a **ferrous casting**. These are total cost indexes because they take into account the components of the **pure metal charge** (pig iron and scrap), **factors linked to transformation costs** (energy consumption, ferro alloys and auxiliary materials) and **the cost of labour and money**.

When talking about **indicative breakdown cost**, we refer to 4 benchmarks: grey cast iron, ductile cast iron, steel and investment castings (castings made with the lost-wax casting technology).

Each benchmark consists of a set of production inputs on which a series of breakdown/aggregation assumptions have been formulated, giving rise to different cases:

- 13 assumptions for grey cast iron castings,
- 3 assumptions for ductile cast iron castings,
- 3 assumptions for steel castings (carbon steels, 18/8 CrNi steels, 11/13 Cr steels)
- 3 assumptions for precision castings (unalloyed C40 steels, stainless steels, cobalt-based superalloys).

Breakdown cost indexes for grey iron castings

For grey iron castings, 13 cases were assumed reflecting possible production cost structures, each of which is obtained on the basis of 12 variable parameters and one fixed. The company cases with a higher order number refer to companies that produce larger castings; it is assumed that as the volume of the casting increases, the impact of the cost of raw materials, energy and sand decreases while the impact of the cost of labour increases.

The index also consists of an invariable component that has been set at 5%.

It is also assumed that a fixed ecological cost contributes to the index, regardless of the size of the castings produced. It accounts for 5% of the total index.

In detail, the 12 variable cost elements are mainly grouped into 3 indexes:

	Metal charge	Energy index	Auxiliary (sand)	Labour cost	Ecological cost	Fixed component	TOTAL
No. 1	48	18	14	10	5	5	100
No. 2	45	17	13	15	5	5	100
No. 3	42	16	12	20	5	5	100
No. 4	39	14	12	25	5	5	100
No. 5	36	13	11	30	5	5	100
No. 6	33	12	10	35	5	5	100
No. 7	30	11	9	40	5	5	100
No. 8	27	10	8	45	5	5	100
No. 9	24	9	7	50	5	5	100
No. 10	21	8	6	55	5	5	100
No. 11	18	7	5	60	5	5	100
No. 12	15	6	4	65	5	5	100
No. 13	12	4	4	70	5	5	100

% Weight of the component. Index based on December 1999 = 100

- **Metal charge**

  This item includes raw materials, from scrap to pig iron to ferro alloys. The calculation assumes a theoretical metal mixture consisting of:

  - hematite pig iron (33%)
  - iron scrap (30%)

- steel scrap (36%), FeMn +FeSi (1%)

- **Ecological index**

  This index is split into three items covering:

  - disposal of foundry sand (20%)
  - disposal of special waste (20%)
  - electrical power (60%)

- **Energy index**

  The basic December 1999 index, set at 100, is split into three items:

  - electrical power (33.34%)
  - coke (33.33%)
  - natural gas (33.33%)

Breakdown cost indexes for ductile iron castings

For ductile iron castings, three cost breakdowns were assumed (A, B, C), each consisting of 16 variable elements. The basic breakdown of the various assumptions, shown in the tables below, is set at 100 in December 1999.

	A	B	C
Pig iron for ductile iron	13,0	13,9	12,1
Steel scrap	4,5	4,8	4,2
Recarburising graphite	1,0	1,1	1,0
FeSiMg	3,0	3,2	2,8
Other materials (FeSi)	2,5	2,7	2,3
Electrical power	5,5	5,9	5,1
Natural Gas	1,0	1,1	0,9
Foundry Coke	5,5	5,9	5,1
Filters & exothermic sleeves	3,0	3,2	2,8
French sand	5,0	5,3	4,6
Core binders	3,0	3,2	2,8
Green sand binders	1,3	1,4	1,2
Other costs (money cost)	6,7	7,2	6,2
Disposal sand cost	5,0	5,3	4,7
Labour cost	35,0	30,0	40,0
Other consumables (consumer prices index)	5,0	5,8	4,1
TOTAL	100,0	100,0	100,0

% Weight of the component. Index based on December 1999 = 100

Breakdown cost indexes for steel castings

The indexes refer to three types of steel: carbon, 18/8 CrNi and 11/13 Cr. For each type of steel, four indexes are calculated for castings with 4 different weight classes:

- from 5 to 20 Kg
- from 21 to 100 Kg
- from 101 to 1,000 Kg
- more than 1,000 Kg.

Breakdown cost indexes for investment castings made using lost-wax casting technology

Three cost breakdowns are assumed for: non-alloy steel castings, stainless steel castings, cobalt-based superalloy castings. Each assumption is made up of six cost elements and the percentage weight of variable parameters is set at 100 in December 1999.

	Non-alloy steel	Stainless steel	Cobalt superalloy
Special steel	**4,62**		
Stainless steel for special use		**14,00**	
Cobalt			**60,22**
Electrical power	**5,54**	**4,66**	**2,26**
Natural Gas	**3,70**	**3,50**	**1,50**
Silical colloidal	**11,54**	**10,50**	**5,38**
Labour cost	**71,6**	**64,16**	**29,04**
Other costs (money cost)	**3,0**	**3,18**	**1,6**
TOTAL	**100,0**	**100,0**	**100,0**

% Weight of the component. Index based on December 1999 = 100

Appendix B

Table 5bis - Raw Material Extra Charge (QEMP) + Coke

TAB 5BIS link to the website

The continuous and uncontrollable increases in coke prices during 2008 have revealed the need for foundries using this energy input to link the raw material extra charge more closely to the cost of this fuel.

After some initial resistance, justified by the desire to not confuse the benchmark of metal charge, meaning pig iron and scrap, Assofond produced a modified version of the Raw Material Extra Charge table, which is now called **Table 5bis**, to take into account the fluctuation of prices for coke used in the production process of foundries that use the cupola furnace as a melting system.

With effect from January 2008, next to Column 5 (grey cast iron castings), the value of which is made up of hematite pig iron (50%) and packs of 30X30 deep moulding foundry sheet metal bales (50%), a column called **5 BIS "grey cast iron castings BIS"** has been added, the values of which are the sum of the values in column 5 "Grey cast iron castings" + 20% of the coke price defined in the conventional benchmark.

For some foundries which thought they could not use the transformation inputs index specifically developed for the cupola furnace, column 5 BIS has since then been the value to be considered for calculating the raw material extra charge for grey cast iron castings using coke.

For more details on the breakdown and inflation of the benchmark, see the "Coke index" section.

Appendix C

ETT – Euro Ton Transformation

link to the website

Example of reversing Assofond indexes on the value of a ton of ferrous casting

Through publication of separate **DTI indexes** for each component of the index, it is Assofond's intention to allow the individual foundry to customise how the overall cost of its inputs is monitored, either through its overall product cycle or separately for each family, or even, in the most detailed case, for the product.

On several occasions, many foundries have urged Assofond to reverse the indexes on the value of a ton of ferrous casting.

Until 2006/2007, Assofond refrained from adhering to such requests, considering it its duty to simply provide a system of indexes in a transparent and controllable form that foundries could use in their own specific and particular reality to monitor costs with their own management control system. In order for this to be possible and effective, it was necessary for each production process to reverse the indexes that Assofond guaranteed as representative of the market, using the weights of their own work cycles, and with the customary observation that the proposed breakdown tables were purely indicative and reflected average values of the sample processes of the foundries examined.

To meet the pressing demands, in 2008 Assofond decided to provide a monthly publication depicting the structure of the product value, applying the trend of the Assofond indexes to it, the so-called **Cyclone 2002 1,000-500** in which basic assumptions had to be made to obtain a single **synthetic index in €/ton**.

Cyclone 2002: 1,000-500

Basic assumption

The basic assumption is an initial transformation value (A-B-C) in the base year 2002 of **1,000 €/t** divided into two equal parts:

- **D:** Direct Transformation Inputs **DTI** = 50% * 1,000 = 500 €/ton
- **A – B – C – D:** Activity Value **AV** = 50% * 1,000 = 500 €/ton

The assumption of the reference value **1,000 €/ton** does not affect the applicability of the tables, while the weights of the breakdown into the two DTI and AV components represent a specific case, which is nevertheless sufficiently representative.

Similarly, to the DTI, an example of how Assofond indexes may be reversed on the value of a ton of ferrous casting has been provided for foundries using an electrical power furnace and for those using a cupola furnace.

Simplified convention

Due to the above sharing difficulties linked to a lack of official reference sources for auxiliary materials, Assofond decided to use a simplified version of the euro/ton example model, indexing Auxiliary Materials to Miscellaneous Consumables (general inflation source ISTAT).

Please note that this convention leads to an underestimation of inflationary dynamics, including the commodity of Auxiliary Materials with significant energy components, in terms of the impact of transport (sands) and energy materials (binders and catalysts).

Analysing past historical series, it is evident that the inflationary trend of Auxiliary Materials could be estimated with an index equally consisting of a general inflation index (Miscellaneous Consumables) and an energy index.
However, we decided to only use the Miscellaneous Consumables index.

Other differences with respect to the DTI

Compared to the Direct Transformation Inputs indexes, there are three new features:

- Underestimation of the inflationary trend for Auxiliary Materials
- Convenience in evaluating the inflationary effect on the Product, as the data in Euro/ton per cast are immediately available
- Aggregation of inflationary components in two broad categories, according to the nature of the inflationary drivers:
    - Energy and Energy Materials (Auxiliary materials), energy drivers.
    - Auxiliary Activities and Materials, general inflation drivers.

Data sources

Raw Material Extra Charge (QEMP)

Pig iron for ductile cast iron, source Milan Chamber of Commerce (hereafter CCIAA), Chapter 431 item 320 - From Producer/Trader to User - Delivered Milan and Province - excluding VAT - C.C.I.A.A. monthly average

Hematite pig iron, source Milan Chamber of Commerce (hereafter CCIAA), Chapter 431 item 310 - From Producer/Trader to User - Delivered Milan and Province - excluding VAT - C.C.I.A.A. monthly average

New Scrap, packages 30x30 cm, non-galvanized, ferrous foundry scrap, source CCIAA, Chapter 431 item 226 - C.C.I.A.A. monthly average

RMEC «ductile iron castings» example benchmark: arithmetic mean between ductile pig iron and packages 30X30

RMEC «grey iron castings» example benchmark: arithmetic mean between hematite pig iron and packages 30X30

RMEC «steel castings» example benchmark: until July 2017 new scrap steel up to 2.9 mm thick, category 50, source CCIAA, Chapter 430 item 60; from August 2019 the monthly delta applies (€/t) for new, loose, foundry sheet metal, up to 2.9 mm thick, source CCIAA, Chapter 431 item 225.

Line 7: monthly average, source CCIAA, according to the calculation algorithm indicated by CCIAA (criteria for calculating average wholesale prices Milan CCIAA).

Line 8: maximum value of the last CCIAA twice-monthly survey. This line changes during the month. Data from the first survey are highlighted in italics to indicate their provisional nature. The data is definitively fixed with the second survey of the month. In contrast to line 7, which contains the official monthly average, line 8 records the maximum value of the last survey of the month, providing a more accurate indication of the market trend.

Direct Transformation Inputs and Euro/ton Transformation

- **Carburising graphite:** average price from monthly Assofond survey at suppliers' premises.
- **Ferro Silicon Manganese:** average price from monthly Assofond survey at suppliers' premises.
- **Ferro-Silicon:** source Fastmarkets - ferro-silicon lumpy basis 75% S, delivered Europe, €/ton monthly average
- **Electrical power:** sources: **GME** (Italian Energy Markets Manager) - reference **PUN** (Italian National Single Price) published at the following link; **ARERA** (Italian Regulatory Authority for Energy, Networks and Environment) - reference charges as per resolutions at the following link.
- **Natural gas:** sources: **GME** – reference **PB-GAS** (Balancing platform managed by the GME) now **MGS** (Market Organised for the Trading of Stored Gas) published at the following link; **ARERA** (Italian Regulatory Authority for Energy, Networks and Environment) - reference charges as per resolutions at the following link.
- **Coke**: source Coke Market Report - foundry Coke, 90/250mm, 10.0% Ash (Delivered) US$/ton cfr northern Europe - Analysis of the Global Metallurgical Coke & Coal Markets.
- **Filters and exothermic sleeves:** average price from monthly Assofond survey at suppliers' premises.
- **Sands:** average price from monthly Assofond survey at suppliers' premises.
- **Core binders:** average price from monthly Assofond survey at suppliers' premises.
- **Green sand binders:** average price from monthly Assofond survey at suppliers' premises.
- **Other consumables:** consumer price index for blue- and white-collar households (base 2015=100) - monthly data – ISTAT

Indicative breakdown cost

- **Heavy cast iron scrap**, source Milan Chamber of Commerce, Chapter 431 item 250 - From Trader to User - Delivered Milan and Province - excluding VAT - mechanical cast iron scrap 1st category (furnace-ready) - C.C.I.A.A. monthly average.
- **Steel scrap (cupola scraps)**, source Milan Chamber of Commerce, Chapter 431 item 220 - From Trader to User - Delivered Milan and Province - excluding VAT - qualified scrap iron and/or corrective steel for cupola furnace (furnace-ready) - C.C.I.A.A. monthly average.
- **Steel scrap (new melted steel sheet for electric furnaces)**, source Milan Chamber of Commerce, Chapter 431 item 225 - From Trader to User - Delivered Milan and Province - excluding VAT - new, loose sheet metal, up to 2.9 mm thick (furnace-ready) - C.C.I.A.A. monthly average.
- **Steel scrap (bales/packages of deep drawing)**, source Milan Chamber of Commerce, Chapter 431 item 226 - From Trader to User - Delivered Milan and Province - excluding VAT – packages 30X30 cm deep drawing sheet, excluding galvanised, tinned and painted sheet metal (furnace-ready) - C.C.I.A.A. monthly average.
- **Cobalt:** source Fastmarkets (Metal Bulletin) - Cobalt alloy grade, in-whs Rotterdam, $/lb.
- **Cost of money:** source Bank of Italy - harmonised interest rates - loans to non-financial corporations – monthly average stocks, reference n-2.
- **Ferro-chrome:** source Fastmarkets (Metal Bulletin) - ferro-chrome high carbon 6-8.5% C, basis 60-64.9% Cr, max 3% Si, cif Europe, $/lb Cr – monthly average.
- **Ferro-manganese:** source Fastmarkets - ferro-manganese basis 78% Mn max, standard 7.5% C, delivered Europe, €/ton – monthly average.
- **Filters and exothermic sleeves:** average price from monthly Assofond Survey at suppliers' premises.
- **Sands:** average price from monthly Assofond Survey at suppliers' premises.
- **Core binders:** average price from monthly Assofond survey at suppliers' premises.
- **Green sand binders:** average price from monthly Assofond survey at suppliers' premises.
- **Other consumables:** source ISTAT - consumer price index for blue- and white-collar households (FOI) (base 2015=100) - monthly data.
- **Labour:** source ANIMA (Federation of Italian Associations of Mechanical and Engineering Industries). Table of average hourly cost of a worker in the general mechanical engineering sector.
- **Nickel:** source ASSOMET - Nickel Ni 99.8 in cathodes, briquettes, drops UNI 3353 – monthly averages price lists
- **Fuel oil:** source Milan Chamber of Commerce – Chapter 410, item 180 - Fuel oil for furnaces and burners - WITHOUT VAT. at 50°C above 12°E dense BTZ (sulphur not exceeding 1%) excise duty euro per Kg 0.031389 delivered to consumer's premises, payment deferred 30 days

Alloy and ferro alloys extra charge

- **Chromium:** source Fastmarkets (Metal Bulletin) - Chromium alumino-thermic 99% min, in-whs Rotterdam, $/tone – monthly average
- **Cobalt:** source Fastmarkets (Metal Bulletin) - Cobalt alloy grade, in-whs Rotterdam, $/lb.
- **Nickel:** source LME London Metal Exchange Official and settlement prices – Cash seller monthly average, $/t
- **Copper:** source LME London Metal Exchange Official and settlement prices – Cash seller monthly average, $/t
- **FeCr:** source Fastmarkets: Ferro-chrome high carbon 6-8.5% C, basis 60-64.9% Cr, max 3% Si, cif Europe, $/lb Cr -

- **FeMn:** source Fastmarkets: Ferro-manganese basis 78% Mn max, standard 7.5% C, delivered Europe, €/ton - Fonte: Fastmarkets
- **FeMo:** source Fastmarkets: Ferro-molybdenum basis 65% min, in-warehouse Rotterdam
- **FeSi:** source Fastmarkets: Ferro-silicon lumpy basis 75% Si (scale pro rata), delivered Europe, €/ton
- **FeSiMn:** source Argus Metal: Silico-manganese 65% Mn
- **FeVa:** source Fastmarkets: Ferro-vanadium basis 78% V min, 1st grade

The €/$ exchange rate used to convert the values expressed in dollars is the LME - London Metal Exchange Monthly Average

Webinars: Assofond Indexes Reading Guide

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