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Mini-presentation on ”Engineering services and related technical consulting services” (SPPI)

CPA: 71.12

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1. Description and characteristics of the industry

1.1 Definition of the industry

- Definition of service

“Engineering services and related technical consulting services” (as called in the 4-digit CPA) are the application of physical laws and principles of engineering to provide advice, to perform or improve processes or to develop new projects. These services are mostly provided by professionals acknowledged for their skills. They include numerous functions: consultancy, feasibility studies, detailed schedules and plans, management of projects. They also include several forms of enterprises, from the independent freelancer to the multinational corporate group.

The field of engineering activities is large: mechanical engineering, civil engineering (public buildings, transportation, infrastructures), private construction engineering, industrial engineering (chemistry, energy, manufacturing, biotechnologies, aeronautics and aerospace...), telecommunications engineering, waste management engineering, geological and geophysical engineering... Engineering activities also include “engineering advisory” which is not necessarily related to a particular project.

A division of the industry can be found in the CPA 5 and 6-digit classification:

71.12.1 Engineering services
- 71.12.11 Engineering advisory services
- 71.12.12 Engineering services for building projects
- 71.12.13 Engineering services for power projects
- 71.12.14 Engineering services for transportation projects
- 71.12.15 Engineering services for waste management projects
- 71.12.16 Engineering services for water, sewerage and drainage projects
- 71.12.17 Engineering services for industrial and manufacturing projects
- 71.12.18 Engineering services for telecommunications and broadcasting projects
- 71.12.19 Engineering services for other projects

71.12.2 Project management services for construction projects
- 71.12.20 Project management services for construction projects

71.12.3 Geological, geophysical and related prospecting and consulting services
- 71.12.31 Geological and geophysical consulting services
- 71.12.32 Geophysical services
- 71.12.33 Mineral exploration
- 71.12.34 Surface surveying services
- 71.12.35 Map-making services

- **Classification issues**

Classification issues are an important concern in the industry.

What we will highlight in this paper is related to the whole 71.12 (in CPA) industry called “Engineering services and related technical consulting services”. For language convenience, we use the terms “engineering activities” to call the 71.12 industry.

There are similarities between 71.12 and other industries:
- 71.20 Technical testing and analysis services
- 74.90 Other professional, scientific and technical services

In France, there is a collective labor agreement called “technical studies offices, consulting engineers offices and consultancy offices” which can be applied to the three industries 71.12, 71.20 and 74.90.
The boundary between these three industries is quite porous.
Some preliminary consultancies consisting in assistance to authorities of the project beforehand of the project schedules (cost estimations by construction economists, for instance) are more likely to be relied to 74.90. Environmental consultancy is also part of 74.90.
Inspection and technical analysis *ex post* are more likely to be relied to 71.20.
Land surveyors are included in 71.12, but they only represent 2% of the industry.

In France, the industry 71.20 is already covered by a price index. The 74.90 price index is under development and will soon be published.

There are also connections with other service industries:
70.22: Management consultancy is part of the 70.22 “Business and other management consulting services“ industry. Sometimes engineering offices offer that kind of service with the global engineering project.
74.10: Pure design of the final product without any development or management of the project shall be related to the 74.10 “Specialized design services“ industry.

1.2 Market conditions and constraints

- Importance of the industry compared to the service industry and the whole economy

In France, the output of the 71.12 industry “engineering services and related technical consulting services” weighs 55.1 billion € in 2015 and nearly 5% of the total output of services industries in the scope of INSEE SPPIs (merchant services excluding financial and insurance services). This CPA-4 industry is second, in terms of output, among our SPPI scope, behind 68.20 “Rental and operating services of own or leased real estate”.
In the whole economy, the 71.12 weighs 2,4% of the total output.

- Public regulations affecting the market situation

The establishment of an engineering office is not yet regulated with strict laws in France. We can only notice that trade federations have published a code of ethics and a qualifying certificate.
Some laws are applicable to public demand:
- Since 2001, state services specialized in engineering cannot obtain an engineering contract without being in competition with private companies in an official call for tender.
- Since 2004, an engineering firm cannot operate on public equipment without an approval.
More recently, the French government tried to encourage the use of BIM (see 1.3) in construction engineering.

- Degree of concentration within the industry

In France, the industry is not very concentrated yet. The engineering industry is mostly (90%) made of firms that realize less than 2 million € of turnover; but these relatively small firms only weigh 20% in the global turnover of the industry. So it is the middle range of firms which represents the most important part of the output of the sector.

In fact, there are different degrees of concentration: in construction engineering, numerous little units have to share out the market; in industrial engineering, especially petroleum-processing engineering or nuclear engineering, some great firms from corporate groups dominate the market.

Very little units are common in building engineering in France, as there are no strict regulations to establish an engineering office. At the opposite, great engineering firms are sometimes trying to merge, in order to reach a critical size and reinforce their negotiation power.

- Type of consumer of the services (B2B, B2C, B2X)

	Output (million €) in 2015	%
BtoB	44 786	81,2
BtoC	1 782	3,2
BtoX	8 582	15,6
BtoAll	**55 150**	**100,0**

Source : ESA (SBS) survey and national accounts, 2015

Households consumption is limited to some services such as land surveyors and consulting engineers specialized in housing; it is a minority in the industry (barely 3% of the output).

French engineering firms are very present at export: about 15% of their turnover.

Engineering activities realize 80% of their turnover with private sector firms. For instance, oil firms are noticeable customers of engineering services, that can help oil platforms to develop new processes or equipment.

- Horizontal/vertical integration

Independent firms (i.e. that are not bound to a corporate group) represent 90% of the unities, but only 24% of the turnover. So, the major part of the turnover is realized by corporate groups. These groups are mainly of French origin.

Almost 40% of the turnover is realized by affiliates held by corporate groups from other industries. These corporate groups hold numerous engineering units. In these units, services for the group itself are not necessarily preeminent, as the corporations ask to their affiliates to enlarge their customer base, in order to adopt a strategical position and to be protected against economic changes in their original market.

- **Trends**

The importance of the engineering industry has continuously increased with time, because of a strong demand, and also a tendency to externalize engineering activities to specialized firms.

The added value of French engineering firms is weaker (40% of the turnover) than in other industries with strong intellectual content. Indeed, intermediary consumption (wages excluded) are at a high level, especially in subcontracting with other engineering firms.

Local authorities are the first public investors in local equipment. In France, because of the situation of public budgets, a noticeable decrease of the investment of local authorities has been observed in the recent years. Since 2014, the French state has noticeably reduced the budget allocated to local authorities (3,7 billlion € each year). In 2016, the French reform of regional administration resulted in mergers of administrative regions. The drop in the public demand of engineering services for buildings and infrastructures is related to the consecutive lack of investment, especially during periods before elections like 2016-2017, when operators stay in a “wait-and-see” attitude. This trend is not homogeneous: great cities and touristic areas manage to maintain a strong investment, whereas rural areas have not sufficient resources to invest in new projects.

Industrial engineering is very sensitive to the global short and mid-term economic environment. Investment is the key factor for new projects. Investment is well orientated in electricity, telecommunications, and nuclear sectors. In manufacturing activities, the investment of big private customers in new projects is still very prudent, even with low-interest rates conditions. But in most cases, existing contracts allow engineering firms to keep their activity at a decent level. Some firms can choose to slightly rise their fees even during uncertain periods, just to avoid a loss of turnover. It can be the case for great firms which are “price-maker” in the engineering industry.

- Product structure, primary / secondary products

We use the SBS source to split the turnover of the industry into detailed products; however, the French SBS questionnaire has its own entries, which do not correspond to the official 5 or 6-digit CPA.

French engineering activities are mostly devoted to construction projects, including transportation.

	Turnover (%)
Engineering services for construction projects	**54,8%**
Engineering services for transportation projects and associated equipment	10,5%
Engineering services for construction of industrial buildings and associated equipment	10,2%
Engineering services for construction of industrial units other than buildings	9,4%
Engineering services as part of an all-inclusive contract	9,0%
Engineering services for construction of non-industrial buildings and associated equipment	8,5%
Assistance to authorities of the project (studies and work coordination, task management)	4,6%
Technical assistance related to usage of complex equipment	2,6%
Engineering services for industrial projects and related prospecting and consulting services	**31,3%**
Engineering services for manufacturing processes and equipment	16,6%
Engineering services, specialized in nuclear systems, armament, geophysics, exploration...)	14,7%
Other engineering services and related technical consulting services	**13,8%**
Engineering services for telecommunication systems	4,0%
Land surveyors activities (measures of land, topography, structures, plans drawing, urban and country planning, land registry)	2,2%
Engineering services for waste management projects, for water, sewerage and drainage projects	1,3%
Other engineering services and related technical consulting services	6,3%

Source : French SBS (ESANE 2015)

- Other industries, having output of the primary products

Of course, many engineering services are internalized in units from other industries, realized by a unit for itself. They are not evaluated in national accounts or in price indices, as it does not generate explicit transactions.

The case when the engineering service is realized by a manufacturer or a builder, provider of the whole project in an all-inclusive contract, is common. The output will not necessarily be taken into account in the engineering industry. It depends on which entries the firm splits its turnover in the SBS questionnaire: many

providers tend to declare their whole turnover as industrial or construction activities even if engineering is included. When engineering is a weak part of the global invoice, its evaluation may be neglected by the provider, even if engineering is essential to deliver. At the opposite, when furnishing of goods and other works than engineering are not the most important part of the contract, the company will make an effort to strictly evaluate time spent and value-creation of engineering acts.

In particular, engineering services can be offered by capital-goods manufacturers; in this case, the engineering service is associated with the sales of these goods, and other services than engineering. For instance, consultancy, productivity studies, installation, and sometimes training courses of the customer's staff may be included in the sale contract, as well as maintenance. In this case, the engineering services are hidden in the sales, and are not well followed by the SBS survey.

1.3 Specific characteristics of the industry

- Nature of selling (e.g. bundling, reselling)

Usually, the owner of a project wants to contract with an engineering firm for specialized competencies or expert knowledge it does not own himself, or in order to take care of the process in specified aspects. The owner of the project describes the main specifications and the help it is expecting, and engineering firms are invited to bid.

Services from other industries are commonly associated with the engineering service (see 1.1): cost estimations (7490), architecture (7111), design (7410), inspection and technical analysis *ex post* (7120), management consultancy (7022).

The function of the engineering firm can be limited, or not, to one particular aspect or to one phase of the project. Sometimes, the engineering firm will furnish an all-inclusive service, bundling the management of the project with the delivery of the final product. In this case, the engineering firm may often subcontract part of the work.

- Development of new products/services in recent years or expected in the near future

Because of the drop of public investment into buildings and infrastructures (see 1.1), engineering services will inevitably lose some weight in the traditional area of construction and public works.

Operators are trying to reduce the costs of building engineering and to gain productivity. One tendency for the near future is the spreading of virtual building, using the BIM (building information modeling). “BIM manager” is now identified as a profession. Every technical information on the building is integrated in the BIM at each step of the construction. In France, building engineering services are encouraged to adopt the BIM; this new tool can improve the fulfillment of the customer's expectations. It will be forcing firms to acquire new competencies and will change the way the transactions are sold. The use of BIM is not taken into account in our transactions list yet. Maybe BIM is not developed in France than in some other countries.

In spite of the lack of investment in new buildings, public markets will be forced to continue their investment in technical sectors such as telecommunications and energy. New standards in telecommunications networks will still ensure a certain level of demand to the corresponding engineering activities.

The same trend is noticed in renovation works, due to the latest standards of energy consumption adopted in law. Renovation works will be increasing and will be more technical in the near future (respect of thermal standards, access standards, ecologist construction...). Renovation works are said to be more risky and less lucrative by engineering firms.

One evolution already noticed is the demand of public and private customers to get transfers of skills from the engineering company, especially during the management of the project. Some engineering firms propose to their customers training courses, so they can be more involved and take part in the project with technical accuracy.

- Short description of business models in the industry. Any recent changes or expected changes in the near future?

As aforementioned, the role of engineering can be realized at several levels:

- by the purchaser (contracting authority) of the project himself (if it has competencies),
- by the main provider of the project (for instance, in the case of an all-inclusive contract, including engineering services with the finished product),
- by a private engineering firm, which can be an affiliate of the purchaser, or an affiliate of the provider.

The development of the third kind of model is related to the increasing complexity of production processes. The increasing standards of quality, the seek for productivity gains lead the producers to improve their processes and to contract with specialized firms.

3. Measurement of SPPI

3.1 General framework

- Objectives of key users

The uses of SPPI are threefold in France: as a deflator for the service production index, as a deflator for national accounts, as an index of price revaluation for contract indexation.

Different characteristics may differ between these sources of SPPI uses: inclusion of taxes and subsidies, inclusion of intra-group transactions (that is to say transactions between affiliates of the same corporate group) and periodicity of the deflator.

National accounts require basic prices for the supply side and purchasers' prices for the uses side. Basic prices measure the turnover of the seller, so subsidies are included whereas taxes are excluded. Conversely, for purchasers' prices, subsidies are excluded whereas taxes are included. For the use of service production index, both taxes and subsidies are excluded from the output value, so they should also be excluded from the deflator. At last, for contract indexations, taxes (except VAT) are included but subsidies are excluded. So, three possible definitions of price (without taxes and subsidies, with taxes and without subsidies, without taxes and with subsidies) are interesting.

For national accounts, intra-group transactions are included inside output (P.1), whereas they are excluded both for contract indexations and for the service production index. At last, national accounts are released both quarterly and annually and the service production index monthly, whereas there is no requirements about periodicity for contract indexation.

In fact, two kinds of quarterly SPPI are released:

- BtoAll, BtoB, BtoC and BtoX "basic prices" SPPI, for the use of national accounts: these SPPI include intra-group transactions, subsidies but exclude taxes.
- BtoB "market prices" SPPI, both for contract indexations and for national accounts: these SPPI exclude intra-group transactions, subsidies but include taxes (except VAT)

which is not completely sufficient to meet every need.

At least in the French context, there are neither subsidies nor taxes for 7112 industry, so BtoB basic prices and market prices differ only from intra-group transactions. For BtoC, market prices should differ from basic prices, because VAT is non-deductible for households, but BtoC market prices are not assessed. Quarterly SPPI have to be broken down monthly by statistical methods for their use as a deflator of the service production index.

- National accounts concepts, measurement issues

For this industry, French National Accounts are calculated at CPA-3 level, and released at CPA-2 level. So, figures that are going to be discussed in this paragraph encompass both 7111 Architectural services and 7112 Engineering services and related technical consulting services.

The supply and use 2015 balance in France for 711 appears below. In brackets, appears the deflator used to assess National Accounts in volume. The deflator perimeter corresponds to 711 Architectural and Engineering services, except if something else is indicated.

Supply (million €)

Output	+ Imports
57 152	+ 10 018
(BtoAll)	(BtoAll)

Use (million €)

IC	+ GFCF for firms and general government	+ GFCF for households	+ Changes in inventories	+ Exports
38 063	+ 17 901	+ 2 352	+ 188	+ 8 666
(balancing item)	(BtoB)	(BtoAll for 7111)	(100)	(BtoX)

IC: Intermediate consumption GFCF: Gross fixed capital formation

For **imports**, no SPPI can be assessed, because there is no sampling frame for imports. BtoAll SPPI is used: it is supposed that import prices and production prices variations are proximate.

Architectural and engineer services are included into **GFCF for firms and general government** when the customer is a real estate promoter, whereas they are included into **Intermediate Consumption** when the customer is a construction enterprise.

In the former case, the promoter owns both the land and the construction before selling or renting them. Fees for architectural and engineer services are directly attributable to the construction. They should be included into GFCF, like the cost of building itself. In the latter case, the construction firm does not own the building: it works for a customer which is the owner of the building. So, architectural and engineer fees are just an external service that has to be included into the own expenditures of the construction firm, and then into IC, and not an element of the construction cost.

Households purchases for 711, which are composed of land surveyors and consulting engineers specialized in housing services, are taken into account into GFCF rather than into final consumption. Indeed, "*households that own the dwellings they occupy are formally treated as owners of unincorporated enterprises that produce housing services consumed by those same households*" (see System of National Accounts 2008, point 6.117). So, with the same reason than for promoters, households fees for architectural and engineer services should be taken into account into **gross fixed capital formation (for households)**.

GFCF for households corresponds mainly to architectural services (out of the scope of 7112). That explains why the deflator only refers to Architectural services. This can be criticized, because it could be possible to use a BtoC deflator at level CPA-3. Nevertheless, this choice has little practical consequence.

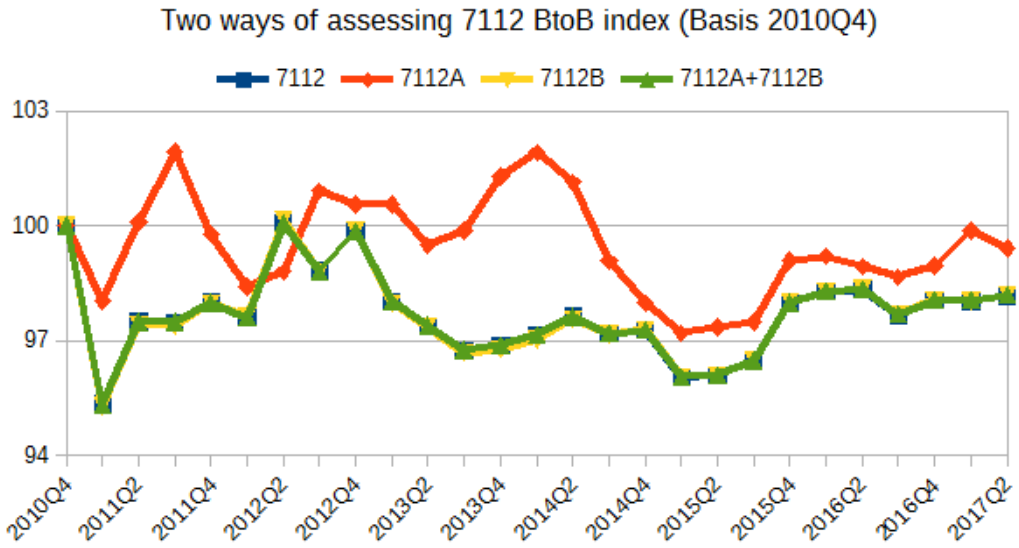
For **changes is inventories**, no deflator is used both because of a lack of a relevant deflator and because the low amount of changes in inventories is not incentive to long investigations.

3.2 Measurement issues

- Product structure in industry, importance of product level details

For product structure in industry, see 1.2 Market conditions and constraints.

To assess the importance of product level details, 7112 SPPI for BtoB has been estimated by two different ways:
- first, by aggregating directly service products indices, like it is done in reality for this industry (see 3.3; "7112" below)
- secondly, by aggregating 7112A and 7112B indices, which are themselves aggregated directly from service products indices ("A+B" below). 7112A and 7112B weights are assessed because of ESA survey.



The graphic above does not show visible differences between both series of 7112 BtoB SPPI. The main reason is that 7112B represents 98% of the overall weights. Figures confirm that the difference between both indices is completely negligible, both in level (always inferior to 0.01 in absolute value) and in variation (always inferior to 0.003 point in absolute value)

This study could have been more interesting if other ways of assessing 7112 BtoB SPPI could have been evaluated, for instance by aggregating 6-digit CPA indices. Unhappily, the aggregation tree is currently under development (see 3.3), so there is no easy way to do it.

- Type of SPPI described, sampling unit used – Industry/Product

According to paragraph b.1 of annex D of Council Regulation (EC) N°1165/98 of 19 May 1998 concerning short-term statistics, the SPPI sampling unit has to be the enterprise. The enterprise is defined in section 3 of the annex of Council Regulation (EEC) No 696/93 of 15 March 1993 on the statistical units for the observation and analysis of the production system in the Community: "*the enterprise is the smallest combination of legal units that is an organizational unit producing goods or services, which benefits from a certain degree of autonomy in decision-making, especially for the allocation of its current resources."*

This has led in France to the definition of a "profiled enterprise", that is to say an autonomous part of a corporate group, which correspond to the previous notion of enterprise. Most often, an enterprise corresponds to a (sole) legal unit.

During the previous update of the sample of this industry, in 2014, the sample was entirely composed of legal units. Nevertheless, the number of groups that are profiled in France is growing quickly, so that, if the sample would be updated in 2017, eight units of the sample would correspond to a part of a profiled group.

The French SPPI is industry-based in the sense that, according to the above-mentioned Council Regulation N°1165/98, SPPI are calculated on the basis of NACE Rev 2 activities rather than CPA products. But they are product-based in the sense that price indices are aggregated from elementary indices that correspond to service products prices. This question is not so important in countries using NACE and CPA nomenclatures because there is a "bijective relation" between NACE Rev 2 7112 activity and CPA 7112 products: any product from NACE 7112 activity is a CPA 7112 product and any CPA 7112 product is produced by the NACE 7112 activity.

- Any data sources available (or used) for replacing surveys?

There is no data source available for replacing surveys for this industry.

- Any use of Big Data in the near future

No use of Big Data is scheduled in the near future for SPPI.

- Any direct volume information available

No direct volume information is available.

- Sampling design. Include any specific issues influencing the design in this industry and the sampling units necessary

For French SPPI, the sampling is determined at two different levels: first, firms and secondly, service products.

Firms

For firms, the sampling is the result of a two-step process:

- first, a statistical "cut-off" sampling
- secondly, a "well-informed choice" method, that tries to determine firms that would be forgotten with the first process.

With the "cut-off" sampling, firms are ranked according to their turnover in the industry, known because of ESA survey or extrapolated. Main firms are chosen, up to a certain rate of the total turnover of the industry, but without exceeding a maximum number of firms.

For 711 Engineering services, during the previous update of the sample, this method failed to "recruit" architectural services firms, so it was necessary to select a second sample, typically for this kind of activities. Besides, this led to modify the general sampling plan so as to select independent "cut-off samplings": a sampling per indicator (BtoAll, BtoB, BtoC and BtoX) and per level of CPA (CPA-4 and CPA-5), each "mini-sampling" with its own parameters. The final sample is the collection of mini-samples.

Secondly, a "well-informed choice" method is applied. First, a research done on the Internet aims at identifying firms that have been forgotten with the first process. This is possible because firms are able to be misclassified. Besides, one or several industry federation of employers, so, in the 7112 case, chambers for architects and engineers, are met so as to discuss about industry matters, and in particular about sample.

The "cut-off" sampling allows this two-step method to determine firms survey: there is no need to determine weights. With a "pure" PPS sampling, it would not be possible to "add" firms because there would be no way to determine weights for these firms.

In practice, 49 firms are currently surveyed every quarter for 7112 Engineering activities, about 418 service products: 260 for BtoB, 45 for BtoC and 113 for BtoX.

Cut-off sampling has nevertheless the drawback that small firms cannot be selected. This is a source of bias, because small firms price policy has no reason to be identical to big firms'. So, there is a possibility that price index estimators could be biased. In practice, economists consider that big firms are rather price-makers whereas small firms are rather price takers, which could lead to a reduced bias.

Service products

"Field surveyors" of our institute visit the sample of enterprises to define or re-define service products that will be followed in a custom quarterly questionnaire. As a result, service products are not sampled from a sampling frame but they are chosen by field surveyors when they visit firms, at the beginning of the update process.

The selected service products have to be representative of the price variation of a product family (kind of product x kind of market). In practice, the products with the biggest turnover within each family are most often chosen.

- Data sources for various weights

Two main sources of weights have been presented before:
- for national accounts weights, see 3.1 National Accounts concepts, measurement issues
- for SBS weights, see 1.1 Product structure, primary / secondary products.

These sources are not perfectly suited to SPPI weight needs: national accounts weights are split between BtoB, BtoC and BtoX but are calculated at CPA-3 level; SBS weights are calculated at CPA-4 level but are not split into BtoB, BtoC and BtoX.

For 711, these 2015 weights are presented below:

	A	B	C	D	E	F
1		BtoB	BtoC	BtoX	BtoAll	BtoAll
2	7111	634	190	106	930	2 003
3	7112	16 307	460	8 853	25 620	55 149
4	711	16 941	651	8 959	26 550	57 152
5	711	46 134	2 352	8 666	57 152	

Figures in red (lines 2 and 3, columns B to D) and black (line 4, columns B to E; column E, lines 2 and 3) come from national accounts and figures in blue (column F; line 5) from SBS. These sources are somewhat different, mainly due to national accounts modifications brought to SBS data.

SPPI weights are estimated by modifying “red” figures so that totals in lines and total in columns be equal to totals in blue. This procedure corresponds to the statistical method of calibration on marginals, which is implemented in the “Calmar” SAS macro, developed at Insee.

This leads to the following 2015 weights for SPPI:

	BtoB	BtoC	BtoX	BtoAll
7111	1 348	570	85	2 003
7112	44 786	1 782	8 582	55 150
711	46 134	2 352	8 667	57 153

3.3 Description of pricing methods and criteria for choosing the method

- Definition of the service being priced

see 1.1

- Price determining characteristics of the service

Engineering production prices are under a strong competitive pressure, especially in building engineering, and the adaptability of wages expenses to the level of demand is very weak: engineers wages are in a favorable context because of recruitment difficulties.

Existing contracts last several years and are a source of price increase, or at least they should help engineering companies to maintain their prices by furnishing a minimal level of activity.

Investment is well orientated in industries like nuclear, electricity or telecommunications (optical fiber, fourth generation wireless telecommunications...). This can help very-specialized engineering structures, or some great engineering firms with specialists in these particular fields, to raise their fees. At the opposite,

investment in oil industry remained very weak until 2017, because of the decrease of the oil barrel price: specialized engineering firms were directly penalized by this context.

Engineering prices can decrease in some situations: for firms (even great firms) in sectors where investment is weak, competition strong, and when the company has not the ability to revalue the existing contracts.

The relatively permissive regulation of the establishment of engineering offices increased the number of enterprises during the years where the demand was stronger. Today, many actors have to share a weaker demand.

The decreasing number of public projects reinforces competition in engineering services mainly devoted to public operators. This can also lead to a price decrease for little or average size engineering offices.

In the recent years, many local authorities developed parallel “parapublic” engineering services, in structures they partially control: urban planning agencies, technical local agencies, public interest groups... This development is not favorably seen by private engineering firms. The transactions from public operators with parapublic structures may not be “at market price” and can sometimes be considered as in group contract. But for most great projects, parapublic structures are led to subcontracting with private engineering firms.

- **Price method chosen**

“Field surveyors” of our institute visit the sample of firms to select price indicators (see 3.2) that can reflect their realizations, without being too complex, in order to be quarterly furnished. Since field surveyors choose the appropriate method according to the situation of the firm, we do not keep only one method and we draw the report afterwards.

In this industry, capital costs and intermediate consumption are relatively weak compared to labor costs. Customers buy specialized competencies above all, most common indicators followed in engineering firms are basically turnover, wages and time spent.

For engineering services, we mainly follow sales prices that are daily or hourly rates by category of staff, for instance “daily price for a telecommunications junior engineer”.

For some firms, we also tried to follow fixed individual services prices, when they are recurrent. But the custom definition of many engineering projects limits that kind of method to little structures with relatively simple acts. This is the case, for instance, with land surveyors.

The case when prices are based on percentages of the project costs (for instance percentage of total construction cost, or percentage of intermediate consumption, depending on the state of progress) has not been encountered, as it is not the predominant price model in French engineering services; percentages of the costs are more usual in connected industries like specialized design (74.10). The total cost of a long project may be not known in advance.

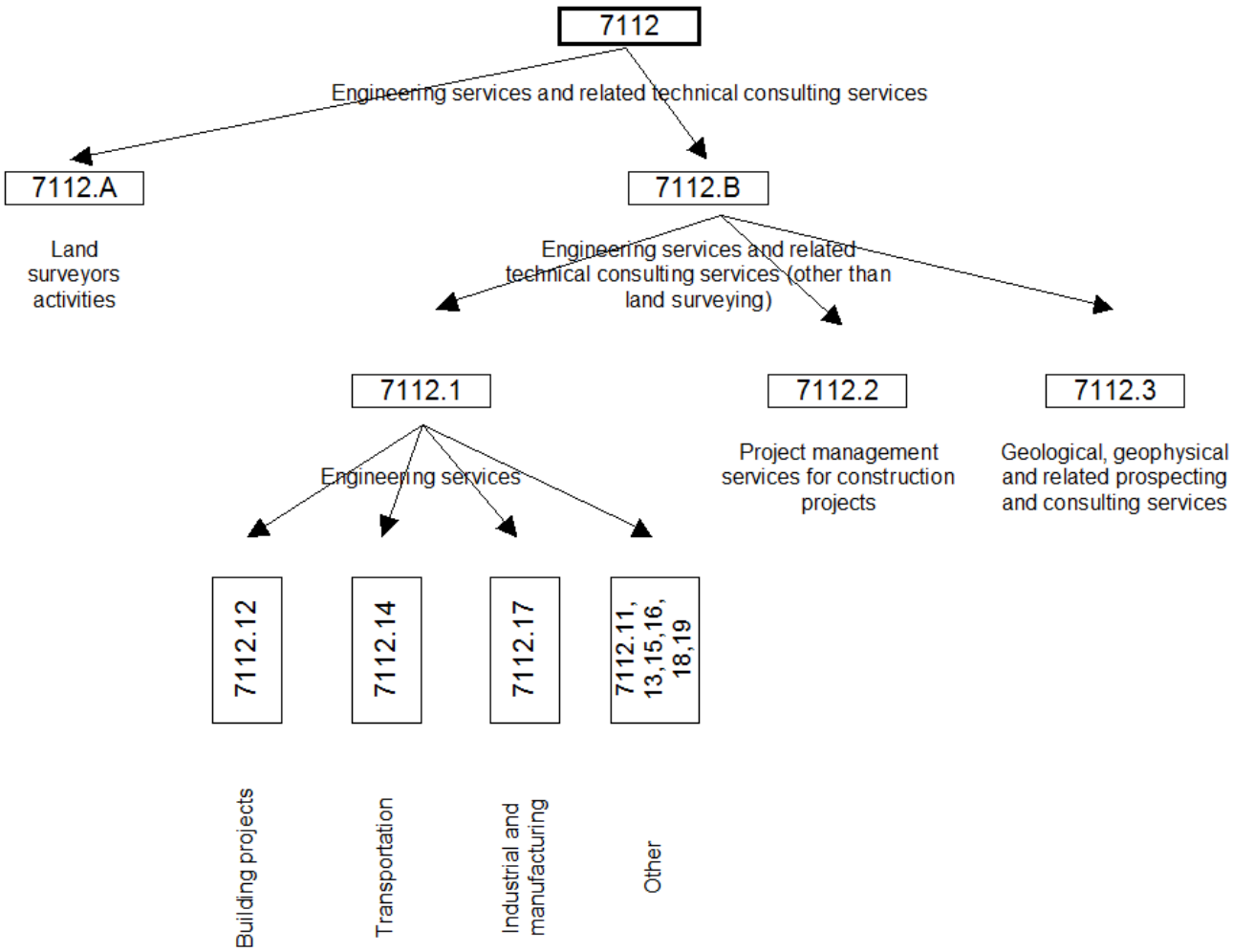
When this kind of indicators seems to be impossible to be furnished by the enterprise, the choice is to follow a turnover ratio per hour. This type of indicator is an implicit price and has many disadvantages, such as making quality adjustment almost impossible. Since our last update process of the engineering industry, we only have a few firms left with this indicator.

We do not use price estimates of fictitious bills models, which are also called “model pricing”, to follow engineering prices. Such models are particularly difficult to define in this industry, even more than in building industry, because fixing all details of the project takes time and leads to unreasonably extended items in the questionnaire. Because they would be too complex in many cases, fictitious bills would also generate response burden, without any insurance that it still would mean something relevant over time.

Unexpected elements during the projects, leading to a difference between the contract price and the invoiced transaction, are common in long projects. Engineering firms are tempted to bid at low prices to get new contracts, and to complete their turnover with possibilities of adjustments. That is why realized hourly rates seems more preferable to us than theoretical hourly rates, contract prices or fictitious models.

- **Description of index estimation procedure, including estimation of missing prices**

As said in 3.2, 7112 SPPI is estimated by aggregating directly service products indices. But the following aggregation tree is currently under development in our SPPI skill center:



With this type of aggregation tree, when a price is missing, we will use two types of estimations:
- an estimation corresponding to the variation of the up-level in the tree
- a constant price estimation.

The first method is the default method. The second method is used (for instance) when elementary series correspond to commission rates.

- Quality adjustment methods and sources of data quality if not obtained directly from respondents

Respondents are allowed to comment their price change, and a comment is requested in the Internet questionnaire when the variation is higher that 10%. Operators in Lyon skill center are asked to call the respondents when the reason of a strong variation has to be explained. They can assign a “quality coefficient” to the price progression, or substitute the transaction by a new one if the gap is too important. This is the main information tool for adjusting quality.

A common turnover strategy for engineering firms is to increase their productivity to spend less time on the projects than agreed in the contract, for the same final service than expected. Nevertheless, for SPPI, we should not divide the charged price by productive hours, otherwise we would implicitly consider productivity as a price effect. So, it is preferable to obtain contract hours or charged hours in our quarterly questionnaire, instead of productive hours. But, on the long run, the effect of productivity can likely be observed also in contract hours. One challenge in our survey would be to measure productivity so as to neutralize it. In big engineering firms, productivity is more and more often seen as a key performance indicator (KPI) so it is easier to obtain measures of *productive* hours than in the past.

The use of new technologies such as BIM (see 4) certainly improves productivity for the engineering firm and may improve quality for the customer. On the other hand, engineering firms initially have to spend time and money on it (buying of software, training courses of the staff...) to be able to include these new technologies in their offer.

New regulations in construction standards can also improve quality for the customer. For instance, with new thermal standards, customers can add value to their projects and expect to sell them with a better price to the final user. That kind of regulations also forces engineering firms to acquire new competencies (increase of internal costs, sometimes subcontracting).

We cannot totally expect that the transaction prices of the engineering firms completely reflect the improvement of the output due to new technologies or better standards. Public market rules, or very competitive sectors in private markets, tend to limit (sometimes to erase) price increases due to new standards or new technologies. Adjusting quality in these cases is a challenge, because the quarterly prices of the respondents may be constant, so we have no clue that quality is improved.

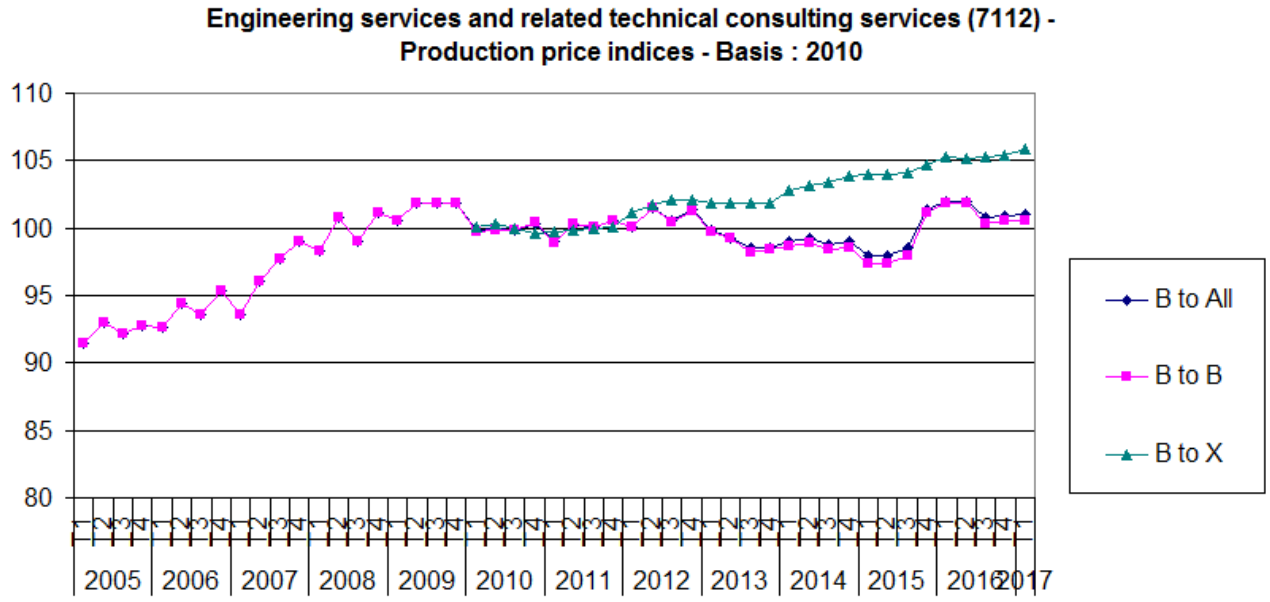
It seems that little or average size engineering offices, which are significant in output data, are not very present in our PPI survey because of the cut-off model used for sampling. Maybe this could generate some bias in the case when little or average size offices, more likely specialized in building engineering, are much more impacted by the loss of public demand.

- Frequency of collection and for which purposes

The SPPI survey is quarterly. Its main purpose is to deflate national accounts. Recently, a monthly services production index has been developed by Insee; SPPI are also used for deflation of this index (see 3.1).

For some industries, SPPI may also be used by companies to index contracts. It seems that it is not the case for the 71.12 industry.

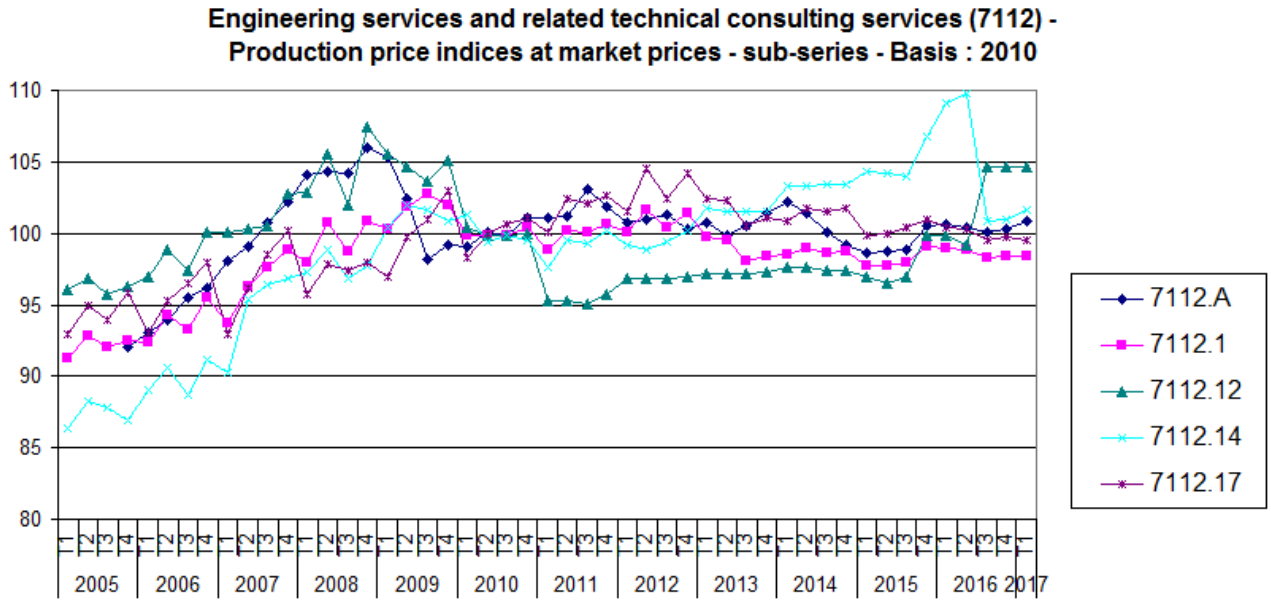
For engineering services, at CPA4 level, we publish BtoB and BtoX indices.
BtoX is published since 2010 only.



We also publish sub-industries indices (BtoB only), based on 5 or 6 digit CPA:

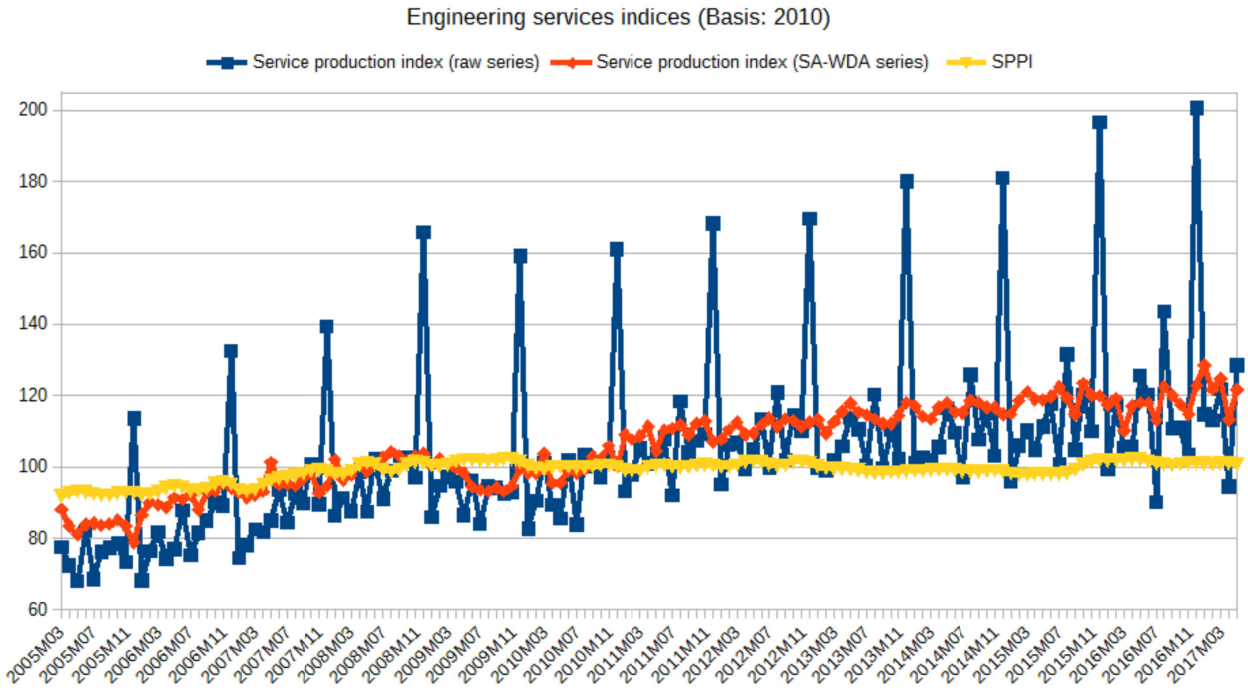
71.12.1 Engineering services
71.12.12 Engineering services for building project

71.12.14 Engineering services for transportation projects
71.12.17 Engineering services for industrial and manufacturing projects
and one index based on French 5-digits NAF :
71.12A Land surveyors



3.4 Evaluation of comparability of Price data with Output data

BtoAll engineering services SPPI is used as a deflator for engineering services production index. The differences between these both indices have been discussed in 3.1.



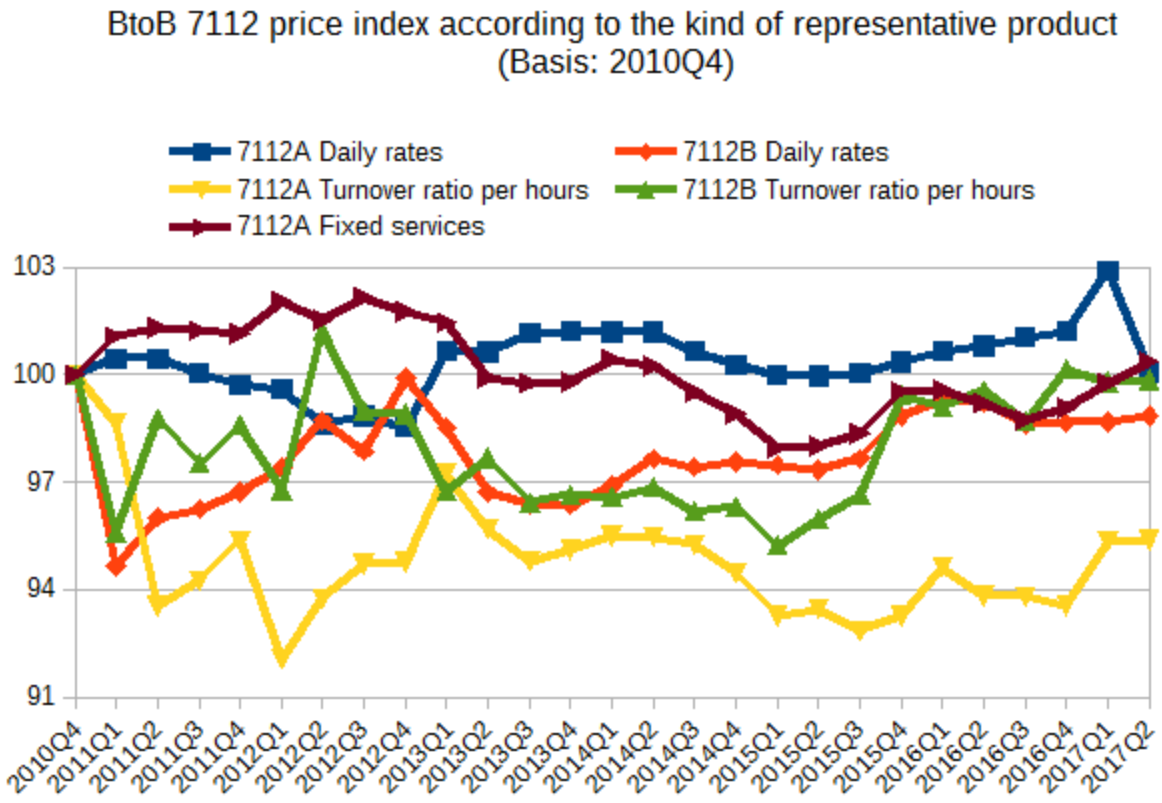
Engineering services SPI (blue) is very seasonal. December points are about 65% superior to other points in average: for accounting reasons, firms are encouraged to bill and recover their services before the end of the year. As a result, January points are in average 8% inferior to the “January to November” mean. On the long run, SA-WDA turnover volume index (red) is growing smoothly but steadily.

At the opposite, SPPI (yellow) is very stable in the long run (it stands inside a 5 point interval from January 2008). In the short run, it is a bit more fluctuating, especially if we keep in mind that the monthly index is estimated from a quarterly index.

4. Evaluation of measurement

- Evaluation of methods (fitness for use)

In this paragraph, we examine whether price variation depends on the price method. The whole set of service products for 7112 BtoB has been split between three categories of methods: daily or hourly rates by category of staff (called “daily rates” in the graphic below), recurrent fixed individual services (“fixed services” below) and prices and turnover ratio per hours (“turnover ratio per hours” below). Prices based on percentages of the project costs and model pricing methods are very rare, so they were not taken into consideration. Service products were also split between 7112A and 7112B, because of the very different weights between both activities. So price variations were studied according to five kinds of categories, given that there is no recurrent fixed individual services transactions for 7112B.



From 2010Q4 to 2013Q2, price series are varying strongly, mainly 7112A and 7112B series of turnover ratio per hours. Price series are smoother from 2013Q2 to 2017Q2.

There seems no obvious difference of trend according to the kind of service products: 7112B turnover ratios per hours index seems to be more dynamic from 2015Q1, whereas its equivalent in 7112A is very stable; 7112B daily rates index is growing slowly but constantly from 2013Q4, when 7112A daily rates index is very stable at least up to 2016Q4.

Inside 7112B service products, variations of daily rates and turnover ratio per hours indices are rather proximate. Inside 7112A service products, turnover ratio per hours index decreases strongly whereas daily rates and fixed services indices are rather stable from 2010Q4 to 2012Q1. From 2012Q1 up to 2017Q2, variations are rather similar on the long run.

Conversely, price volatility seems to depend on the kind of service products: price volatility is rather low for fixed services, medium for daily rates and high for turnover ratio per hours. The reason is probably that fixed services are clearly definite, so there is low product mix, which is less the case for daily rates and above all for turnover ratio per hours, which incorporates important mix product, that leads to volatility.

- Summarize trade-offs between the measurement practices described in section 3 and the needs/concepts of the National Accounts (e.g. implicit price index)

Some differences between needs and measurements have been discussed in 3.1 National accounts concepts, measurement issues.

Another point to mention is the deflator for GFCF for households. GFCF is assessed at purchasers' price, so its deflator should also be assessed at purchasers' price. Whereas there is no specific tax for this industry, there is a difference between basic prices and purchasers' prices, because VAT is not deductible for households. So VAT should be included into BtoC index at purchasers' prices.

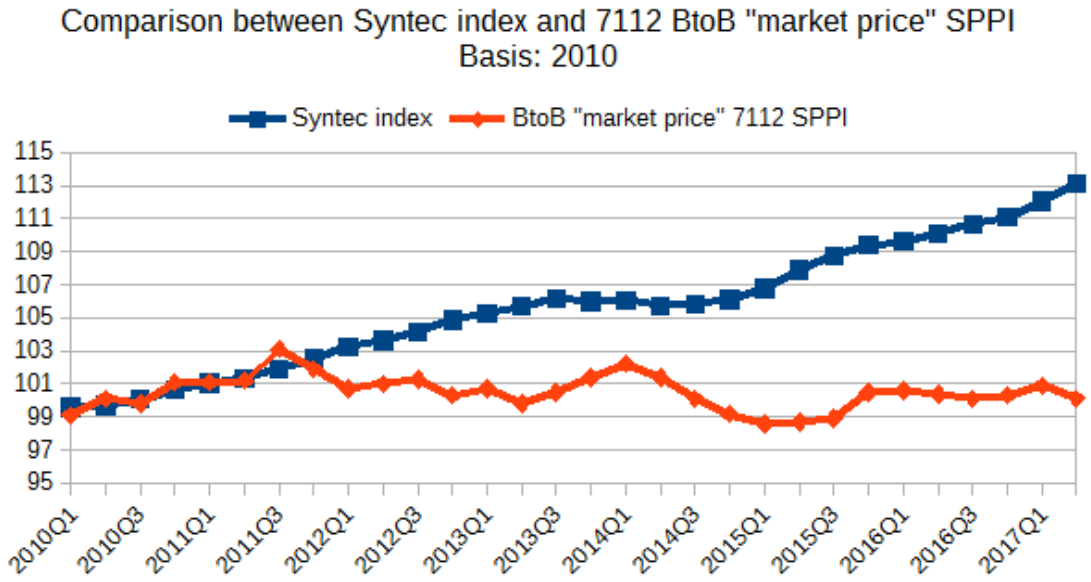
- Any practical advice on how to adjust the gap between measures and concepts

From now on, only BtoB prices are assessed both at basic prices and at market prices. It should also be the case for BtoC prices. This is not done, mainly because BtoC purchasers' prices are usually within the scope of CPI.

- Other sources of deflators where SPPIs are not available (if applicable)

There is no CPI for this industry because 7112 services bought by households are included into investment rather than into consumption (see 3.1 National accounts concepts). Nevertheless, Syntec Federation, a grouping of federation of employers specialized in engineering, digital, studies, consultancy and vocational training releases a monthly index that measures labor costs variation in activities within the competence of this Federation, which includes 7112 Engineering services but is far broader. Syntec index is representative of labor costs (wages and salaries and employers' social contributions) per full time equivalent.

This index is acknowledged within the sector and, like 7112 SPPI indices at market price, is also used to index contracts.



Source: Wikipedia

The Syntec index is very regular, which is due to the fact it is smoothed by a moving average. Nevertheless, it is far more dynamic than BtoB 7112 SPPI. The Syntec index measures the labor costs per full time equivalent, so it does not take into account the fall in prices that gains of productivity permit.

- Lessons learned

- Future challenges and ways to meet them (classification issues, product developments, relevance of statistical methods used…)

The main challenge for this industry consists of taking into account the impact of BIM correctly. BIM should raise productivity and so reduce costs of engineering services for building projects. Depending on methods chosen to assess price index, this raise of productivity would appear or not into the index. It is the case when the service product corresponds to the cost of the building project of a “standard” building. Nevertheless, this kind of service products is rather rare, at least in France. It is not the case when the service product corresponds to the hourly or daily cost of a building project developer. In the latter case, the gain of productivity will not affect the price index. Nevertheless, it should be verified that BIM would not induce a new Solow paradox: « You can see the BIM age everywhere except in the building productivity statistics ».

Moreover, BIM allows to improve the quality of construction: during the construction of the building by improving coordination between participants, by identifying upstream problems in the design of the building, but also throughout the lifetime and the demolition of the building, by supplying useful data about its construction. All these elements seem to be difficult to integrate into a price index and so BIM could lead to underestimate price decrease in the engineering services price index.