35th Voorburg Group Meeting on Services Statistics

September 24th – 25th, 2020

Revisited Sector Paper:

ISIC 71.1
Architectural and Engineering Activities and Related Technical Consultancy

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Introduction

The Voorburg Group first studied the price indices for architectural and engineering activities in 1991 with a report on a study for setting up a price index for consulting engineering services based on model pricing by Statistics Canada. Canada reported more about their SPPI experience in this field in 1992 and 1994. After another paper on price indices for this activity by Norway in 2000, a collection of several approaches towards an engineering SPPI by six NSOs was presented in 2002 by the US Bureau of Labor Statistics.
Changes in the conditions of the market of the presented sector occurred slowly over time, so a revisited sector paper by Bernhard Goldhammer from 2008 presented the Voorburg Group's previous work in combination with new developments in the consistent framework of the Sector Paper adopted in 2006.
This "re-revisited" sector paper presents the Voorburg Group's previous work in combination with new developments in the consistent framework of the Sector Paper adopted in 2017 with the adoption of the new content development framework. This paper also summarizes the experience of Norway, Mexico and Poland for collecting turnover data and France, Croatia, Italy and Japan for collecting price data for the architectural and engineering activities, as presented and discussed at the 32nd VG meeting in New Delhi, India.

1. Description and characteristics of the industry

1.1 Definition of the industry

Definition of service

The Architectural and Engineering activities sector is an important part of professional, scientific and technical activities and is made of disciplines that, applying physics, chemistry and mathematics knowledge, provide technological responses to different customers' needs and they usually are custom made. Although activities related to architectural services and engineering services are classified into the same activity group 71.1, types of services they offer are quite different. Architectural services refer to the aesthetical and functional design of buildings, cities and landscapes, while engineering services deal with the technical design

of buildings and other products and services, often involving technical consultancy. Engineering services are diverse, covering a wide range of various projects. Furthermore, some of these services are closely related to the construction sector. Substantial differences in the services provided also have considerable effects on the economic performance of these two activities (71.11 and 71.12), in particular on the pricing mechanism.

Industry classification

ISIC Revision 4 (International Standard Industrial Classification of All Economic Activities) describes “architectural and engineering activities and related technical consultancy” in group 711, class 7110 with no further breakdown. Together with technical testing and analysis, it forms division 71. NACE and ISIC Rev. 4 are aligned, except NACE group 711 Architectural and engineering activities and related technical consultancy is split across two classes: 7111 and 7112, where ISIC has only one class.

According to ISIC Rev.4 classification the group Architectural and engineering activities and related technical consultancy is classified as follows:

711 Architectural and engineering activities and related technical consultancy
7110 Architectural and engineering activities and related technical consultancy
712 Technical testing and analysis

According to NACE Rev. 2 classification the industry division M 71 Architectural and engineering services is classified as follows:

71 Architectural and engineering activities; technical testing and analysis
71.1 Architectural and engineering activities and related technical consultancy
71.11 Architectural activities
This class includes:
- architectural consulting activities: building design and drafting; town and city planning and landscape architecture
This class excludes:
- activities of computer consultants, see 62.02, 62.09
- interior decorating, see 74.10

71.12 Engineering activities and related technical consultancy

This class includes:

- engineering design (i.e. applying physical laws and principles of engineering in the design of machines, materials, instruments, structures, processes and systems) and consulting activities for: machinery, industrial processes and industrial plants; projects involving civil engineering, hydraulic engineering, traffic engineering; water management projects; project elaboration and realisation relative to electrical and electronic engineering, mining engineering, chemical engineering, mechanical, industrial and systems engineering, safety engineering
- elaboration of projects using air conditioning, refrigeration, sanitary and pollution control engineering, acoustical engineering etc.
- geophysical, geologic and seismic surveying
- geodetic surveying activities: land and boundary surveying activities; hydrologic surveying activities; subsurface surveying activities; cartographic and spatial information activities

This class excludes:

- test drilling in connection with mining operations, see 09.10, 09.90
- development or publishing of associated software, see 58.29, 62.01
- activities of computer consultants, see 62.02, 62.09

71.2 Technical testing and analysis

NAICS 2017 (North American Industry Classification System) corresponds to ISIC and NACE at the 4-digit level; at lower levels it is subdivided into eight industries:

54	Professional, scientific and technical services
541	Professional, scientific and technical services
5413	Architectural, engineering, and related services
54131	Architectural services
54132	Landscape architectural services
54133	Engineering services
54134	Drafting services
54135	Building inspection services
54136	Geophysical surveying and mapping services
54137	Surveying and mapping (except geophysical) services

54138 Testing laboratories

ANZSIC 2006 (Australian and New Zealand Standard Industrial Classification) has fewer levels, in fact its 3-digit level corresponds to the 4-digit one of the other classifications:

69 Professional, scientific and technical services
692 Architectural, engineering and technical services
6921 Architectural services
6922 Surveying and mapping services
6923 Engineering design and engineering consulting services
6924 Other specialized design services
6925 Scientific testing and analysis services

Product classification

The various international product classifications provide considerable detail and it is unlikely that SPPIs could be produced at the most detailed product levels. Instead, the finest levels of the product classifications could be used to measure prices for homogenous groups of services, which could then be aggregated to form a robust price index.
In the classification used in European countries (CPA 2015), the industry division 71 Architectural and engineering services; technical testing and analysis services is classified using the same first 4 digits as NACE, with detailed categories as follows:

71 Architectural and engineering services; technical testing and analysis services
71.1 Architectural and engineering services and related technical consulting services
71.11 Architectural services
71.11.1 Plans and drawings for architectural purposes
71.11.10 Plans and drawings for architectural purposes
71.11.2 Architectural services for buildings
71.11.21 Architectural services for residential building projects
71.11.22 Architectural services for non-residential building projects
71.11.23 Historical restoration architectural services
71.11.24 Building project architectural advisory services

71.11.3 Urban and land planning services

71.11.31 Urban planning services

71.11.32 Rural land planning services

71.11.33 Project site master planning services

71.11.4 Landscape architectural services and architectural advisory services

71.11.41 Landscape architectural services

71.11.42 Landscape architectural advisory services

71.12 Engineering services and related technical consulting services

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 (hazardous and non-hazardous)

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 and evaluation services

71.12.34 Surface surveying services

71.12.35 Map-making services

71.2 Technical testing and analysis services

Classification issues

Classification issues are an important concern in the industry. There are similarities between 71.12 and other industries: 71.20 Technical testing and analysis services and 74.90 Other professional, scientific and technical services.

In France, there is a collective labour 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 of assistance to authorities of the project before the project is scheduled (cost estimations by construction economists, for instance) are more likely to be classified in 74.90. Environmental consultancy is also part of 74.90. Inspection and technical analysis ex post are more likely to be classified in 71.20.
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 this kind of service within a global engineering project.
74.10: Pure design of the final product without any development or management of the project should be classified in the 74.10 “Specialized design services“ industry.
Unclear lines between construction, manufacturing and engineering services in parts of the industry were mentioned by Mexico and Norway as well.

1.2 Market conditions and constraints

Importance of the industry and concentration within the industry

In some countries, the industry trend is decreasing in terms of turnover (revenue), but with signs of recovery in recent times. In many countries there are a significant number of small enterprises that generate most of the turnover. Some countries cover all activities in 71.1 whereas others only cover activities within engineering activities.
In Italy, industry 71 Architectural and engineering activities; technical testing and analysis is dominated by class 7112, Engineering activities, in terms of enterprises, employees and turnover. Together Architectural and Engineering activities (7111 and 7112) cover around 90% of the industry for each of the three variables, specifically 95.5% for enterprises, 87.7% for employees and 84.2% for turnover. From 2006 to 2015, the industry experienced a decreasing trend in Italy. The crisis of the sector is self-evident and durable but SBS data is beginning to show the first signs of recovery. The vast majority (89.4%) of the enterprises operating in this industry have fewer than 2 employees and generate about 61% of total

turnover. Large enterprises represent less than 1%, however their turnover is not negligible and it is about one third of the small enterprises turnover.

In Croatia, activity class M 71.12 is more important than M 71.11 (NACE Rev.2) as the majority of enterprises (83.6%) of M 71.1 are classified into class M 71.12. Similar patterns are present for persons employed (84.4%) and for turnover (89.5%) in class 71.12. In this industry small companies dominate.

In France, the output of the 71.12 industry "engineering services and related technical consulting services" is 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). 71.12 represents 2.4% of total economic output. 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 represent 20% of the global turnover of the industry.

In Norway, in 2015 in terms of turnover, the strongest division in sector M is M 71.1 Architectural and engineering activities (NACE Rev.2), within which the service Other technical consultancy has the largest turnover share (52.3%).

Public regulations affecting the market situation

The establishment of an engineering office is not yet regulated with strict laws in France. 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.

Architectural and engineering services in Croatia are regulated by the Act on Architectural and Engineering Services in Physical Planning and Construction. Based on the Statute of the Croatian Chamber of Architects and Civil Engineers, in 2013 this institution adopted new Official Scale of Fees for Services by Architects and Engineers. This Scale of Fees arranges architects' and civil engineers' fees for the services relating to the elaboration of area planning documents, project/design elaboration, technical consultancy and construction supervision services. These rates are a starting point and they provide the basis for each tender offer.

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

Architects and engineers provide services to households, businesses, government and for export. Households consumption is limited to some services such as land surveyors and consulting engineers specialized in housing. Architectural and engineering firms are very present at export (France 15%, Croatia 35% of their turnover), but the largest share of turnover is realized from other businesses.

Horizontal/vertical integration

The sector of architectural and engineering activities is characterized by a huge variety of different services offered in many sub-sectors. Many of those services are input to almost all industrial and construction sectors. In most cases, planning, design, construction operation and maintenance are classified into disciplines and executed in phases, in an adversary environment and with little interaction between phases and disciplines. Vertical integration in the architectural and engineering industry exists when companies provide both architectural and engineering services, especially in large companies.
In France, independent firms (i.e. that are not bound to a corporate group) represent most of the units, but a small share of the turnover. So, the majority of turnover is realized by corporate groups. Almost 40% of the turnover is realized by affiliates held by corporate groups from other industries and these corporate groups hold numerous engineering units.

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 engineering firms seems to be weaker than in other industries with strong intellectual content. Indeed, subcontracting among engineering firms is prevalent. Industrial engineering is very sensitive to the global short and mid-term economic environment and investment is the key factor for new projects. Because of declining public investment in buildings and infrastructure, engineering services will inevitably suffer reduced revenue in the traditional area of construction and public works. Operators are trying to

reduce the costs of building engineering and to gain productivity. One current trend is the increased use of virtual building design, using the BIM (building information modelling) for example (France, 2017).

1.3 Specific characteristics of the industry

Nature of sales

When big and complex projects need to be implemented, large engineering or architectural companies sometimes engage sub-contractors when they don't have a sufficient number of their own qualified experts. Sub-contractors are often small engineering or architectural companies. Certified architects and certified engineers may perform their services in their own certified sole practice office, a joint-practice office and/or within a legal entity registered for carrying out professional tasks. Engineers and architects are often organized in a single practice or perform their services for a single legal entity.
Services from other industries are commonly associated with the engineering service, for example: cost estimations (7490), architecture (7111), design (7410), inspection and technical analysis ex post (7120) or management consultancy (7022).

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

In Japan, about 30 percent of the surface surveying companies have already introduced drones (unmanned aerial vehicles (UAV)) in 2017. The main issue is how to deal with new technologies like drones in the engineering services. The SPPI is going to be rebased soon, and the Bank of Japan intends to incorporate the prices of new technologies like drones but the suitable pricing methods need to be discussed.
France noted that because of the decline in public investment into buildings and infrastructures, engineering services will inevitably experience declines in revenue percentage in the traditional area of construction and public works. In an effort to reduce the costs of building engineering and to gain productivity. Virtual building design, using the BIM (building information modelling) has emerged as a recent trend . "BIM manager" is now identified as a profession. All technical information related to the building is integrated in the

BIM application at each step of construction. In France, building engineering services are encouraged to adopt BIM; this new tool can improve the fulfilment 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 France price transactions yet.

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 ensure a certain level of demand for the corresponding engineering activities. The same trend is noticed in building renovations, due to the latest standards of energy consumption adopted by law. Renovations, rather than new buildings, will be increasing and will be more technical in the near future. Renovations by engineering firms are said to involve more risk and to be less lucrative than new construction.

2. Turnover / output measurement

2.1 General framework

Objectives of key users

National accountants use the turnover statistics for measuring the industries value-added in national economies. Output data are available to the public and may also be used by other businesses and regulators to monitor the growth of the industry, and, occasionally to support policy decision-making.

National Accounts issues

Norway noted that the National Accounts (NA) have observed increasing imbalances in the supply-use tables within some service industries , e.g 71.1.

Total use= Intermediate consumption + Final consumption + Gross Fixed Capital formation + Changes in inventories + Export

Changes in inventories are increasing. As this variable is a residual in the supply-use table, this indicates *an increasing amount of output with no corresponding use.*

Typically, service industries do not have significant inventories. In Norway NA is calculated at the establishment level, which should make inventory levels even lower than at the enterprise level.
There are at least two possible explanation factors related to increased inventories. One is the increasing complexity of enterprises and enterprise groups. This complexity increases the risk that internal transactions are included in output measurement.

2.2 Measurement issues

Product structure, importance of product level details

As mentioned in the revisited sector paper by Bernhard Goldhammer from 2008, the Voorburg Group has not previously addressed turnover practices for architectural and engineering activities. The recommended development options presented in Goldhammer paper were based on a survey of 15 countries producing turnover statistics in advance of the 2008 Voorburg Group meeting in Mexico.
The fees for architectural and engineering services – forming the revenue and adding up to the turnover to be measured – are varied and are measured as fixed fees, hourly fees, and percentage fees. Measurement of these fees is straight forward. Additional expenses have to be included in the turnover figure as well.
Architecture and engineering companies often offer services classified in other service sectors. This may include provision of personnel or facility management. When turnover collection is based on products, it is recommended to survey the companies for all activities they do, so a real product-based turnover can be measured. It is not a challenge for an industry-based approach, where the main activity determines classification. However, many countries offer turnover data for sub-sectors as well. Especially when publishing very detailed data, it is imperative to check that the assignment of the respondents to the sector is correct. All NSOs that use surveys or a census for measuring turnover do this by questioning the activity of the responding companies. This is a harder task when using administrative data.
Poland noted that European SBS regulation (anex 8) requires only turnover data by product and residence for enterprises +10 employees. In Short Term Statistics there are no product

level data by residence or type of client available. Poland and Norway reported that they do not collect product level data, onlyestablishment level.

2.3 Description of methods for measurement

Description of estimation procedure

Combination of sample and administrative data is used in many countries for Architectural and engineering services. Goldhammer (2008) noted that while information about all companies was derived from registers, some of them were sampled in a representative way and checked for their activities and other data. The administrative data could then be adjusted by the figures from the sample survey. A big problem with the use of administrative data is that it has not been designed to obtain statistical economic indicators.
Some weaknesses:
- Definition of “turnover” is different: e.g., the tax authority includes sales of assets which are not included in what turnover statistics want to measure.
- Large corporate groups with many small subsidiaries are treated as one company by the tax authority; hence, turnover gained by sales between those subsidiaries is not counted - a mistake in terms of turnover as an economic indicator.
- Turnover for which no tax is paid is quoted, but often in doubtful quality.
Poland noted that they have access to VAT data but reliable monthly data can not be estimated. Questionnaire is therefore used.
When using only administrative data, NSOs have to be aware of weaknesses like that and find fitting remedies. Goldhammer (2008) noted that for developing turnover statistics, the NSOs may follow the approaches listed in the table below. Over the years, there have not been many changes in that field, so approaches listed in the table are applicable today.
Table1. Options for Developing Turnover Statistics – Architectural and engineering activities

Category	Data Source	Level of Detail Collected	Frequency	Cost	Comments
Best	Survey/Census	Industry turnover and product turnover detail;	Sub-annual collection (monthly or quarterly)	- Most expensive - Largest response burden	- Allows greatest flexibility to identify specific revenue streams, residential and non-residential allocations can be collected directly. - Timely data
Good	Survey/Census	Industry detail only	Sub-annual	- Expensive - High response burden	- Industry detail may not be sufficient to delineate sources of revenue or important residential/non-residential components using ISIC. - Timely data
Good	Combination of census (large companies) and administrative data	Industry detail only	Sub-annual	- Less expensive - low response burden	- Industry detail may not be sufficient. - Timeliness questioned - Different definitions for turnover in administrative data files may cause (justifiable) bias
Minimum	Administrative (tax data, industry association data etc.,)	Industry detail only	Annual	- Least expensive - Little or no respondent burden	- Income and production definitions can differ adding imprecision to estimates using tax data in place of actual revenue received for services - Least timely

Source: Goldhammer B, Revisited Sector Paper on 7110 Architectural and engineering activities and related technical consultancy, 2008

Frequency of collection and for which purposes

In order to achieve coverage of service activities in STS, which reflects the increased importance of services and which must meet users' needs in a better way, a lot of changes have been proposed as a part of FRIBS (Framework Regulation Integrating Business Statistics) for European Countries, such as:

- Production of a new measure, the Index of Service Production (ISP), on monthly basis
- Obligatory monthly data collection on turnover and index calculation even for small countries, instead of quarterly periodicity used so far.

Because of that, many countries have supplemented the quarterly dynamics of conducting a turnover survey with monthly dynamics of turnover changes in service activities.
For calculation of ISP, when the deflation of the monthly turnover in service activities is in question, the fact is that most of the service price indices are available only at the quarterly level and if we use them for deflation purposes there is a need to disaggregate them into three monthly indices. In Croatia, for example two methods will be used for disaggregation, depending on the data availability. Croatia has a quarterly engineers and architects index at disposal for deflation purposes and for calculation of ISP, to calculate a sufficiently correlated monthly index from the quarterly index sufficiently correlated auxiliary index[1], applying the model-based approach in using this auxiliary information, will be used. Otherwise, the linear interpolation method will be used.

Challenges measuring output

Goldhammer (2008) in his revisited sector paper identified the following major challenges for developing turnover statistics:
- misclassification of companies: often, companies in the business registers have wrong activity codes. This leads to biases in the results of the statistics.
- Sub-contracting/off-shoring: Sub-contracting means double counting of turnover. A related problem when using value-added tax data are corporate groups and their internal sales not listed in the tax data but required for turnover data.
- Poor data quality in registers.
- Assuring the continuity of long-time series which is threatened by classification and methodology changes.

[1] Auxiliary index method
-If there are several auxiliary indices for one quarterly index, they are aggregated to one value by using formula for weighted arithmetic mean.
-When for each quarterly index we have just one auxiliary index we apply the following formula for disaggregation

$I_Q^i = I_Q * \frac{M_A^i}{\overline{M_A^Q}}$

where I_Q^i ($i\epsilon\{1,2,3\}$) are first, second and third month of the quarter, M_A^i are the respective auxiliary monthly base-year indices and $\overline{M_A^Q}$ is the average of the three auxiliary monthly base-year indices inside the quarter. The described procedure can work well only when is applied on the historical data, when all the quarterly indices are already available and quarterly indices can be directly disaggregated and then used for deflation.

In presentation from 2017, which summarizes the experience of Norway, Mexico and Poland, the following challenges were identified:

- STS: No product level data, by residence or type of client are available
- Internationalisation/Globalization – meausurement challenges - risk of including output from a foreign subsidiary in the domestic production
- Increasing complexity of enterprises and enterprise groups: Increases the risk that internal transactions are included in the output measurement
- Relations between different entities in one enterprise
- Timing of activity and payments are not necessarily consistent
- Unclear line between construction, manufacturing and engineering services in parts of the industry
- No collection of product data – establishment level (NA can not use only enterprise level)
- Export data is based on a sample survey

Communication between national accountants and turnover statisticians about the methods being used in national accounts will help ensure that efforts are in line and the resulting statistics will be as applicable as possible. However, national accounts is not the only user of turnover data so it is important to ensure that other needs are met as they are identified as important.

Q&A from 2017 Voorburg meeting - Output

“After the prepared presentations, the Group entered into questions for the presenters. India began with a question regarding the challenge of accrual accounting. Norway responded that payment and provision of a service are not always temporally connected. Payment could be received in one period while the actual provision of the service takes place in a different period. India noted that while it is a big problem for engineering, all industries are required to use accrual accounting. Another delegate asked if the split of production (intermediate/final) causes an issue with the output or with the national accounts? What part of the output is used for fixed capital formation? Norway did not find that to be a problem because fixed capital formation data comes from Structural Business Statistics (SBS)

and much of the work goes into construction. India asked if geological surveying is part of the actual output or part of this industry? It is often only done by governments. Norway responded that it is part of output but that the activity is dominated by the private sector rather than the government"(Murphy J 2017).

3. Measurement of SPPI

3.1 General framework

Objectives of key users

France noted that the uses of SPPI are threefold: as a deflator for the service production index, as a deflator for national accounts and 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.
In Croatia, from 2016, SPPIs for M71.1 are regularly sent to Eurostat. In the same year, SPPI results were nationally disseminated for the first time and data are now regularly published in quarterly dynamics. The results of that survey are effectively used in the national accounts as deflators. It must be pointed out that SPPI for M71.1 together with other industries will also be used in the compilation of the ISP (index of services production). Some reporting units also occasionally use the SPPI for M71.1 for the purpose of escalating their contracts.

3.2 Measurement issues

Type of SPPI, sampling unit – Industry/Product

In Italy, the Engineering Services SPPI is compiled with prices collected by a quarterly business survey and its structure is industry based.
The French SPPI is industry-based in the sense that, according to the Council Regulation, SPPIs are calculated on the basis of NACE Rev 2 activities rather than CPA products. 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.
The methodology used for the compilation of SPPI in Croatia is based on the product approach. Product based indices are created from service groups selected by sampled reporting units. In the questionnaire form, reporting units have to provide information on the prices of representative services for each of the service groups for which they reported data on the turnover share. Price movements for those services are then aggregated to form service groups. The price index for the activity as a whole is calculated by using price indices of service groups.

Sampling design

The SPPI survey is quarterly in all four countries. Data sources are from a survey in all countries, except the Bank of Japan uses a other Databases from Ministry of Land, Infrastructure, Transport and Tourism.

Sampling design in France is the result of a two steps process. First, „cut-off" sampling using turnover as the measure of size, and second, a „well-informed choice" method which tries to determine firms that would be forgotten with the first process and that are architectural services firms.

Italy uses a stratified sample of enterprises by turnover, PPS sampling with large companies integrally sampled.

Croatia uses a combination of probability sampling, (for small enterprises, even with 2 employees) and Census (for medium-sized and large enterprises), with two size measure criteria: turnover and number of employees.

3.3 Description of pricing methods and criteria for choosing the method

The previous sector paper - Architectural services

According to the previous sector paper, the main conclusion was the most important and difficult aspect of architectural services is the uniqueness of each project: the projects are typically performed only once. Repeated services are hardly observed.

Architects categorized their customers into three main groups: private households, private enterprises and public institutions. They all tend to have different pricing mechanisms and service requirements.

In order to ease the compilation of an SPPI, the statistical offices tend to focus on the collection of prices for the core business of the architects. So, prices may only be collected for structural engineering and just for one type of customer.

Regarding pricing methods, two approaches were dominant: Pricing based on working time and model pricing. Pricing based on working time tracks hourly charge-out rates that are usually distinguished by position of staff, type of service and sometimes by type of customer, too. To avoid the productivity bias, many statistical offices used model pricing – or, at least, tried to. Some offices even switched to pricing based on working time because model pricing resulted in very poor response rates.

Other methods in use were percentage fee, contract pricing and component pricing based on repeated services.

The previous sector paper – Engineering Services

The main difficulty in determining prices for engineering services are caused by the need to make a distinction between services related to construction versus non-construction related services. Major pricing methods for engineering services were: Model Pricing and Pricing based on working time. Also some alternative methods were used.

The advantages of Model pricing method were good service comparability over time, the avoidance of productivity bias, no need for quality adjustment and a „precise" estimation according to an exact definition of the service.

Disadvantages of this pricing methodology include: quickly outdated models; influence of negotiations on price-subjective estimation; and different results when different project leaders estimate the same project.

Pricing based on working time was then the standard method for measuring engineering services. It was the easiest way to get valid price quotations with realised hourly rates being preferred.

In 2002, the Netherlands and Canada presented innovative approaches for the collection of prices for engineering services. The Netherlands method may be referred to as realised contract pricing. It requires the quotation of standard hourly rates every year. For a certain quarter, the respondents quoted several completed contracts, with their worked hours by qualification and the total price billed to the customer. The basis for index calculation were standard rates, updated by realisation rate (which is billed price divided by standard price).

Some considerations from previous sector paper were:

- Major tasks are measuring productivity progress and quality adjustment
- The need for communication to convince the respondents of the necessity and advantages of an SPPI
- The requirement to measure new types of services that were created over time: e.g. "design-build contracts": bundled packages of services including architectural, engineering, and construction services in a single contract. In that case it was considered rather as a part of the construction sector, not included in SPPIs.

2017 –new experiences – pricing methods

In France, the pricing methods chosen for engineering services are time based methods in which the sales prices are followed as daily or hourly rates by category of staff, and also direct use of repeated services, following fixed individual services prices when they are recurrent. The next method used is percentage fee in cases when prices are based on percentage of project costs. An additional method is a turnover ratio per hour – when percentage fee seems to be impossible to be furnished. Quality adjustment is almost impossible when using the turnover ratio per hour method.

In Italy, chosen pricing method is model pricing, in which each respondent has to provide the description of three different projects. Projects can be hypothetical or based on real transactions. The variables that identify the model include: customer type; market type; service life span; reference cost; category of work; functional destination; work identification and type of activity.

In Japan model pricing is used when differences in service quality are large. The Bank of Japan uses the price data from other databases instead of mailing the survey to reporting companies. The surveyed price is calculated from data published by Ministry of Land, Infrastructure, Transport and Tourism (Man-day costs by Ranks of Engineers) and from results published by governments (bid results).

The time-based method is used in cases when the quality of the service is proportional to the quantity of labor input. The other methods also used a redirect use repeated services, the unit value method and the list price method.

In Croatia the time-based method is used in all groups of services. There are 3 different types of time-based method:

1. Hourly charge-out rate - simplest time based method
2. Hourly list rates -Price = List Price per hour x quarterly hours invoiced/ quarterly hours worked
3. Wage rates – Price = Wage data per hour x quarterly hours invoiced/ quarterly hours worked x (1/100) x (100 + margin rate).

Another method used is the direct use of repeated services when services are relatively homogeneous (e.g. some geodetic services especially for small reporting units).

Percentage fee is used in the case when prices are based on percentage of project costs- mostly for complex building projects.

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

In France, respondents are allowed to comment on their price change, and a comment is requested in the Internet questionnaire when the variation is higher than 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 with a new one if the gap is too large. 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 to in the contract, for the expected final service. Nevertheless, for SPPI, NSOs should not divide the charged price by productive hours, otherwise this 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.
Services in this industry are often complex, with many components included and in Croatia this is helped by several rules implemented on the web-based questionnaire form. When a reporting unit reports a representative service, this service has to be specified by service code, by detailed factors that are relevant for its price formation and by pricing method used for reporting the price. Also, the reporting unit has to provide information on price in current and previous periods, on unit of measure referring to the reported price and on the reason for price changes or reasons for missing data. Web applications for SPPI surveys have several types of automatic data checks at the micro level (individual web questionnaire): - errors, warnings, logical and numerical controls, controls at questionnaire level, and administrator’s individual investigation of web questionnaire with selected characteristics.

Frequency of collection

The SPPI surveys are quarterly in all four countries.

Q&A from 2017 Voorburg meeting- SPPI

"In the French presentation, it was noted that "pure" design with no development is classified in the specialized design industry. Price is an issue in an environment of low price bidding. Quality change is often not resulting in price changes. Unable to quality adjust these things – flat prices but constant quality pricing might be declining. A delegate asked where in the aggregation structure are B2B, B2X, and B2All? France separates the turnover during the field visit. Then representative services are collected for each. Price indices are calculated and then summed up and weighted. Indexes are published quarterly, 55 days after the reference period. A delegate asked France about the quality of the split in B2B, B2X, and B2C. France noted that the Syntex series is more known and more used. Their field surveyors sometimes do question the initial splits when the data look wrong. The splits by type of customer are often a bit rough. Overall questions and observations followed. One delegate noted that many engineering enterprises lease their engineers to the customers – kind of like a labor supply service. Are other countries faced with this problem? Also, different countries are using different price determining characteristics. Norway only sees the first problem in temporary employment. For the second part, Norway has a hard time getting employee characteristics for civil engineering projects so they are using a more product based approach. Croatia chooses the price determining characteristics by the actual type of project. US model pricing uses a truncated approach to employees on projects. There might be 15 or more engineers on a project but they only track the top five or so in the model pricing specification. That is a common practice across industries using this type of model specification approach. Croatia also uses a cutoff. A delegate asked Japan how they get the actual margin and Croatia how they get the percentage fee when considering issues such as capital allocation. Japan gets the profit margin from the companies themselves. Once or twice a year they are updated. Croatia asks respondents for the project value and the percentage of that accounted for by architectural and engineering services. When the project extends longer than a year, the price remains unchanged. That may not be an optimal solution. Another delegate asked the group broadly if they see internal work as a big problem. Many companies have their own engineering services department or similar. A delegate posed a question about technological change. Should new technologies be reflected as quality or price changes? Norway noted that new technologies have different impacts

depending on the pricing methodology being used. Norway tries not to use charge out rates in industries impacted by rapid replacement of workers. The US asked if we are missing important aspects of the industry or technology change when small units are not included in samples? Probably. BIM is very expensive and small units really cannot afford the cost. For some countries and methods, annual price changes are the norm. Other countries and methods show that prices for civil engineering services change regularly" (Murphy J 2017).

4. Evaluation of measurement

The sector of architecture and engineering activities is characterized by a huge variety of different services offered in many sub-sectors. Especially engineering services are an input to almost all industrial and construction sectors. This variety creates challenges to both turnover and price programs. Regarding classification, all classifications have similar breakdowns on higher aggregation levels, but show variations regarding the detailed breakdowns.

For turnover measurement, many countries use a variable mix of administrative and survey data. Information from administrative data alone seems not to be sufficient to disaggregate turnover at an appropriate level. When using only administrative data, NSOs have to be aware of weaknesses like that and find fitting remedies. In 2017, major challenges identified were:

- Globalization which lead to risk of including output from a foreign subsidiary in the domestic production
- Increasing complexity of enterprises and enterprise groups which as well increases the risk that internal transactions are included in the output measurement
- Measurement challenges bacause of the relations between different entities in one enterprise
- Timing of activity and payments are not necessarily consistent
- Unclear line between construction, manufacturing and engineering services in parts of the industry
- No collection of product data – establishment level and National Accounts can not use only enterprise level
- Export data is based on a sample survey

Communication between national accountants and turnover statisticians about the methods being used in national accounts will help ensure that efforts are in line and the resulting statistics will be as applicable as possible.

Uniqueness, a main aspect of architectural and many engineering services, and a wide range of services lead to variety of pricing methods but mostly used are these four methods. Time based methods are still the most popular because they are easy to report, but on the other hand, often changes in labor productivity are not captured. Model pricing is suitable for unique services but on the other hand it is difficult for respondents to comprehend and provide estimation for the price change. Direct use of repeated services is a simple method but suitable only for homogenous services. Percentage fee is a straightforward method to use. There are multiple factors that influence the price of engineering services and these methods may not adequately reflect actual prices received.

All these methods have some advantages but also some disadvantages.

New issues and questions, based on findings from the meeting in New Delhi, were identified. One question “Should new technologies be reflected as quality or price changes? “ Norway noted that new technologies may have different impacts depending on the pricing methodology being used. E.g. Norway tries to avoid using charge out rates in industries impacted by rapid replacement of workers. Also one of issues is how to incorporate the prices of new technologies like drones or BIM (building information model) and how to quality adjust? One more challenge is that in this industry there are a significant number of small enterprises that generate most of the turnover and consideration should be given to survey them also. For example, in Croatia due to the significance of the small enterprises, sample design was set-up as a combination of probability sampling for small enterprises and a census for large enterprises. Small units were selected into the sample using Probability Proportional to Size (even enterprises with 2 employees). Some study and analysis about the effect of probabilistic sampling when small units are included by comparison with traditional purposive sampling surveys were made. Analysis focused only on empirical results but results confirmed that if small enterprises were not taken into account in the sample design in the case when there is large number of smaller units that significantly contribute to the total value of the population characteristics, there was significant bias in the indices.

5.0 International Progress

The following table summarizes international progress on measuring prices and output for this industry as compiled by John Murphy of the U.S. Census Bureau from country - provided progress reports. 22 countries responded in 2017

	Number of Countries
PPI details >= CPC	5
PPI details >= CPC soon	0
Turnover details >= CPC	5
Turnover details >= CPC soon	0
Industry prices calculated	16
Industry turnover collected	21
Detailed turnover and prices well aligned	2
Detailed turnover and prices well aligned soon	0
Industry level turnover and prices aligned	12
Industry level turnover and prices aligned soon	1
Other - no industry coverage for prices and/or turnover, etc.	7