# <u>Price Indexes for Engineering Services</u>

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# Measuring Output Prices for Engineering Services
# In the United States

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Producer Price Index
U.S. Bureau of Labor Statistics

## I. Abstract

The calculation of constant quality prices for the output of Engineering services present statistical agencies with several challenges. Engineering services are generally customized for the unique requirements of specific clients which make month to month price comparisons difficult. Significant technological innovation along with changes in construction related government regulations add to the price measurement complexity. The U.S. Producer Price Index (PPI) publishes measures of price change for the output of Engineering services based on repricing fixed services over time that are periodically updated to reflect evolving market conditions.


## II. Introduction

Engineering services prices are usually determined by a fee structure that is fixed, non-fixed or a combination of the two. Fixed fees are negotiated percentages of predetermined construction budgets. Non-fixed fees may include a negotiated percentage of construction cost (where total construction cost is unknown), hourly rates based on a multiple of actual firm expenses or per unit rates based on the consumption of labor inputs by category. Price may also be determined through negotiation that incorporates features of both fixed and non-fixed fee structures.

The custom nature of industry output and complex fee strategies present statistical agencies with difficult measurement challenges. A perfect solution to these challenges is unlikely, but in the real world the "best" practical solution is one that is most consistent with the theoretical underpinnings of the Fixed-Input Output Price Index (FIOPI) model targeted by the PPI. The most significant measurement challenges are those that have a direct impact on the deflation properties of an Engineering services price index. For instance, engineering services companies obtain jobs based on competitive bids that may not actually reflect the final transaction price. The final price for delivered services may be significantly different than the original bid price due to interim change orders and unforeseen circumstances. Differences between the bid price and the actual transaction price are most likely due to changes in the service provided, which violates the matched model assumption. Another, but more difficult to detect measurement challenge is created when new technologies, such as software, are introduced to the mix of input requirements[1]. Once again, the FIOPI model is violated but in a more subtle way. Does new software enable a change in the type of output or just more of the same output? The answer to this question also has implications for the deflation properties of an Engineering services price index. Also contributing to the price measurement challenge are new building codes and other government mandated changes for safety and environmental issues. The solution to the price measurement challenges described so far reduce, in concept, to a constant quality output index. Unfortunately, the more complex

[1] Software requirements or other technological production support tools are unlikely to be included in job specifications provided to statistical agencies by sampled respondents.

the nature of output, the less likely that appropriate data is available to quantify and value quality change.

The remainder of this paper is organized as follows.

- •Section 3. Industry outputs
- •Section 4. Industry business model
- •Section 5. Sample design
- •Section 6. Availability of industry data
- •Section 7. Index publication structure
- •Section 8. Pricing methodology
- •Section 9. Technical issues
- •Section 10. Survey methods
- •Section 11. Index analysis
- •Section 12. Future industry trends
- •Section 13. Need for future work

# III. Definition of Industry Outputs/ Types of Services

## Definition of Industry Outputs

The 1997 NAICS definition of engineering services states, "this industry comprises establishments primarily engaged in applying physical laws and principles of engineering in the design, development, and utilization of machines, materials, instruments, structures, processes, and systems. The assignments undertaken by these establishments may involve any of the following activities: provision of advice, preparation of feasibility studies, preparation of preliminary and final plans and designs, provision of technical services during the construction or installation phase, inspection and evaluation of engineering projects, and related services."

The unique repriced item is identified by either the contract between the client and designer combined with internal data used to calculate a fixed price, or a contract combined with a representative, sub-sampled billing invoice in cases where a fee is not pre-determined.

## Types of Services

Engineering services are customized and may encompass a wide variety of services. Pure engineering firms supply design, analysis, and consulting services pertaining to specialized structural, mechanical, electrical, and other components and systems. These include, but are not limited to: structural framing, foundations, ground stability, drainage, plumbing, HVAC, assembly line configurations, power generating facilities, environmental impact studies, roads, bridges, tunnels, and various types of electrical systems.

Engineers apply their design, analysis, and consulting skills to a broad range of projects. These projects can be defined in two categories.

**Project Categories Defining Building Related Services:**

1) **Residential Housing:** single unit and multi-unit housing
2) **Commercial Buildings:** office buildings, shopping centers, lodging facilities, warehouses, restaurants, service stations, and other commercial buildings
3) **Public and Institutional Facilities:** hospitals, educational institutions, churches, banks, prisons, convention centers, sport facilities (e.g., stadiums and auditoriums), government buildings, libraries, museums, parking garages, and other public and institutional facilities.
4) **Industrial- Manufacturing Facilities:** plant, mill, factory building design and configuration.

**Project Categories Defining Non-Building Related Services:**

1) **Hazardous, Non-Hazardous, Sewage, and Water Treatment or Disposal Project**
2) **Environmental Engineering and Associated Impact Studies**
3) **Infrastructure Development:** highways, roads, bridges, and tunnels
4) **Mass Transit and Materials Transport:** airports, railroads, subways, harbors, ports, pipelines, and other transportation related projects
5) **Power Generating Facilities:** hydro-electric, nuclear, fossil fuel, other power generating facilities, and any accompanying layout and design of relevant equipment
6) **Naval and Marine Equipment:** craft design and renovation, configural aspects of propulsion system design
7) **Communications Equipment and Systems**
8) **Other Non-Building Related Services:** chemical and oil refineries, layout and design of industrial equipment and other machine, tool, and industrial production related projects, dredging, mining, excavation, drilling rigs, land reclamation, outdoor recreational facilities, reservoirs, and other non-building projects

# IV. Business Model

## A. Industry Organization

The size of engineering establishments varies greatly, from those with thousands of employees to those that only have a few employees.

**Establishment and Employment for 2001**

| NAICS | NAICS Description | Number of Employees for week including March 12 | Total Establishments |
|---|---|---|---|
| 54133 | Engineering services | 842,122 | 44,523 |
| 541330 | Engineering services | 842,122 | 44,523 |

Source: *administrative frame; 2001*

Engineers are concerned with design, analysis, and consulting services for building and non-building related projects. There are basically two types of establishments found in this industry: establishments providing engineering services only and establishments providing a combination of engineering and architectural services.

1) Vertical integration: Vertical integration does exist in the engineering industry when firms provide both architectural and construction services. There is no horizontal integration in the engineering industry.

2) Outsourcing/resellers: Outsourcing in the engineering industry involves subcontracting the related construction of architectural service activities.

3) Array of services provided: Engineering services are customized to meet the demands of each client. Therefore the specific service provided will vary substantially from contract to contract. Although the particulars of each transaction make a matched model difficult, the underlying engineering services provided are consistently defined by the design, analysis, and consulting services for building and non-building related project. Engineering services can be represented by the preparation of documents resulting from the design, analysis, and consulting performed in accordance with the provisions of an agreement between the service provider and the client.

## B. Identification of Operating Units

The 2001 administrative frame identified 44,523 establishments in the engineering industry. The establishments range from very large, with over 1000 employees to extremely small, with 1-4 employees. The majority (59%) of establishments have less than 5 employees, while 35% of establishments have between 5-50 employees. The remaining 6% of the establishments have between 50-1000+ employees.

| **Number of employees** | **Number of firms** |
|---|---:|
| less than 5 | 26,221 |
| 5 to 9 | 6,784 |
| 10 to 19 | 5,114 |
| 20 to 49 | 3,831 |
| 50 to 99 | 1,328 |
| 100 to 249 | 823 |
| 250 to 499 | 239 |
| 500 to 999 | 100 |
| 1000 or more | 83 |
| | |
| **Total** | **44,523** |

### C. Government Regulation

Government regulation of engineering services influences price setting and price movement. Each state maintains structural and non-structural design codes that set minimum standards for the design, analysis and consulting required on construction projects. As a result, there is a de-facto minimum purchase requirement for many engineering services that may vary by state.

In addition to state codes, federal legislation may also influence engineering services prices. For instance, in the early 1970's Congress passed the Brooks Act which establishes selection guidelines that must be followed when the government awards a contract for engineering services. One of the requirements of the Brooks Act is that each potential engineering services provider must be ranked according to their qualifications. Once the rank is established, the government must select the most highly qualified firm. The Brooks Act also limits fees for the design aspect of any federal project to 6% of estimated construction costs. This price cap limits the service provider's ability to increase prices in periods of construction growth due to competitive restraints that may be caused by the ranking process. Currently, there is no pending anti-trust or other industry-wide litigation between the government and the engineering industry.

### D. Public Ownership/ Government Subsidization

There is no public ownership or government subsidization in the engineering industry.

## V. Sample Design

### A. Sample frames

#### 1. Stratification variables- relation to classification structure

The term stratification, as it is used in the PPI, refers to the grouping or ordering of frame units with respect to one or more characteristics. Explicit stratification may be used to partition frame units into two or more nonoverlapping homogenous groups called strata. Explicit stratification was not used in the PPI's sample design for the engineering services industry.

#### 2. Alternative frames

Administrative frames are the default frame source used by the PPI. They provide SIC and employment data, however more detailed information may be required for an explicit stratification strategy as described above. Occasionally the PPI can identify and purchase an alternative frame that provides the detail required to support a more flexible sample design. For engineering services an ideal alternative frame would identify firms by type of service and provide a measure of size for each activity. This type of data could support a meaningful stratification, but does not appear to be available in the United States.

### B. Identifying the sample unit- record center relation to classification structure

The profit-maximizing center is the preferred sample unit for the PPI. It is the unit of a company within which prices are formed, products are marketed, and records are kept. This unit closely corresponds to the economic concept of the firm, the unit whose behavior is explained in economic theory.

### C. Reporter burden issues

Reporter burden for engineering services is partly dependent on the preferred pricing methodology. For instance, burden is likely to increase if the custom nature of output requires reporters to estimate prices for a fixed project over time. In other words, to obtain comparable pricing data, a reporter may be asked to estimate prices (taking into account current market conditions) for a sampled project long after the project has been completed. The PPI has limited the number of items (projects) per sample unit to minimize reporter burden, which suggests the need for a large sample size.

## VI. Industry recordkeeping practices

### A. Data availability for engineering services

Industry record-keeping practices suggest that for multi-unit firms all information necessary for identifying the terms of different contracts and for estimating prices based on selected terms are available at corporate central offices.

### B. Composite goods and bundling for engineering services

The input costs for engineering services include labor, capital (i.e., computers), and overhead. When clients purchase engineering services, they purchase specialized knowledge and the experience necessary to apply this knowledge. The price of engineering services can be influenced by many factors, but one of the most important is the cost and markup of labor inputs. Engineering services are normally priced per transaction rather than for individual services provided. The following is a list of some of the labor input categories that firms may use in calculating a price.

Sample of potential charge categories

| | | |
|---|---|---|
| -Architect | -Geotechnical Engineer | -Asbestos Analyst |
| -Architectural Engineer | -Mining/Mineral Engineer | -Interior Space Planner |
| -Structural Engineer | -Environmental Engineer | -Cost Estimation Engineer |
| -Mechanical Engineer | -Manufacturing Engineer | -Specification Writer |
| -Electrical Engineer | -Industrial Engineer | -Principal |
| -Civil Engineer | -Transportation Engineer | -Project Manager |
| -Marine Engineer | -Traffic Analyst | -Drafter |
| -Petroleum Engineer | -Fire Prevention Engineer | -Technician |

As previously mentioned a non-fixed fee structure is often used for engineering services and presented in the form of a billing invoice. The billing invoice can include the following items that make up the fee structure: a percentage of construction cost, hourly fees based on either a multiple of actual firm expenses or per unit of categorized labor input, and blended methods that include actual firm costs plus fixed fee or actual firm cost plus a percentage of construction costs. The sum of the fee structure items included in the billing invoice represents the entire transaction.

## VII. Publication structure and relationship to the CPC

### A. Publication Structure

The primary services provided by engineering firms may be classified either as building or nonbuilding related. In building related activities such as residential housing or commercial facilities, engineers work with architects, whose main function is to provide a general design concept and project layout. Examples of non-building related activities are water treatment projects and mass transit.

Publication Structure

- Engineering design, analysis, and consulting services
  - Primary services
    - Building related services
    - Nonbuilding related services
  - Other receipts

### B. Why a general publication structure was chosen

The publication structure selected reflects the two major classifications of engineering services outputs. A more detailed publication structure would have required a larger sample size or a great deal more frame refinement to identify and certainty-select sample units by project type. The cost-benefits associated with either alternative did not support a more detailed publication structure.

### C. Relationship of publication structure to the CPC

The publication structure for the engineering industry corresponds with Central Product Classification (CPC) V1.0 group 833. CPC classifies Engineering Services as group 833 which is further divided into:

•8331-Integrated engineering services
•8332-Project management services concerning construction
•8333-Engineering advisory and pre-design services
•8334-Engineering design services

•8335-Engineering services during the construction and installation phase
•8339-Other engineering services

Comparability with a publication structure suggested by the CPC would require a detailed specification for each repriced project, but each CPC activity may not have a corresponding output price because engineering services are bundled.

# VIII. Pricing methodology

### A. Methodologies chosen

**Fixed fees**

Fixed fees are negotiated as percentages of predetermined construction budgets that may also be designated as stimulated or lump sum or fee for square foot designed. If a project's scope and cost can be easily defined, a fixed fee contract offers price certainty to the client as well as incentives for the engineering firm to deliver services with maximum efficiency.

For fixed fee contracts, the internal estimate used in formulating the competitive bid or negotiated price should be used to obtain labor input categories, charge rates, quantities data, as well as any other relevant information. A services specification is provided in Example 1 that identifies the total cost of the job including the total time and the fee per hour. Respondents are asked to update the estimated fee per man-hour while keeping all other service details constant.

**Nonfixed fees**

Nonfixed fee structures include: a percentage of construction cost (where total construction cost is unknown), hourly fees based on either a multiple of actual firm expenses or per unit of categorized labor input, and blended methods that include actual firm costs plus a fixed fee or actual firm costs plus a percentage of construction costs.

The percentage of construction cost method (when scope and cost are unknown) allows price variables to remain open. Total fees are unknown until the entire project is completed. The cost plus methods are a blend of those described above, combining the security of a stable, fixed fee with a functional, variable reimbursement mechanism. The hourly method will most likely be used for preliminary design projects, small sub-contracted jobs, and consultation work. This method entails a minimal level of commitment.

To extract price data from nonfixed fee agreements, a design contract in conjunction with a corresponding billing invoice is required. An example of such a specification is provided in Example 2 for a non-fixed fee structure that describes the project and includes a breakdown of personnel that worked on the project and their respective hourly wages. Information contained in a billing invoice will be used to represent the entire transaction, and it is this item that will be used in repricing. Respondents are asked to update the hourly rate and the total fee based on the fixed hours worked.

***Estimated new transaction price***

Each service is a unique combination of inputs used to create a custom output. During repricing, companies estimate a hypothetical current price for the service identified at initiation. This type of price is referred to as the estimated new transaction price. When estimating this price, service providers need to consider their current negotiation- bidding position in combination with the prevailing economic climate. Various pricing possibilities exist based on the level of detail and quality of information that the company is willing to provide.

There are four methods for capturing the characteristics of a transaction needed to obtain an accurate estimated net price over time. They are listed below in order of preference:

1) Specification based price (standard fees with adjustments indicated)
2) Specification based price (adjustments not indicated but included in reported price)
3) Best available narrative description (standard fees with adjustments indicated)
4) Best available narrative description (adjustments not indicated but included in reported price)

The preferred estimated net transaction price over time is based on input specifications, with all adjustments indicated. This type of price requires companies to identify the following: detailed input specifications, standard fees for the various levels of professional assistance provided (i.e., list prices), quantities provided, and adjustments to list prices. This information is generated when a service provider makes a fee calculation for a given project based on its standard hourly fees that are in turn used to make a percentage or lump-sum adjustment prior to submitting a competitive bid or during firm-client negotiations.

The contract may be either fixed or variable fee based. The following is an example. An establishment estimates a bid or enters negotiation with a potential client regarding a design project titled, "Building Fire Protection System Renovations". The service provider whether calculating a bid proposal or entering negotiations has previously estimated its standard fee (i.e., an ideal, list price based on its hourly fee schedule and an estimate of time required to complete the service). For this example assume an initial bid/negotiated price of $250,000. However, negotiation leads to a fixed fee of $225,000, a 10% discount from the original proposed price. In addition to identifying this adjustment, the reporter is able to identify the labor charge categories, rates, and quantities used to calculate the $250,000 estimate. This situation might also occur if a nonfixed fee agreement is used. The transaction price might be explicitly based on the firm's stated hourly fees, quantities provided, and include an *X%* discount. Here, a sub-sampled bill representing the contract will provide a detailed breakdown of professional fee categories, quantities provided, and rates. Data regarding the *X%* discount applied must be available, and might be obtained from either the disaggregated contract or the sub-sampled bill. In either case, when detailed input data, standard fees (i.e., list prices), and adjustments are obtained, the reporter will be most able to estimate a current net price for the disaggregated bundle of services.

### B. Alternative Methodologies

**1.** The second most preferable estimated net price will be based on input specifications, with all applicable adjustments built in to the price data (i.e., adjustments included in reported price). Using the previous example, the reporter might simply identify the net price of $225,000 for the entire fixed fee contract, or identify a billing period's invoice where hourly fees have the *X%* discount already applied. This alternative has identifiable input categories, rates, and quantities, but does not separate standard hourly fees from the adjustment/discount when providing a net price.

**2.** The next least preferred estimated net price does not have a detailed input specification available but data pertaining to both standard fees and adjustments have been identified. This situation may occur in extremely large transactions if reporters are reluctant or unable to re-estimate a project specification with extensive levels of labor inputs, man-hours and charge categories. This method can still offer a representative estimated price if a good narrative service description is obtained.

**3.** The least preferred estimated net price does not have a detailed input specification nor data pertaining to adjustments/discounts applied to standard fees. As in example 2, a best available narrative description is substituted for a detailed input specification. Unlike example 2, the reporter is unable to separate the standard list price from the applicable adjustments, thus providing a price with adjustments included for the contract or sub-sampled bill. This method is considered the weakest because it provides the reporter with the fewest prompts for maintaining comparability estimated prices over time.

The nature of the service is best defined when the data collected includes labor categories, rates, and quantities. Reporters will be able to use this information to precisely estimate what the service would cost in subsequent periods. When this information is unavailable, reporters will be forced to use less precise information to estimate the current level of compensation for a vaguely defined service.

List prices for engineering services are explicitly stated in their standard hourly fee schedule or internal calculations they make on fixed fee contracts based on a full premium price. Because transaction prices commonly differ from list prices, it is important to explicitly identify both standard hourly fees as well as any adjustments that result from the bidding-negotiation process (i.e., a price with adjustments indicated). This information provides reporters with the best opportunity to accurately estimate prices when annual or semi-annual changes to hourly fee schedules occur as well as more subtle monthly variations resulting from changing economic conditions.

### C. Limitations in the chosen methodology

Establishments should be able to provide meaningful price estimates with the preferred methodologies as long as they continue to provide similar services. In the engineering industry, this is usually not a problem because most basic types of services are provided long-term. Therefore, using monthly price estimates for fixed services limits the number of substitutions that would otherwise occur due to the custom nature of output. However, new item bias may be introduced when estimating prices for fixed services. Mandated rules and regulations, such as environmental requirements, may change or new engineering services may be created.

# IX. Technical Concerns

### A. Quality adjustment

As mentioned above, engineering services for the most part should remain unchanged over the short-term. Furthermore, the "estimated pricing" method will allow the service delivery process, type of buyer, and contract terms to be held constant in most cases. Exceptions will occur when a service is no longer offered; a service is fundamentally altered due to government regulation; a service delivery process is modified; a service client change (loss of government contracts) or a service contract term(s) change.

When a service is discontinued, an attempt will be made to substitute a similar service and directly compare prices (i.e., one with similar primary inputs and input quantities).

When a service is fundamentally altered or the service delivery process is modified, a direct comparison may not be possible. Therefore, the best option is to identify the changes in primary inputs (i.e., type of labor input, rates, and quantities) for the purpose of accessing whether the new input requirements and their costs enable an explicit quality adjustment.

However, certain technological improvements to inputs such as the introduction of computer aided design may enable the same exact service priced in a prior period to be produced more quickly (requires less labor-hours) in the current period thereby reducing costs that may lead to lower fees. In this case, input requirements have changed but the service provided has not, therefore the price reduction is valid, i.e. an explicit quality adjustment is unnecessary.

### B. New item bias

The outputs of the engineering services industry may evolve due to changes in regulations or new types of services. As services evolve they may exhibit different price trends relative to sampled services, referred to in the PPI as new item bias. To address new item bias, the PPI periodically contacts each reporter to review their sampled services and determine whether new types of services have been introduced. If new services are identified, probability techniques are employed to give these new services a chance of selection.

### C. Impact of customization on the pricing methodology

The custom nature of engineering services has in large part determined the preferred pricing methodology of estimating prices for a fixed set of services. Because the exact same service is rarely duplicated reporters are unable to provide monthly transaction prices for current period output that is comparable to the sampled reference period output.

## X. Survey vehicles

### A. Methods used to secure cooperation and sampled items

Cooperation was obtained through personal visits to sampled engineering service firms by knowledgeable BLS field economists. Field economists then disaggregated the firms output, and from the disaggregation applied probability techniques to sample unique services.

### B. Methods used to reprice

When the field economist completes the initial on-site visit, repricing of sampled services are provided by a designated respondent through a mail survey.

### C. Strategies used to secure and maintain data quality

Secure computer systems keep reporter data confidential and PPI industry analysts maintain quality by reviewing the data. The PPI analyst directly contacts reporters for confirmation and causes of unusual price changes or new service introductions. If a reporter consistently fails to return mail survey forms then the analyst contacts the reporter as a reminder and determines if there is a problem and how it needs to be resolved. The analyst also keeps abreast of industry developments that may affect pricing trends and changes in the types of services provided. .

## XI. Time series data and analysis of published indexes

PPI time series data from 1997-2002 show that prices for engineering services have accelerated relative to more aggregate measures of price change. Chart 1 helps to illustrate the growing relative acceleration of engineering services prices compared to the CPI- U All Items and the PPI for Finished Goods.

The more rapid inflationary rate exhibited by engineering services may be at least partly due to the intensity and specialization of labor inputs. Charts 2 and 3 compare the PPI engineering services price index with the BLS hours and earnings series. While labor rates are not the same as billing rates, it is clear that the primary input to engineering services is labor; therefore it should not be surprising that there appears to be a strong correlation between engineering services prices and labor rates. However, deviations between the two measures are also apparent and should be expected in the future as margins change and other non-labor features of fee structures are negotiated.

**Chart 1- PPI ENGINEERING SERVICES VS. CPI-U VS. PPI - FINISHED GOODS**

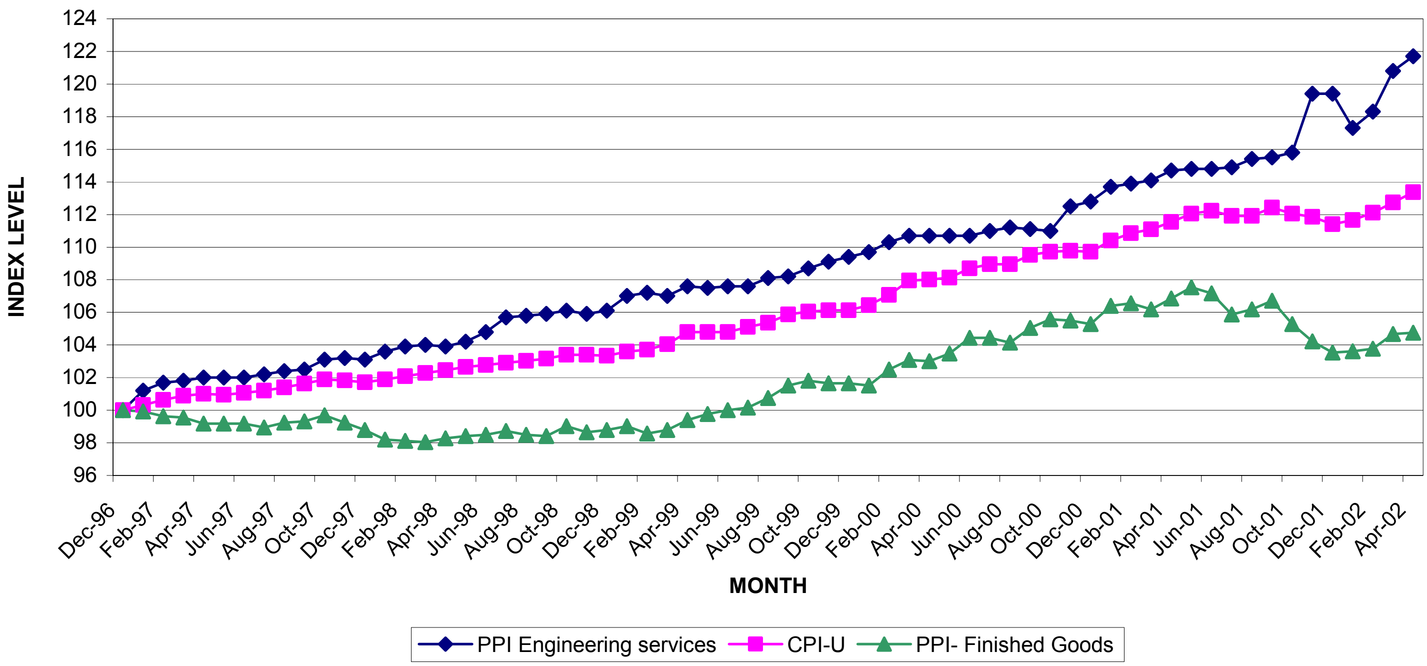


**Chart 2**
**SIC 8711 ENGINEERING SERVICES - AVERAGE WEEKLY EARNINGS VS. PPI**

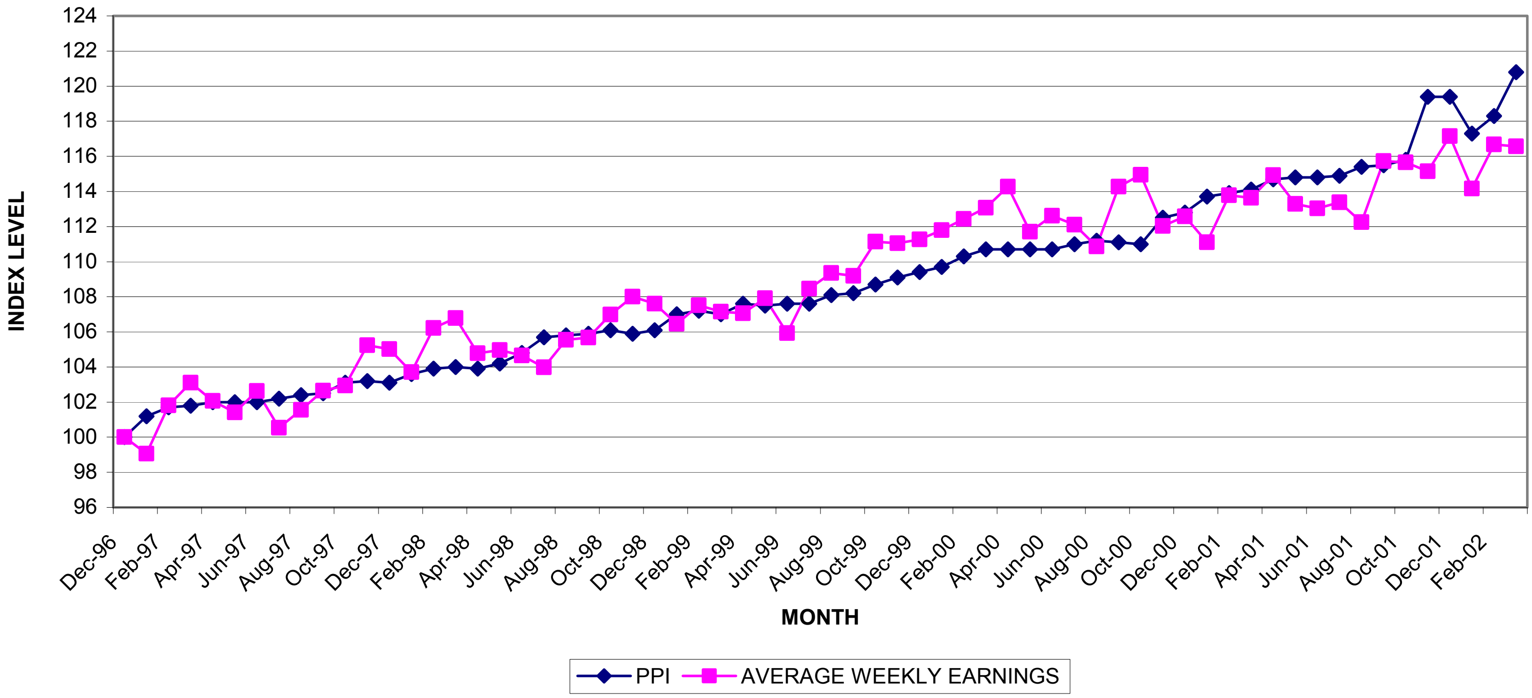
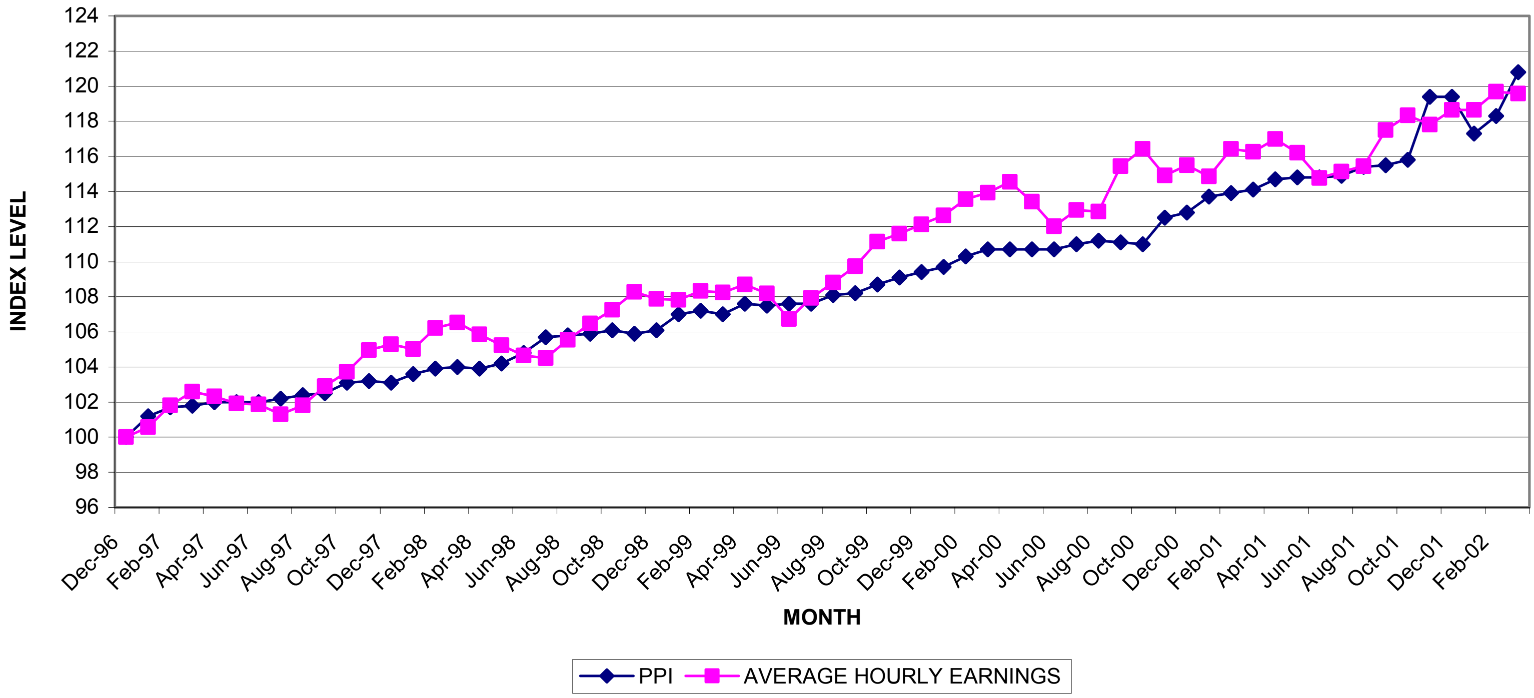


**Chart 3**
**SIC 8711 ENGINEERING SERVICES - AVERAGE HOURLY EARNINGS VS. PPI**



## XII. Evolutionary changes in Engineering Services

The engineering industry has rapidly adopted and continues to introduce new technologies to improve or make more efficient the delivery of services to clients. For example, the Internet enables engineers to bid for projects and sell their services online. The growing capital deepening from more intensive use of computer and software technologies impact engineering services in several ways. Computer and software technology enable more accurate and timely cost estimates, reduce administrative costs, and provide sophisticated tool sets for solving difficult problems. The formulas used for stress tests in computer structural modeling can provide results in hours rather than days and may offer more design flexibility due to rapid solution of multiple "what if" scenarios.

The World Trade Center tragedy on September 11 has also had a large impact on the engineering industry. Currently, building regulations and codes are under review and likely to change for infrastructure security issues including fire control, ingress-egress designs, water supply and electrical safety

## XIII. Conclusion

Engineers' use two different types of fee structures: fixed and non-fixed. The method used varies according to project requirements and firm-client negotiations. Fixed fees are negotiated as percentages of predetermined construction budgets. If a project's scope and cost can be easily defined, a fixed fee contract will supply price security to the client and an incentive for the firm to maximize profits through efficient work. Nonfixed fee structures include: a percentage of construction costs, hourly fees based on either a multiple of actual firm expenses or per unit of categorized labor input, and blended methods that include actual firm costs plus a fixed fee or actual firm costs plus a percentage of construction costs.

There are however limitations in the chosen methodology of estimating prices for a set of fixed services are adjusted for changing market conditions. New item bias may occur when mandated building regulations change or new engineering services are introduced. Reporter burden is also a concern because of the potential difficulty in repricing a fixed project specification over time. However, the chosen pricing methodology is a pragmatic response to the custom nature of industry output and the need to maintain continuous time series that have a comparable pricing basis.

Identifying and valuing quality change is another important consideration. To the extent that output quality changes over time either through new government regulations or other influences, the PPI is dependent on reporters identifying such changes in complex project specifications. The use of a proactive intervention methodology such as directed substitution for new item bias may partially address this issue.

## Example 1

**UNIT OF MEASURE**: ENTIRE CONTRACT

**TYPE OF PRICE**: AVG FEE/MAN-HR

**SPECIFICATION**
NONBUILDING ENGINEERING. FEE STRUCTURE: FIXED. BID CONTRACT. ENGINE HEAD. MACHINE L-5832. SERVICE INCLUDES: PROCESS CHECK, FOUNDATION & STATION LAYOUT, CONTROLS & STANDARDS LINE-UP, MACHINE DETAILS, ALL BASES, PROBE BRACKET, SPINDLES & DRIVES, TRANSFER BAR & LIFT, FEED, HEAD & SPINDLE MOTOR LIST, BUSHING PLATES, PART ID ASSEMBLY, BROKEN TOOL DETECT, IDLE RAIL & RAIL ASSEMBLY, TIE PLATE ASSEMBLY, WORK & IDLE FIXTURES, PART ROTATE, MOVING RAIL ASSEMBLY, CUTTER LOAD ADJUST, CUTTER LOAD ASSIST. QUOTE FOR 4 & 6 CYLINDER PARTS. NO INCLUSION FOR PROTECTION FOR 12 MM PART GROWTH OR ADDITION OF 5 CYLINDER PART. FYI: CONTRACT VALUE: 459,000

MAN-HRS REQUIRED: ABOUT 11,000
ESTIMATED FEE/MAN-HR: 41.67

## Example 2

**UNIT OF MEASURE**: SUB-SAMPLED BILLING INVOICE

**TYPE OF PRICE**: ESTIMATED NET

### <u>SPECIFICATION</u>

NONBUILDING RELATED ENGINEERING. FEE STRUCTURE: NONFIXED HOURLY. METHOD USED TO OBTAIN CONTRACT: QBS. CONTRACT ID: DUMMY BILLING INVOICE. PROJECT TITLE: WASTEWATER TREATMENT PLANT SOLIDS DESIGN. FEE BREAKDOWN (PASS THROUGHS EXCLUDED). NEW (11/96 FORWARD) BILLING RATE APPLIED:

| | | |
|---|---|---|
| DIRECTOR OF ENGINEERING: | 1.00 HRS @ $148.00 PER = | $148.00 |
| PROJ. DIRECTOR/STRUCTURAL: | 87.25 HRS @ 140.00 PER = | 12,215.00 |
| PROJ. DIRECTOR/SANITARY: | 436.00 HRS @ 135.00 PER = | 58,860.00 |
| PROJ. DIRECTOR/SANITARY: | 1.00 HRS @ 130.00 PER = | 130.00 |
| SR. SANITARY ENGINEER: | 21.25 HRS @ 135.94 PER = | 2,888.62 |
| SR. STRUCTURAL ENGINER: | 50.50 HRS @ 127.50 PER = | 6,438.9 |
| SR. CAD DESIGNER: | 36.50 HRS @ 90.00 PER = | 3,285.00 |
| ADMINISTRATOR IV: | 24.75 HRS @ 85.50 PER = | 2,117.61 |
| SR. TECHNICIAN: | 42.50 HRS @ 79.02 PER = | 3,358.31 |
| CAD DESIGNER I: | 58.50 HRS @ 79.36 PER = | 4,642.56 |
| SR. TECHNICIAN II: | 37.00 HRS @ 83.24 PER = | 3,079.70 |
| CIVIL ENGINEER: | 78.00 HRS @ 74.40 PER = | 5,803.20 |
| SR. TECHNICIAN II: | 2.00 HRS @ 61.04 PER = | 122.08 |
| CADD TECHNICIAN III: | 1.75 HRS @ 63.30 PER = | 110.78 |
| SR. WORD PROCESSOR: | 6.25 HRS @ 54.81 PER = | 342.55 |
| SECRETARY II: | 25.00 HRS @ 55.50 PER = | 1,395.00 |
| RECEPTIONIST: | 1.00 HRS @ 44.18 PER = | 44.18 |
| | | |
| TOTAL (ACTUAL TRANSACTION PRICE): | | 104,981.47 |

# Appendix 1

## Engineering Services Prices: Australia

**Carolyn O'Rourke**
**Australian Bureau of Statistics**

**a. Business model**
Australian and New Zealand Standard Industry Classification (ANZSIC) class 7823 includes all businesses mainly engaged in providing consultant engineering and quantity surveying services. Consultant engineering services account for almost all of industry income (99%) with the remaining 1% attributable to quantity surveying services. Due to the negligible contribution of quantity surveying services to the total industry activity, these services are not covered by the price index of consultant engineering services.

In terms of business size, the consultant engineering services industry is dominated by businesses with employment of less than 20 persons (98%). Although these businesses dominate in terms of numbers, firms employing 100 or more persons account for the majority of industry income (50%). The major expense item for these businesses relates to labour costs, with this component accounting for 45% of all expenses.

Within the consultant engineering industry, income can be generated by a variety of distinct services. Consultant engineering services are broken down into the following fields: chemical; civil; building/structural; electrical/electronic; mechanical; mining and geotechnical; industrial/process engineering; and other consultant engineering services. Income attributable to each field was fairly evenly spread with the exception of chemical, which only contributed 2% of industry income.

**b. Overview of government regulation**
The Australian consultant engineering industry is not bound by government regulation. The Australian Consultant Engineering Association produces a publication titled 'Guideline Fee Scales for Consultant Engineering Services'. This publication lists fees to be charged for broad categories of service. The guideline fees do not represent transaction prices. In practice, prices for services are typically determined through negotiation between service providers and buyers of the service. There are a number of approaches to determining fees which are described below. Price movements within the industry are mostly due to market forces. Some firms in specialised fields can charge higher fees due to their market dominance in that field.

**c. Final pricing methodology employed**
There are a number of approaches that firms can apply to determine the fee for service: (1) competitive tendering; (2) time basis; and (3) percentage fee. Competitive tendering is typically applied in relation to projects of a large value whereas time basis is utilised for smaller projects. Generally with competitive tendering, the company evaluates the task at hand and submits a fee proposal that is likely to win the job considering market conditions and the competing firms. In practice, the process requires determining the number of drawings required; estimating the cost of each drawing from past experience and arriving at a reasonable fee which is then expressed as a lump sum. Time basis is another method employed in calculating price. The respective charge out rates are multiplied by the number of hours spent on the project by each corresponding level of staff. The sum of which is the total fee. The Percentage fee is calculated as a percentage of the estimated or actual cost of the work.

A number of pricing methodologies are employed in data collection for this industry. For each firm in the sample, the pricing data and methodology used relates to the firm's most common approach to fee determination. In general, a combination of simple model and time basis approach has been utilised.

**d. Limitations/concerns about published data**
At present, the scope of this index is limited in terms of the types of engineering services priced. Pricing data for this index has been collected in relation to building/structural and civil engineering services only. Given that industry income attributed to particular consultant engineering fields is

relatively evenly spread, the scope of this index is to be increased. In particular, pricing data is required to be collected for electrical/electronic, mechanical, mining and industrial engineering services. In addition, the geographical representation of respondents could also be expanded.

**e. Analysis of "goodness" of your published data.**
At present we have in place a quality assessment service industry review program. The aim of this program is to assess the quality of published service industry producer price indexes. The "goodness" of this particular index will be assessed through this process in order to identify the nature and extent of any weaknesses in the index and, where necessary, make recommendations on those areas where review, maintenance or index redevelopment is required. Considering information in (d) above, the future sample may be extended to cover additional types of engineering services and to better represent all Australian states.

**Consultant Engineering Producer Price Index** (Base of index 1998-99 = 100.0)

| Period | Index number |
|---|---|
| Sep 1998 | 100.5 |
| Dec 1998 | 100.3 |
| Mar 1999 | 98.9 |
| Jun 1999 | 100.3 |
| Sep 1999 | 102.3 |
| Dec 1999 | 102.7 |
| Mar 2000 | 103.1 |
| Jun 2000 | 103.3 |
| Sep 2000 | 103.7 |
| Dec 2000 | 103.9 |
| Mar 2001 | 104.9 |
| Jun 2001 | 105.2 |
| Sep 2001 | 107.3 |
| Dec 2001 | 108.3 |
| Mar 2002 | 109.5 |
| Jun 2002 | 110.0 |

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# Appendix 2

## Engineering Services Prices: Canada

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**BUSINESS MODEL**[2]

"The consulting engineering industry is composed of those firms for which the supply of services represents more than approximately 50% of their turnover."[3] The Financial Times of London considers the engineering sector to be "one of the best bellwethers of the overall performance of industry."[4]

### 1.1 Size of Industry

In 1999, consulting engineers accounted for a 63% share of the $270 billion dollar worldwide market for technology-based design services, worth $237 billion. Total earnings for Canada in this industry amounted to C$9.6 billion (1998). This amount constitutes 0.25% of total revenue in Canada for that year.

### 1.2 Employment

The main activities of firms are construction and building services at 63% of reported man-hours; technology-based design at 16%; management consultancy at 3%; control and inspection at 2% and training at 2% as well.

Worldwide, the industry employs 2.3 to 3.5 million people. In Canada, the industry employs 48,000 in over 8000 establishments. 8000 employees work outside of the country. "Canada ranks fourth in the world in terms of revenues derived from the export of engineering services."[5] Two Canadian firms, SNC-Lavalin and AGRA Industries Ltd. have over 5000 employees each, although most firms typically have less than 25 employees.

### 1.3 Distribution of Firms and the Structure of the Industry

The average Canadian firm earns less than $300,000 per year. Revenues are almost directly proportional to the number of employees, but the turnover per engineer is higher in the smaller Canadian firms at $90,000 compared to $78,000 per engineer in the large companies.

Consulting engineering firms tend to be very large or very small, the resulting gap in mid-sized firms is likely due to post-recession re-structuring and mergers and acquisitions. In addition, the larger firms tend to become larger because they have the

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[2] Clayton Therrien, Prices Division is the author of Business Model

[3] An unique capacity to address the priorities, The consulting engineering industry's sector report for the *World Summit on Sustainable Development 2002*, A review by FIDIC, the International Federation of Consulting Engineers , of the consulting engineering industry's response to the Rio Agenda 21 process, January 2002

[4] Financial Times (on-line), June 17, 2002

[5] Who We Are, Association of Consulting Engineers of Canada, 2001

capacity to enter into Private-Public Partnerships (PPP) or other innovative funding arrangements, where smaller firms can not compete. Gaining experience in large-scale infrastructure projects enhances the ability of the firm to compete for future large-scale projects.

### 1.4 Array of Services Provided

Consulting Engineers in Canada tend to develop infrastructure for the resource-based economy. In 1998, types of projects included: buildings, 13%; highways, 6%; transportation, 9%; municipal services, 10%; environmental services, 5%; mining and metals, 7%; pulp and paper, 3%; oil and gas, 14%; power generation, 8%; other industrial services, 8%; and other engineering projects, 17%.[6]

### 1.5 Government Regulation

Engineers are self-governing with regard to professional standards as provided by provincial statute. Licensing, regulation and discipline within the profession are maintained at this level. National and international organisations are co-ordinators and facilitators; they do not have a direct disciplinary role.

Consulting Engineering work is based on contracts. Therefore, government regulation consists of maintaining the rule of contract. However, engineers must consider every type of applicable law concerning building codes, environmental standards, labour codes, etc. at every stage of a project. Failure to consider all possible scenarios could result in a breach of contract.

## 2. PRICING METHODOLOGY[7]

### 2.1 Model Pricing to Estimated Output Price Approach

The model pricing approach to price measurement involves pretending that a given contract can be repriced through time. Respondents model the behavior that they would normally go through to negotiate the contract price for a project. They provide price estimates repeatedly over time for the same model(s). Price change is measured by comparing these estimated model prices over time.

These model contracts may be generic or specific to the firms which are repricing them. In the case of consulting engineering services, it was recognized that there is too much variation among the types of projects that firms undertake to allow specifications for a

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[6] Statistics Canada survey of engineering and scientific services, 1998.

[7] The overview of the methodology for the consulting engineering presented here is a short and updated summary of an earlier paper written by Jennifer Winters, Prices Division, Statistics Canada entitled *"Survey of Consulting Engineering Service Prices: The Evolution of an Index"*, December 1996.

generic model to be compiled. Instead, individual respondents were asked to select models that they were familiar with. For repricing, respondents were instructed to assume that they were working on the projects outlined in their model contracts for the first time. In this way, productivity improvements associated with repeating a given project would not be reflected in model price changes. In addition, respondents were asked to reprice models taking into account changes in market conditions.

Initial respondents to the price survey of consulting engineering were project managers. Each was asked to provide information on a consulting engineering project that was representative of the type of service usually provided by their firm. Many respondents provided project proposals that outlined the type of work to be completed and an estimate of cost by type of input. Only the fee income portion of this cost estimate by type of service was to be used in repricing consulting engineering services. However, repricing based on proposed project would only provide a measure of the value of the project the firm expected to receive if they won the contract.

As a result, these respondents were recontacted and asked to select one or more recently *completed* contracts which were representative of the type and scale of work that the company expects to continue doing in future. These contracts were chosen to reflect typical clients, field of specialization, size of project and relationship to the client. Respondents were asked to provide a description of the project selected and a breakdown of the revenue and expenses associated with this project by type of service and/or engineering discipline. This information was to be used to allocate fee income by type of consulting engineering service so that elemental indexes could be compiled for each type of service. These detailed project descriptions were to serve as the basis for future repricing.

In repricing these model contracts, we expected to observe changes in fee income from three sources: the number of hours of in-house labour, salaries or wages paid, and the mark-up charged on in-house labour costs. However, the first repricing of these contracts revealed very different results. No changes were observed in the number of hours or mix of people charged to these model projects. In general, the same change in labour rates was observed for all groups providing different types of service for a given project. In addition, there was little change or no change in the mark-ups charged on in-house labour even though economic conditions had clearly worsened.

It was eventually realized that the respondent's apparent repricing was really just an arithmetic adjustment of the original project value using a global adjustment factor. The adjustments, by and large, were in the salary portion of the contract and many were based on average wage rate increases. It was also realized that we were collecting expected instead of realized mark-ups. Firms build into their proposals the mark-up they would like to receive, although they may alter this in order to win contracts. Until a project is actually undertaken and completed, however, the mark-up which a firm would realize is not known. This value can only be guessed at by the respondent when they reprice model contracts over time.

From these observations, it was decided that indexes based on the model pricing approach would not accurately reflect enough of the influences that account for changes in the price of consulting engineering services. More specifically, price variation related to changes in the way services are provided and in the way fees are estimated, as well as to changing economic conditions would not be reflected in model price indexes. In addition, the response rate for this survey was low because the repricing was a time consuming exercise and respondents had little confidence in the model pricing approach. As a consequence of these concerns, the model pricing approach was eventually abandoned.

### 2.2 Estimated Output Price Approach

Instead of trying to measure change in contract prices directly, we approximate the movement in these prices based on a composite of indexes which measure changes in the value of components of service contracts over time. This approach differs from an input index approach in that mark-ups are included as a factor of production and changes in factor productivity is taken into account in estimating the price indexes.

To ensure that the ratio data that we collect reflects all types of contract revenue and that mark-ups on other expenses are taken into account in estimating the consulting engineering price index, we ask for a ratio of revenue to expenses for all types of contracts (reimbursed or not). By defining the ratio in this way, respondents should not systematically exclude the value of lump sum or fixed fee contracts. The second type of data that we ask is the average change in wage rates by geographic market.

The following equation is used to calculate a proxy for labour productivity in the consulting engineering industry:

$$\textbf{Labour Productivity} = \frac{Value\ Added(VA)}{Salaries\ and\ Benefits}$$ [8]

[8] Value Added = Net Operating Profit + Salaries and Benefits + Depreciation (on computer equipment) + Bad Debts + Interest Paid
*Net Operating Profit* = (Total Operating Revenue – Total Operating Expenses)
*Total Operating Revenue* = Fee Income + Reimbursable Expenses + Sub-Consultants Fees + Other Operating Revenue
*Total Operating Expenses* = the sum of all expenses on survey. These are: direct project related salaries and wages, usage charge for communications, reproduction costs, sub-consultant fees paid to engineers, other sub-consultant fees, other reimbursables, project related non-reimbursables, general and administrative salaries and wages, total employee benefits, occupancy costs, lease and rental of computer equipment, depreciation on computer equipment, purchased legal accounting, auditing, management and other services, professional liability insurance, communications, bad debt expense, interest expense, all other general and administrative expenses.
Salaries and Benefits = Direct Project Related Salaries and Wages + General Administrative Salaries and Wages + Total Employee Benefits

Instead of trying to measure change in contract prices directly, the movement in contract prices for consulting engineering services is estimated based on a composite of indexes. These indexes measure changes over time in the major value components of contracts: the cost of labour and mark-ups.

Consultations with consulting engineering firms for model pricing revealed that much of the data we would try to collect under the new pricing approach would be readily available to us.

The composite price index for consulting engineering services comprises the following:

a. *Wage rate index* is intended to measure the average change over time in the wages or salaries paid to in-house labour whose time is charged to projects.

b. *Realised net multiplier index* is intended to measure the average change over time in the realised mark-ups on the labour services and on other inputs charged to contracts.

These indexes are combined in a multiplicative fashion which is intended to reflect the way that firms calculate the fees they charge to clients under time-based contracts. The logic of this formula is illustrated by the example below.

| | | | | |
|---|---|---|---|---|
| ($/day) | **X** | (# days) | **X** | (overhead and profit factor) |
| wage rate index | | hours of labour index | | realised net multiplier index |

**Wage Rate Index**

Data on the average of the annual percentage changes in salaries or wage rates is collected to compile the wage rate portion of the consulting engineering service price index. Respondents are asked to calculate this average based on changes in the wages and salaries of employees whose time is charged to projects for each region in which their firms were active.

**Realized Net Multiplier Index**

The realised net multiplier portion of the consulting engineering price index is intended to reflect the impact on price of market conditions in the consulting engineering service industry. This index is estimated based on ratios of revenue to expenses. These ratios are performance indicators for the industry. Respondents are asked to calculate ratios of revenue to expenses for groups of projects in different fields of specialisation and markets.

As a result, these ratios reflect the average realised mark-up on both labour and non-labour inputs for similar types of projects. The limitation of this approach is that the group of projects used in calculating ratio data varies from year to year. As a result, the change in ratio values captured by the realised net multiplier index may reflect changes in profits and overhead, as well as changes in the mix of projects. The grouping of projects by field of specialisation and market is one attempt to mitigate this problem.

### 2.3 Limitation in the methodology

The creation of price indexes on consulting engineering services faces the same problems as other price indexes. It is difficult to insert new categories of services until respondents are required to supply a new revenue distribution by category of services. How frequently the new sample of services for the same respondent will be updated is a question that cannot be answered at present. It will depend to a large extent on how fast the industry is evolving.

As the data collection process continues from year to year, new services will be added to the selection of categories originally selected

## 3. PUBLICATION

The structure of the publication is as following

### 3.1 Fields of specialisation

Eleven fields are available to the users:

1) Buildings
2) Transportation
3) Municipal
4) Environmental
5) Industrial
    6) Mining
    7) Pulp and Paper
    8) Oil, Petroleum and Natural Gas
    9) Power generation and Transmission
    10) Other Industrial
11) Other Engineering Projects.

### 3.2 Geographical Levels

National: Canada
Regional: Atlantic, Quebec, Ontario, Saskatchewan & Manitoba (Prairies), Alberta, British Columbia and Territories, Foreign.

### 3.3 Price components

1) Total price
2) Wage rate
3) Realised net multiplier

## 4. ANALYSIS OF "GOODNESS" OF PUBLISHED DATA[9]

The index of consulting engineering services has been compiled for over 10 years from 1989 and its trend has been upward since its creation. It is not easy to analyse its "goodness," because of a lack of comparable service statistics in Canada.

However, it is considered that the index is acceptable when compared with Canada's economic trend and other external sources (Department of Industry, associations).

[9] See Appendix I for survey results

## 5. BIBLIOGRAPHY

**Winters, Jennifer,** *Survey of Consulting Engineering Service Prices: The Evolution of an Index,* Internal Paper, Prices Division, Statistics Canada, December 1996

**Lowe, Robin,** *Developing Price Indexes for Consulting Engineers: The Canadian Experience*, Voorburg Group, 1994

**Bordé, François,** *Developing the Consulting Engineering Services Price Index*, Internal Paper, Prices Division, Statistics Canada, 1998

**Canadian Council of Professional Engineers**, Website (www.CCPE.com)

**APPENDIX 2 – Survey Results**

## Engineering Services Per Type of Service, Total Price, Canada

| (1997 = 100) | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Buildings | 86.3 | 90.6 | 94.2 | 94.7 | 96.8 | 99.1 | 98.2 | 99.7 | 100 | 103.2 | 107.5 | 111.9 |
| Transportation | 85.3 | 89.2 | 92.2 | 94.8 | 97.4 | 97.5 | 97.1 | 98 | 100 | 104.4 | 107 | 109.2 |
| Municipal services | 88.8 | 92.2 | 96.2 | 99 | 101 | 101 | 100.5 | 98.6 | 100 | 102.2 | 104.4 | 108.4 |
| Environmental | 83 | 87.8 | 90.7 | 92.6 | 92.2 | 94.4 | 95.6 | 98.4 | 100 | 101.2 | 104.8 | 108.3 |
| Industrial | 83.3 | 87.6 | 90.4 | 94.1 | 94.5 | 94.4 | 97.7 | 98.3 | 100 | 102.8 | 105.8 | 106.1 |
| Mining, metallurgy | 81.6 | 86.9 | 91.6 | 96.1 | 98.2 | 99 | 98 | 99.1 | 100 | 100.8 | 104.4 | 103.3 |
| Pulp and paper | 94.4 | 96.3 | 97.4 | 102.4 | 97 | 95.3 | 98.3 | 98.6 | 100 | 104.9 | 110.3 | 110.1 |
| Oil, petroleum | 78.1 | 82.8 | 85.6 | 88.9 | 90.9 | 90.1 | 95.4 | 96.1 | 100 | 103.3 | 103.4 | 103.1 |
| Power generation | 81 | 88.3 | 90.9 | 97 | 97.4 | 98.2 | 98.7 | 99.7 | 100 | 102 | 104 | 104.3 |
| Other industrial | 86.3 | 87.5 | 90 | 90.6 | 91.7 | 93.2 | 99.7 | 99.9 | 100 | 102.6 | 107.8 | 111.2 |
| Other engineering | 93.2 | 96.3 | 96.8 | 101.2 | 103.3 | 103.7 | 100.9 | 97.6 | 100 | 101.9 | 102.5 | 107.4 |
| ***Total Engineering*** | ***85.9*** | ***89.9*** | ***92.7*** | ***95.6*** | ***96.8*** | ***97.4*** | ***98.2*** | ***98.4*** | ***100*** | ***102.8*** | ***105.6*** | ***107.9*** |

Source: CANSIM Series, table 327-0007

## Total Engineering Services, Total Price, Per Region,

| (1997 = 100) | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Atlantic Region | 83.4 | 86.2 | 89.2 | 92.6 | 92.8 | 94.6 | 97.0 | 98.0 | 100.0 | 100.8 | 102.9 | 103.6 |
| Quebec | 86.6 | 91.4 | 94.7 | 97.6 | 99.6 | 100.1 | 99.0 | 99.0 | 100.0 | 102.5 | 105.9 | 108.1 |
| Ontario | 90.3 | 94.3 | 96.3 | 97.8 | 98.8 | 99.3 | 99.4 | 99.2 | 100.0 | 103.0 | 105.9 | 109.3 |
| Prairies [1] | 89.6 | 93.2 | 95.2 | 99.8 | 101.7 | 97.4 | 99.0 | 98.6 | 100.0 | 103.4 | 106.5 | 108.4 |
| Alberta | 81.8 | 85.2 | 88.2 | 92.6 | 93.0 | 93.6 | 96.0 | 95.8 | 100.0 | 103.7 | 105.6 | 107.7 |
| British Columbia [2] | 80.1 | 84.2 | 87.9 | 91.6 | 93.2 | 95.8 | 97.7 | 99.1 | 100.0 | 102.7 | 105.5 | 107.2 |

1 = provinces of Manitoba and Saskatchewan

2 = includes Northwest Territories, Yukon and Nunavut

## Appendix 3

# Engineering Services Prices: France

**Benoit Buisson**

## I) Business model

In 1999, France's 25,200 engineering firms garnered total revenues of 21.5 billion euros. Engineering and design services account for almost 10% of all service activities in France. Engineering studies cover various fields: industry, building and major infrastructures (highways, tunnels, dams, etc.).

The 150 000 people working in this sector are employed mostly by small firms (90% of the firms employ less than 10 people). The 75 largest companies, with more than 200 employees, generate almost 30% of this sector's activity.

The market is segmented between firms working in other countries and those specialising in the domestic market. Almost 20% of the sector's companies export, and a third of their revenues are generated abroad. The big engineering firms do most of their business abroad. Small and medium businesses cater to specific market niches, with projects involving the environment (impact and noise studies, waste treatment, site decontamination, etc.) offering particular opportunities for development The survey conducted on domestic market price trends does not include firms doing almost all of their business abroad.

Some engineering firms work for only one major client, so that often the notion of market price has no meaning. In fact, some large companies have converted their engineering departments into subsidiaries that work for a single client and are not made to compete with other companies.

Almost one fifth of the activities in this area have to do with the sale of equipment and installations in connection with "turnkey" contracts. In this case, it is very difficult to really isolate the "services of professionals " component from the "equipment sales" component when determining prices. In order to consider only the "services of professionals" component, the price study will not cover turnkey contracts.

The missions of engineering firms may be limited to simple technical recommendations, but may also extend to the complete supply of installations, including start-up. Within the engineering profession, there are three types of works : design (preliminary studies, basic design, preliminary project design and detailed project design), works management, coordination and execution (drafting of calls for tenders , acceptance of works, handling of turnkey contracts), and supplementary service (search for financing, training, and assistance in operation). Engineering companies can also provide clients with highly qualified personnel even when these companies are not assuming prime contracting responsibility.

## II) Government regulation

Public contracting, i.e. concerning in particular design and engineering contracts awarded by government agencies, is governed by the law of 12 July 1985.

This law stipulates that the remuneration associated with a contracting must take into account three parameters: the scope of the mission, its degree of complexity and the projected cost of the works. The general approach is to determine the complexity of the project in relation to an operation of average complexity. To accomplish this, what is proposed is the determination of a coefficient within an indicative range per type of structure.

The general process by which prices are determined is then the following:
- Discussion on elements of project complexity
- Determination of complexity coefficient
- Determination of reference rate for a basic mission. This rate is expressed in percentage of the amount of the works exclusive of tax. Scales (for building sector and infrastructure projects) are published to determine this rate. Multiplication by the complexity coefficient yields a remuneration rate for the entire mission.
- The price of the rendered service is obtained by applying this remuneration rate to the cost of the works.

The method was also used as a reference by the engineering sector's trade association. It is thus applicable

| Type of contract | Remuneration method | Comments |
|---|---|---|
| pricing per hour or controlled expenditures | Services are remunerated on an hourly basis: an hourly rate is negotiated when the contract is signed. | Often used for preliminary studies (when the project has not yet been completely defined) |
| "Cost plus fee" or "cost plus" | Payment is based on real cost plus an added fee. | This type of contract offers the client some monitoring leeway. |
| Lump sum<br>or "Fixed Fee" | All categories of expenditures are grouped to obtain a fixed sum when the contact is signed.<br>Lump sum for services (the sum covers only the design services).<br>Lump sum for services plus equipment, and possibly also construction (the sum includes design, works and purchase of equipment). Example: a turnkey contract is a lump sum agreement covering service, plus equipment plus construction. | Type of contact prevalent in Europe.<br>The client is sure of how much is being spent, but has very limited leeway on the monitoring of work execution and workmanship).<br>The margin of the engineering firm depends to a great extent on the cost estimates. The lump sum must include risk remuneration |
| Percentage | The engineering firm is remunerated on a pro-rated basis in relation to the purchases made and the work. Contractors are paid directly by the client. | Used very seldom |

*Source: Syntec Ingénierie*

to private contracts. It should be noted that the described system is based on free negotiation. It simply provides a price determination framework for the client and the engineering firm. Project complexity and the complexity coefficient are in particular open to discussion by the two parties.

## III) Pricing methodology

There are four price determination methods in the engineering field: hourly charge out rates (pricing per hour), cost plus fee, lump sum and percentage. The following table summarises the principle of these different price determination methods

Different price analysis methods were considered. Initially, it had been decided – whenever possible – to examine lump sums related to precise contracts. This approach was not found to be very effective owing to the extent of one-time services, with few recurrent contracts. Even when engineering firms thought it would be possible to apply the same procedure for services of this type, it was found in practice that prices fluctuated greatly as time passed. This reflected the fact that the nature of the work changed considerably even if the client was the same. Thought was also given to the possibility of examining contracts with the same complexity coefficient (see "Government regulation" above). In practice, this turned out to be very difficult. For the same complexity coefficient, the nature of the works could be different. The negotiation may cover the complexity coefficient, which of course influences the price. At the present time, lump sum contracts represent only 4% of all the services analysed.

Price trend analysis covers mostly the analysis of fees (84 %) - by type of qualification – charged by the engineering firm to its client. In most cases, we analyse hourly prices or daily prices by type of qualification. This corresponds closely to pricing per hour, with most of the services having to do with intellectual services (turnkey contracts have already been considered separately). For the calculation of weighting, the usual method was applied:
- Initially, the domestic market revenues (excluding purchase-sale and inter-branch subcontracting) of the surveyed company for the basic period are determined
- These revenues are broken down according to the collection nomenclature (see "Analysis of validity of published data")
All fees by qualification, within the company and within each sub-branch of the activity, are weighted according to the weight of this qualification in the firm (personnel x hourly rate).

For a small number of companies, it was decided to analyse the ratio of revenue to productive labour. However, this ratio is analysed generally. There is thus a structural effect related in particular to changing qualifications within the company. This analysis method applies to some large companies and represents 12% of the services analysed.

## IV) Limitations / concerns with published data.

The main difficulty in the analysis of fees by type of qualification lies in the tracking of list prices rather than transaction prices. Discussions with professionals have however shown that hourly rates by qualification (list prices) for a given period took into account the hourly rates negotiated during the previous period. In fact, the analysis method appears to be valid from the long-term viewpoint (trend analysis) but less so from a short-term viewpoint. It would thus not be valid to try to detect economic turnarounds based on the price analysis of engineering services. However, the management methods used in this sector, unlike the accounting methods, do not make it possible to do better.

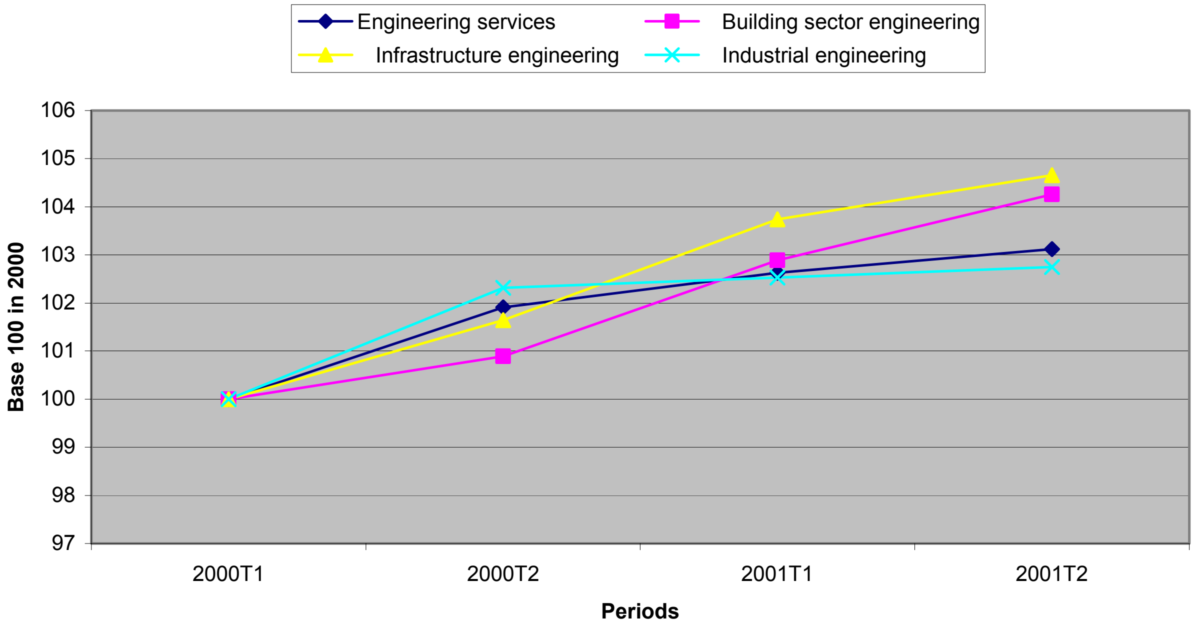
Moreover, the method appears to be better suited to engineering and design intended for the industrial sector rather than the building sector. In fact, there is probably less force account invoicing for building sector design and engineering. Similarly, the law relative to public contracting is applied especially in the building area, where there are fewer but larger projects.

## V) Analysis of validity of published data

Price trend surveys for the engineering industry are carried out semi-annually. The survey covers 150 firms. As concerns breakdown by activity, the design and engineering services intended for the industrial sector represent 68% of activity, those for the building sector 16 %, those for infrastructures 12 %, and the other services 4%. The response rates for each semi-annual survey are around 80%.

For the basic period of the first half of 2000, we currently do not have enough elements to complete an in-depth analysis. The following chart summarises the value of the indices over the June 2000-December 2001 period.

ENGINEERING SERVICES




Price increases turn out to be particularly moderate (1.8 % annual average) over the survey period. The years 2000 and 2001 offered good economic conditions for the entire engineering sector. In addition, many firms changed over to the 35-hour workweek during this period, and this is reflected in the smaller number of days that could be invoiced throughout for the year. This reduction could have been offset by a rise in prices. In fact, it is likely that the margins of engineering firms fell during the period. This point remains to be confirmed.

# Appendix 4

## Engineering Services Prices: Netherlands

**Aurél Kenessey**
**Statistics Netherlands**

**Introduction**

Statistics Netherlands started a pilot survey to study the feasibility of different pricing methods. After discussions with the industry organization, we conducted qualitative field research from which we acquired a lot of knowledge about the industry, the market and how prices come about. The firms were asked to try several pricing methods (described below) simultaneously. At this moment, we are evaluating their response. After this, we plan to choose the methodology that will be used for the larger scale survey.

**Business Model**

Engineering and architectural firms (NACE 7420) realized a turnover of 6.8 billion Euro's in 1999. Export accounted for nearly a fifth of this total and the top twenty firms realized a third of this total. Nearly 4000 companies with two or more paid employees were registered as belonging to NACE 7420 in 2001.

The industry is hard to classify. The main trade organization uses a classification of type of work in the following breakdown: Construction and Building, Planology, Traffic and Transport, Waterworks and Infrastructure, Technical Installations and Telematics, Acoustics and Physics of Civil Engineering, Environment, and Organization and Economics. However, companies usually organize themselves differently. On top of that, companies have regular reorganizations in which disciplines are redefined. A generally accepted classification is impossible because of this. The turn-over statistics of Statistics Netherlands (which will provide weights) have still another breakdown.

**How do prices come about in the market?**

The basis for determining output prices is the costs-side (input). In December, a company estimates next year's income and billable hours, resulting in a minimum average hourly fee per grade of worker. This minimum for covering costs lies at the basis of the two most common methods for charging clients: lump sums and charging directly on a per hour basis.

- Lump sums
  The following steps occur before a lump sum contract is concluded. (1) based on the description of the project, the engineering firm estimates how many hours of which grade of workers will be needed. (2) These hours are multiplied by the list prices (of hourly rates), this results in the **"standard price".** (3) Depending on market situation, work portfolio etc., the firm can higher or lower this price, arriving at the **"offered price"**. Only this price is communicated to the prospective client. (4) Clients can often negotiate about this price, therefore the **"final price"** can be different from the offered price. This standard market practice can be blurred by a change in the description of the work during any of the steps above and often after the project has started. For example, the client can decide to skip part of the assignment to lower the price.
- Per hour basis
  Charges on a per hour basis occur especially when it is hard to predict the amount of work that has to be done. Some companies keep their hourly prices strictly in accordance with the yearly updated price list; others offer and negotiate different prices.

With lump sum contracts, the engineering firm takes the risk for more work than planned, while charging per hour places the risk on the client's side. Consequently, lump sum contracts tend to have higher prices than contracts on a per hour basis.

Other ways exist for prices to come about, e.g. a fixed percentage of the client's total investment in a real estate project. This applies to a negligible share of the market.

**Government Regulation**

There is little government regulation effecting prices or price development.

Different levels of government are often clients of engineering firms themselves. There seems to be an unwritten rule that the lowest bidder gets the lump sum contract; quality or reference projects of a bidding firm are not or hardly taken into account by the government.

## Pricing Methodology

### Model prices

Ideally, real market transactions of similar services take place periodically. This happens too little in the engineering industry and is therefore disregarded. A periodical repeat of exactly the same services can be approached by fictitious model prices. It is operationalized in the Netherlands as a recalculation of a project that the respondent carried out in the past. The respondent can choose one or more representative projects as models. This leads to an understandable bias towards small projects. If respondents calculate a new "standard price" (see also section A), the survey turns into one of hourly charge-out rates, but with an undue emphasis on the rates of those workers who are overrepresented in the chosen model project. In this case, it is preferable to measure charge-out rates directly, with right weights.

### Standard charge-out rates

It is easy to survey the list prices with hourly charge-out rates. These lists tend to be updated only by every January 1. These prices are "hard" data and as most engineering firms have quite stable financial planning (and realization of plans, including the per capita profit margins), the resulting price index is potentially plausible and sturdy.

### Realized hourly rates; fee per period

This method measures prices from services that consist only of deployment of professionals to a client. The income generated in the period under consideration is divided by the number of hours worked in this period. This leads to a realized hourly price. It is important to ascertain the relation between the worked hours and the income, e.g. to keep income from third party contracting or sales of goods out of the calculation.
The more homogenous the service (i.e. type of worker) the better the price observations and resulting price index. Therefore, the figures are preferably broken down to grade of worker or discipline, or individual long-term projects are monitored. This method resembles a detailed volume-method in which the hours worked are the quantity indicators. Another way of looking at this method is as a unit value method in which the units are hours worked directly for a client.

### Realized hourly rates; realization of hourly rates in lump sum contacts - Best of two worlds?

This method combines the advantages of measuring the list prices of standard hourly rates (firmness) and lump sums of new contracts (real transactions). After every quarter, respondents are asked to choose a representative set of projects of which the lump sum contract was concluded in the quarter under consideration. For each of these contracts, both the "standard price" (necessary hours multiplied by the standard hourly rates) and the real, "final price" (see also section A) are surveyed. The ratio of these is the *realization rate of the list prices*.
For constructing the price index, the foundation is the list of standard charge-out rates that changes only yearly (see above). On this backbone of hourly rates the quarterly realization rate is applied to arrive at an up-to-date price level. Once a year the basic hourly rates are updated.

## Limitations/Concerns with results

### Quality change when hours are the basic transaction unit.

The "economic value" that is created in the average hour for the client might change gradually. Improvements in the value for the client probably take place, e.g. more, better and more versatile drawings can be made per average hour thanks to new hard- and software. This gradual increase is a drawback of any method based on hourly rates, because the quality of the basic transacted unit - the worked hour - increases. This prompted Statistics Netherlands to survey these gradual changes separately. Although the industry finds the topic and the questions very interesting, the results are discouraging. The gradual change is very

hard to quantify. More important than the gradual change of "economic value" of a professional's hour is a qualitative change in the type and character of work demanded by the client. It is easy for engineers to be flexible to client demands, but this blurs any comparisons of hours worked in the present period with earlier periods.
From the conceptual side, the following position could be taken. If the quality adjustment for the hours worked (as units that are transacted) are based on an analogy of the "option costs" method from the manufacturing PPI, respondents would consider any price change of (realized) hourly fees as a pure price change. This favors pure hourly fees as an appropriate basis for an output PPI.

**Model prices**
As discussed above, a model gets quickly outdated as the nature of work changes continually. It is possible for respondents to deliver a model price estimate, but if they have to take last year's project in mind, they realize that this assignment would never occur in the current market; it would lead to a different project approach of the engineering firm and, worse, it would have other client specifications and expectations resulting in a different final product.
Ideally, respondents would estimate a "final price" or, less ideal, an "offered price" (see also section A), but this makes the survey very subjective, turning the survey into one of market sentiments.
Many respondents enter hourly rates from a new price list in previous calculations, resulting in a new "standard price". They might take a limited productivity increase into consideration (i.e. lowering the necessary hours) mainly because they are prompted by Statistics Netherlands to do this. In other words, there is a trade-off between using hard objective data on hourly fees and subjective data that suit a PPI better, at least in theory.
A respondent told that when different workers within his own company are asked to bid on the same project, quite different prices result since every project leader perceives a project differently. Consequently, many respondents consider repricing an old project too subjective.

**Analysis of "goodness" of published data**

The project is in too early a stage to report on the plausibility of results.

## Appendix 5

# Engineering Services Prices: New Zealand

**Piyasena Liyanage**
**Statistics New Zealand**

## INTRODUCTION

This paper mainly outlines the methodology of the engineering services index and its concerns within the New Zealand Producers Price Indexes (PPI) - outputs and inputs. The purpose of this paper is to examine the engineering services industry and to find out its relationships with the other PPIs.

## BACKGROUND OF THE INDUSTRY

Before the June 1998 quarter, the format of the PPI was based on the New Zealand Standard Classification (NZSIC). But, from the June 1998 quarter, the PPI was produced according to the Australian and New Zealand Standard Industrial Classification (ANZSIC 1996). However, ANZSIC is consistent with National Accounts (1996) industry groups.
The following shows the engineering services index within ANZSIC 1996.
Division L: Property and business services
Sub-division: L78 (Industry L04) Business services
Group: L782 (Industry L041) Technical services
Class: L7823 Consultant engineering services
Sub-class: L782300 Consultant engineering services

## IDENTIFICATION OF THE INDUSTRY

The index for engineering services is a representative commodity, which means a good or service chosen to represent a regimen set (one or more goods and services). The identical item is priced from period to period to provide a price relative for that regimen set.
This representative commodity index is feeding to 73 outputs and inputs (PPI) indexes as follows.

- 1 - representative commodity (Basic metals services index-weight 2,575 of 10,000)
- 1 - outputs index (feeding to National Accounts Working Industry level with a weight of 3,343)
- 9 - outputs indexes (bearing small weights)
- 62 - inputs indexes (for different intermediate consumption with small weights)

However, one continuous output linkage can be identified **(**Engineering services → Scientific research and technical services → Business services → All industries). For more details, see the chart & the table in appendices A and B respectively.

#### SCALE OF THE INDUSTRY

The engineering services industry, the scientific research services industry, the architectural services industry and the other technical services industry fall under the scientific research and technical services industry.

The main industry group for these indexes is the property and business services index. According to the Annual Enterprise Survey (AES), the total gross output of all industries was $202,747 million in the year 2000. The property and business services industry group and the engineering industry contributed 12.9 percent and 0.7 percent respectively to the all industry group.

In view of definition changes within industries during the implementation of the 1993 System of National Accounts and a change in the methodology for the selection of samples within AES, it is not possible to directly compare the output of the industry for 1994 and 2000.

The following table shows the distribution of weights within the main industry group based on AES 1994.

| Outputs industry | Percentage * | |
|---|---|---|
| **Research and Technical Services** | **18.4** | - |
| Engineering Services | - | 7.6 |
| Scientific Research Services | - | 5.0 |
| Architectural Services | - | 4.2 |
| Other Technical Services | - | 1.6 |
| **Computer Services** | **10.9** | - |
| **Legal and Accounting Services** | **21.8** | - |
| **Other Business Services** | **46.1** | - |
| **Other Outputs** | **2.8** | - |
| **Total** | **100** | **18.4** |

* Based on the Annual Enterprise Survey (AES) in 1994.

#### PRICING METHODOLOGY

The current methodology is to represent the price of the output of engineering services with charge-out rates which are collected from a number of individual respondents and then entered into an internal questionnaire where a calculation takes place to effectively "model" a number of standard jobs.

There are three items which are effectively priced for engineering services within the PPI:

- **Maximum hourly charge-out rate for principals**- this maximum price is used for representing general engineering work charged for on an hourly basis. When Statistics New Zealand (SNZ) redeveloped the index in 1998, an estimate from a representative of the Institute of Professional Engineers New

Zealand (IPENZ) was that approximately 40 percent of general engineering work would be charged for in this manner.

- **Fees for general engineering work (by value) -** this is calculated by applying a standard scale of fees (supplied by the above institute -IPENZ) to a value of general engineering work. The value of general engineering work is being adjusted by the Site works Index, that is part of the Capital Goods Price Index (CGPI), on a quarterly basis. This item has half of the remaining weight (30 percent).

- **Fees for industrial building (by value) -** this is also calculated in a similar manner to the above, using two asset types (shops & offices; and warehouses & factories) of the CGPI published indexes on a quarterly basis. This item receives 30 percent of the weight.

The weighting together of these items has been done on the basis of reasonable estimates. The weighting process is an arithmetic procedure that reflects the value of expenditure or income for item(s) as index weights. These weights relate to a common numeric base such as 100,1000, 10,000 and so on. Statistics New Zealand sums the PPI weights to 10,000 for calculation purposes and expresses them as percentages for publication of index regimens. The weights are calculated according to the relative importance of the goods and services within the industry.

The current New Zealand Producers Price Indexes were constructed according to the building block structure in 1998. The prices for the representative commodity index (engineering services) are collected quarterly in different ways:

1. Professional **engineering fees** - suggested maximum hourly charge-out rate (weight 2,000)

2. Engineering **draughting fees** - charge-out rate per hour (weight 2,000).

3. Professional engineering fees - for an **industrial building** - calculated from suggested range of fees (weight 3,000).

4. Professional engineering fees - for **general engineering work** - calculated from suggested range of fees (weight 3,000).

Prices for items 1 and 2 are collected on the Labour Cost Survey questionnaire, used primarily to calculate the Labour Cost Index. The other two (3&4) items' prices come from "model prices" (spreadsheet) which were explained earlier in this chapter.

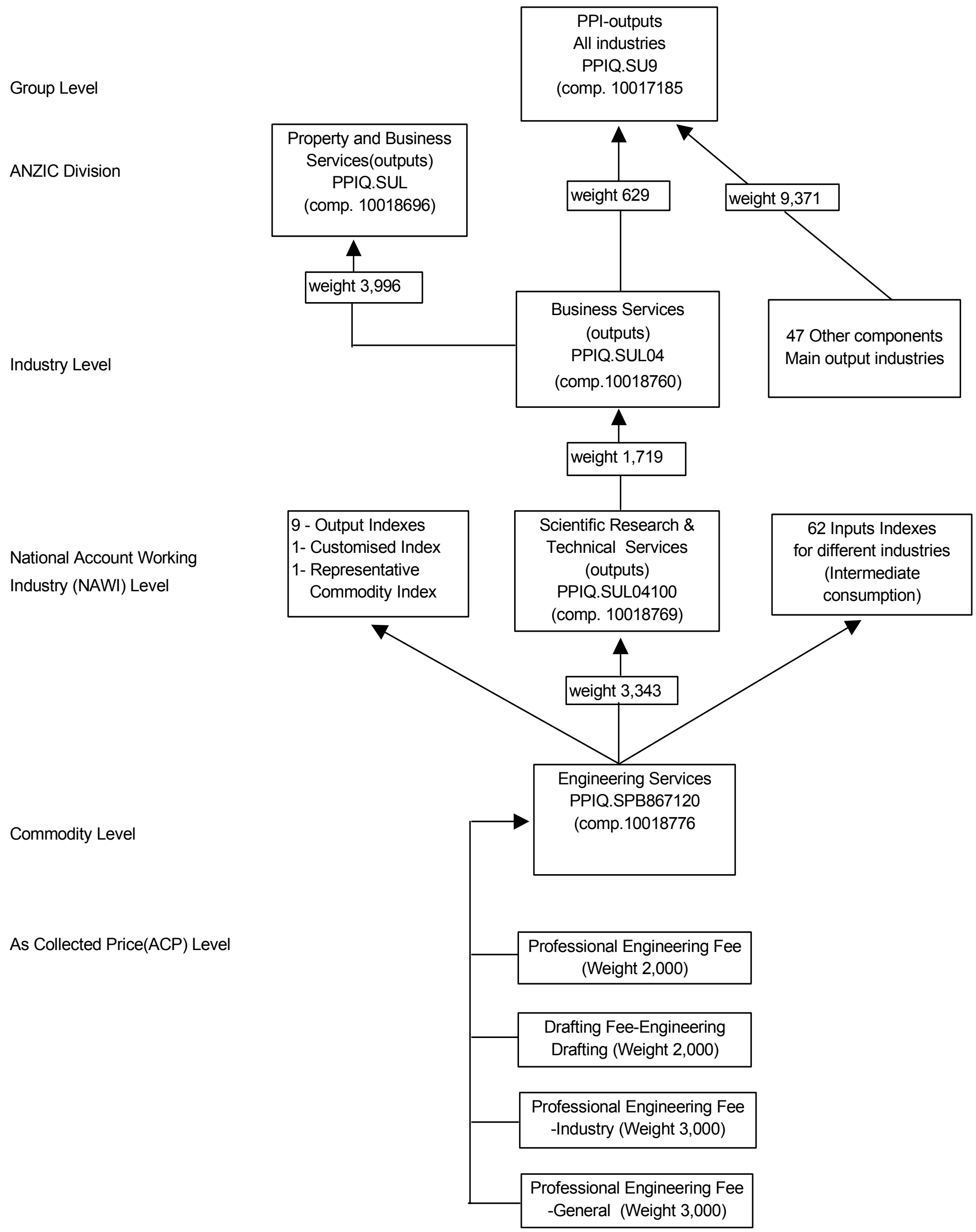
There is not a big difference between what we want to price and what we price today. But, there are some other pricing areas that we do not cover currently in the industry, such as a percentage charge for the ranges of value of estimates.

(eg. 5% fee for a $50,000 contract, 4.5% from $50,000 to $100,000 and lump sum for entire contract up to $50,000 or $100,000).

#### CONCLUSION

In summary, this paper has explained the methodology of the index for engineering services and examined the characteristics of the index. Though there are some limitations like sample size and use of charge – out rates as proxies for prices of engineering services, this index is capable to show the general price movements in the industry of engineering services.

**Flowchart of Engineering Services in PPI-outputs**

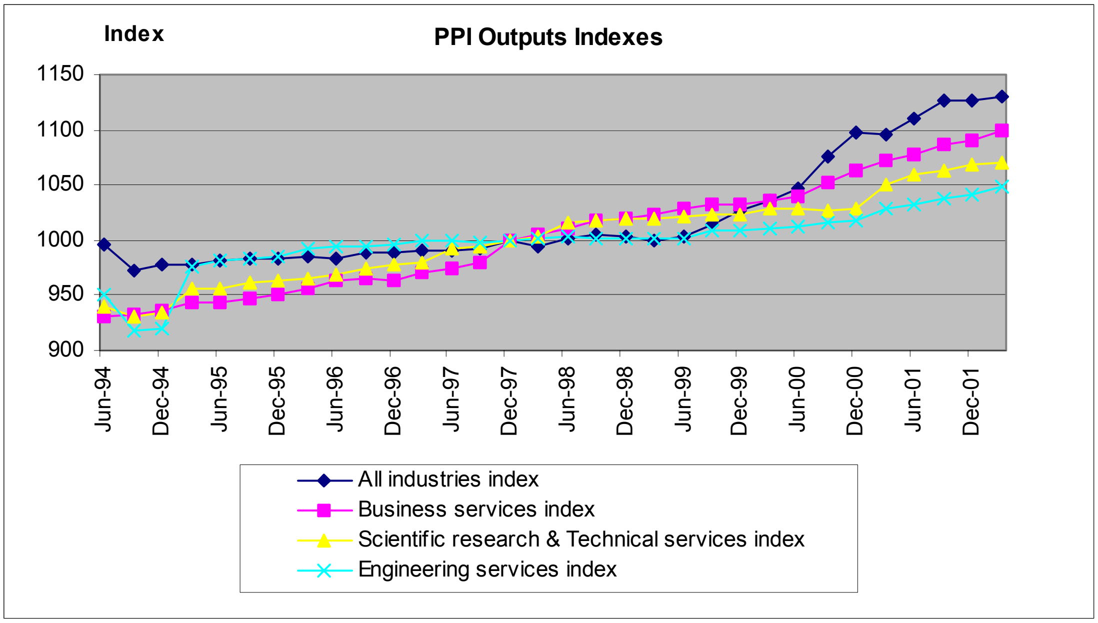


## Appendix-B

**Producers Price Indexes**

Outputs - Division (ANZSIC) - Base December 1997

| Quarter | All Industries Index | Business Services Index | Scientific research & Technical services Index | Engineering services Index |
|---|---|---|---|---|
| | PPIQ.SU9 | PPIQ.SUL04 | PPIQ.SUL04100 | PPIQ.SPB867120 |
| Jun-94 | 996 | 931 | 940 | 951 |
| Sep-94 | 972 | 933 | 931 | 919 |
| Dec-94 | 977 | 937 | 935 | 920 |
| Mar-95 | 977 | 943 | 957 | 976 |
| Jun-95 | 981 | 943 | 957 | 982 |
| Sep-95 | 984 | 947 | 962 | 984 |
| Dec-95 | 983 | 950 | 964 | 986 |
| Mar-96 | 985 | 956 | 966 | 992 |
| Jun-96 | 984 | 963 | 968 | 994 |
| Sep-96 | 988 | 965 | 975 | 995 |
| Dec-96 | 989 | 964 | 978 | 996 |
| Mar-97 | 991 | 970 | 979 | 999 |
| Jun-97 | 990 | 974 | 992 | 999 |
| Sep-97 | 993 | 980 | 995 | 997 |
| Dec-97 | 1000 | 1000 | 1000 | 1000 |
| Mar-98 | 995 | 1005 | 1004 | 1001 |
| Jun-98 | 1002 | 1010 | 1016 | 1003 |
| Sep-98 | 1005 | 1018 | 1017 | 1002 |
| Dec-98 | 1004 | 1019 | 1019 | 1002 |
| Mar-99 | 999 | 1024 | 1019 | 1002 |
| Jun-99 | 1004 | 1028 | 1022 | 1002 |
| Sep-99 | 1014 | 1032 | 1024 | 1008 |
| Dec-99 | 1026 | 1032 | 1024 | 1009 |
| Mar-00 | 1035 | 1036 | 1028 | 1010 |
| Jun-00 | 1046 | 1040 | 1028 | 1013 |
| Sep-00 | 1075 | 1053 | 1026 | 1016 |
| Dec-00 | 1097 | 1063 | 1028 | 1017 |
| Mar-01 | 1096 | 1072 | 1051 | 1029 |
| Jun-01 | 1110 | 1078 | 1060 | 1033 |
| Sep-01 | 1126 | 1086 | 1063 | 1038 |
| Dec-01 | 1126 | 1090 | 1068 | 1042 |
| Mar-02 | 1130 | 1100 | 1071 | 1048 |


Index
PPI Outputs Indexes
1150
1100
1050
1000
950
900
Jun-94
Dec-94
Jun-95
Dec-95
Jun-96
Dec-96
Jun-97
Dec-97
Jun-98
Dec-98
Jun-99
Dec-99
Jun-00
Dec-00
Jun-01
Dec-01
All industries index
Business services index
Scientific research & Technical services index
Engineering services index

# Appendix 6

## Engineering Services Prices: Sweden

**Martin Bylin**
**Martin Ribe**
**Statistics Sweden**

## Introduction

Since January 2000, the Department of Economic Statistics at Statistics Sweden has been conducting a project with the purpose of developing price indices for the service industries in concordance with the European Union's recommendations. These indices will be used within the National Accounts to calculate the production value of services, in constant prices. The service price indices will also serve as a foundation for calculating price controls, and for business cycle analyses. The purpose of this paper is to briefly describe the development of a producer price index for engineering services and the methodological difficulties encountered.

## The Swedish engineering services industry

Engineering services in Sweden include consulting work within heating and air conditioning, energy, electricity, industrial engineering, project management, construction and installation (site engineering), and even meteorological services and geodetic studies. Many large groups of companies have one or more subsidiaries that often offer all of these services.

Total net sales in the engineering services industry in Sweden were SEK 50 250 billion in 2000, according to Sweden's Business statistics. There were 20 200 enterprises within the industry, which together employed 46 546 people. Most of these enterprises (98.5%) have fewer than 20 employees. In terms of sales, the 10 largest enterprises are accounted for 18 per cent of total net sales, while the 100 largest enterprises are accounted for 42 per cent of total net sales[10].

## The market and price setting for engineering services

During the development process, the project has had contact with and visited several of the larger enterprises in engineering services, as well as the industry association, the Swedish Federation of Consulting Engineers and Architects. These contacts have provided useful information as a foundation for future work.

The market for engineering services is extensive and varied. It includes electrical installation, heating and air conditioning, inspection, and industrial engineering for different industries. In connection with these services there are also elements that are not exactly consulting services, such as education and software production. The latter activities will not be addressed here, since they can be considered to belong to other industries.

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[10] For further information see Bylin M. & Ribe M. (2001) Service price index for architectural, engineering and related technical consultancy services SE-SIC 92 group 74.2, TPI project report no.3

Engineering services have in the last few years changed and become more rationalized as a result of technological developments, for example the increasingly more effective computer accessories. Technological developments can be expected to continue to rationalize the work, through even better computer-aided design (CAD) programs and other developments. The workload can often go in waves; large projects can be difficult to organise such that the volume of work is constant over time. In addition, there are fluctuations in the economy and in demand. General oversupply or undersupply in the market also impacts the prices of the services.

Charging by the hour seems to be a dominant form of price setting in this industry, usually with periodic invoices even if some modifications occur. This information comes from the contacts the project has had with the industry. Previously, there were often fixed offers with a set total amount for the entire project, but now it seems that this is something that the industry have relinquished.

Hourly rates normally vary based on different personnel categories, not by the type of work. Personnel categories that are used include project manager, person responsible for a project, or person responsible for an assignment. Each category can have one or several rates within it. The categories can vary somewhat across different enterprises, and the meaning can even vary within a group of companies with uniform names. The category “project manager” and “person responsible for a project” can be different for different projects, since the projects can be of completely different orders of magnitude. In addition, an individual consultant’s personal qualifications and reputation can influence the rate charged.

Electrical installation, heating and air conditioning, and the like are considered to be fairly tangible areas for measuring prices. They involve relatively homogeneous types of services, and it should thus be possible to track hourly rates for different personnel categories.

It is also be fairly easy to measure prices in the area of examination and inspection. Here it is possible to follow prices for certain specified services (”model pricing”), instead of hourly charges.

It is more difficult to determine prices for industrial engineering services. Projects in this area can be very large with different phases that have different requirements in terms of consulting contributions. The qualifications of the consultants can also be important. There is the risk that hourly rates even within personnel categories are not completely comparable over time, due to changes in the content of the services. Furthermore, enterprises may be paid for the customer value or benefit from the services, in addition to the actual hourly charges. The price can sometimes vary with the extent to which the finished product’s performance turns out to exceed the specified minimum requirements.

**Definition of engineering services**

Engineering services are defined as engineering consulting work specified by an hourly volume, activity area and category of personnel. These types of services occur in different areas.

**Quality from a customer perspective**

If there are ”famous experts” among the leading consultants at an engineering consulting enterprise, this seems to be considered a form of guarantee that the enterprise has high quality services. This can result in higher hourly rates for the entire enterprise. At a more basic level, the education of the engineers is also a form of guarantee of a certain basic level of quality. The above-mentioned quality aspects should be relatively constant over time and therefore not very problematic for calculating indices. It is true for some of the engineering services, such as electrical installation, heating and air conditioning, and inspection. A different situation can arise concerning industrial engineering services. The customers' quality requirements may vary more over time depending on the nature of the current services. ”Famous experts” can also be important here as a quality guarantee.
It is also true that the quality of the planning of an industrial plant can partly be measurable afterwards, when one sees the resulting performance. For example, one can determine the amount of remaining pollutants in purified fumes in order to measure the quality of a flue-gas cleaning plant.

**Sample**

The sample is taken as a sequential PPS sample with the sample probability proportional to the number of employees plus one. Sweden's Business register are used as a sampling frame. The rationale for this is that the number of employees is a more stable variable than total sales, which is missing for a number of enterprises and is often out-of-date. The correlation between the number of employees and total sales is relatively high, which indicates that the number of employees is a reasonable proxy for total sales. The approximation is better for larger enterprises than for smaller enterprises.

**Data collection**

Data will be collected quarterly using form or electronic forms. Average hourly rate charged during the relevant quarter, for an optional personnel category in each area, will be collected for each of five fields of operations. The five areas are project management, industrial engineering, electrical engineering, heating and air conditioning/energy, and construction and installation. For weighting purposes, it is advantageous to also collect data on the number of hours invoiced for each personnel category. At the moment there is a trial survey in progress where a number of voluntary enterprises within the field of engineering services participate. These have been given a questionnaire (appendix 1) and up to the present half of the enterprises have been able to answer the questions, which may be seen as promising for our project in the future.

**Quality adjustments**

Actual performance per engineering consultant hour may increase due to technological developments. In order to get prices that reflect constant service performance, one could hypothetically need to adjust quality for any possible performance increases. This is however hardly possible and potentially also not desirable, and therefore is not done. This is judged to be true for certain of the engineering services, such as consultancy on electrical installation, heating and air conditioning, and inspection.

Quality adjustments could be more necessary in the case of industrial engineering, since the content of the services may well vary more over time. Even here, however, quality adjustments are hardly practical. If some form of charging for customer benefit occurs in addition to charging for hours worked, this can in a way reduce the need for quality adjustment of hourly invoicing, since it partly takes care of a factor that reduces comparability.

**Future plans**

The goal during 2002 is to complete the production of an index for engineering services together with an index for architectural services. These fields of activity are similar to each other for instance in their basing hourly rates on different personnel categories.