

Construction Input Cost Indices: Methodology [November 2014]

Executive Summary

This document describes the production and use of input cost indices for construction, a separate report addresses construction output price indices. Official construction cost indices have been published since the 1960s, originally by the Ministry of Public Building and Works and subsequently by the Department of the Environment and the Property Services Agency and successor government departments and agencies. In recent years, indices have been produced by the Building Cost Information Service (BCIS) of the Royal Institution of Chartered Surveyors and Carillion, a major contracting company, and published by the Department for Business, Innovation and Skills. In 2013, the contract for production of the construction cost and price indices was awarded to AECOM, a construction consultancy firm, and part of that contract was to investigate and, if appropriate, develop alternative approaches to the production of the indices. The rationale behind the request for new approaches were concerns that both the methods and the data used were no longer appropriate due to sample size issues, number of revisions to published data and the transparency of the methodology.

This document relates to construction input cost indices produced from data provided by AECOM and ONS to be published in the construction output statistics release. The first figures using the new approach will be published in December 2014 (Q3).

The key users of construction cost and price indices are the ONS to deflate construction output and new orders current price data and the construction industry, industry analysts, and public and private sector [client] organisations. Principal uses include:

- Pricing contracts
- Estimating activities
- Evaluating proposals
- Monitoring changes over time
- Operating cost reference systems
- Producing financial models for projects
- Updating estimated costs to current prices
- Analysing variations in projects
- Updating variation of price contracts
- Forecasting

Introduction

Issues with the previous methodology used to produce the construction price and cost indices (PCIs) have been identified in reviews by the Department of Enterprise and Regulatory Reform (BERR)^{1,2} and its successor, the Department for Business, Innovation and Skills (BIS)³, and in an assessment by the UK Statistics Authority^{4,5}. While some issues have been addressed, there remain concerns relating to sample sizes, revisions, coverage and transparency.

The previous methodology used to derive resource cost indices measured the notional trend of input costs to a contractor in terms of increases in the cost of labour, materials and plant by application of the BCIS Price Adjustment Formulae Indices (PAFI) for Building (Series 3), Specialist Engineering (Series 3) and Civil Engineering (1990 Series) to cost models. The PAFI were based on ONS Producer Price Indices (PPIs).

¹ https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/16480/Davis_Langdon_report_-_BERR_final_revised_260310.doc

² https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/16481/BIS-response-to-Davis-Langdon-report.doc

³ <https://www.gov.uk/government/publications/uses-of-construction-prices-and-cost-indices-results-of-bis-consultation>

⁴ <http://www.statisticsauthority.gov.uk/assessment/assessment/assessment-reports/assessment-report-95---construction-price-and-cost-indices.pdf>

⁵ <http://www.statisticsauthority.gov.uk/assessment/assessment/assessment-reports/confirmation-of-designation-letters/letter-of-confirmation-as-national-statistics---assessment-report-95-and-169.pdf>

The indices were national averages. Material costs were generally representative of UK prices. Labour costs were generally representative of wage agreements in England and Wales.

Within the previous suite of resource cost indices there were seven RCIs:

- Resource Cost Index of Building Non-Housing (NOCOS)
- Resource Cost Index of House Building (HOCOS)
- Resource Cost Index of Road Construction (ROCOS)
- Resource Cost Index of Infrastructure (FOCOS)
- Resource Cost Index of Maintenance of Building Non-Housing (NOMACOS)
- Resource Cost Index of Maintenance of House Building (HOMACOS)
- Resource Cost Index of All Construction (ALLCOS)

The Resource Cost Indices were weighted averages of the Price Adjustment Formulae Indices (June 1990=100) and were weighted according to the categories of construction work shown above. The weightings for HOCOS, ROCOS, FOCOS, NOMACOS, HOMACOS and ALLCOS were assessed by a panel of Chartered Quantity Surveyors in 1998. The weightings for NOCOS, previously known as APSAB, were assessed when the index was first published in the 1970s.

Since AECOM were awarded the contract for the development and production of the PCI we have spent the past fifteen months reviewing the previous approach and suggesting methodological improvements for both the construction input cost series and the construction output price series. Our review indicated that there was an opportunity to refresh the methodology for input cost estimation and make it more representative of the modern construction industry. Our preference was for methods that are transparent and explanatory and based on data that are reasonably readily available and reliable. Our focus was on types of work rather than projects to avoid sample size problems and to improve representivity.

Our approach to the PCI now includes direct price observation within the input cost series and a secondary data approach in the derivation of the output price series, essentially the inverse of the previous approach which used secondary data to derive the input cost series and direct price observation to estimate the tender price indices which subsequently informed the output price series.

This document contains the following sections:

- About the output
 - o Relevance
 - o Sources of data
 - o Timeliness
- How the output is created
- Concepts and definitions

About the Output

Relevance

Input cost indices should reflect, as accurately as possible, the actual costs paid by contractors for any materials, products and equipment hire, together with reliable sources for labour costs. AECOM have adopted a basket of goods approach for input cost estimation that:

- Aims to produce different cost trends for the diverse types of construction output (aggregate output rather than construction project related to avoid the problems of aggregating to an industry measure from project related data)
- Aligns with other cost and price index methodologies (i.e. CPI)
- Provides linkages to national accounts (i.e. better alignment with the Standard Industrial Classification)
- Is based on relatively easy to collect data, with respondents required to provide purchase costs for items that can be reasonably easily specified
- Uses a manageable but comprehensive basket of items as a proxy for all construction
- Provides the opportunity to assign items to different baskets that represent different types of work
- Allows for changing materials, products and technologies over time

Sources of Data

A basket of construction inputs was compiled by AECOM in late 2013; the master list comprises 220 resources grouped into 20 resource sub-groups. Input selection was based on:

- Our expertise as construction cost consultants
- BIS Building materials statistics
- Analysis of input/output tables (supply and use)

The purpose of the AECOM master list is to represent the main inputs to all kinds of construction work (both new work and repair and maintenance) and to permit the selection of sub-sets of the list for particular types of work:

- Housing
- Non-Housing
- Infrastructure

Figures 1 and 2 below highlight the typical material coverage of the basket of goods and the work activities within which these are applied.

Figure 1: Schedule of material types

Bituminous material	Manufactured metal, ironmongery, boilers
Cement	Miscellaneous
Clay bricks	Other metals (copper, zinc, aluminium, cast iron)
Clay pipes	Plant (includes accommodation; fuel and machinery)
Clay tiles	Plants
Concrete blocks, slabs kerbs and like	Plastics
Doors and windows	Reinforcement
Earthworks and aggregates	Sheet steel, lintels, sheeting, metalwork
Foamed plastic insulation	Stone
Glass, includes fibre-glass	Structural steel
Gypsum	Timber
Labour	

Figure 2: Schedule of work sections

Ceiling finishes	Masonry
Cement and concrete	Miscellaneous
Doors	Plant and machinery buildings
Drainage - above and below ground	Plant and machinery excavators
Electrical	Plant and machinery fuel
Excavate and filling	Plant and machinery general
External works and surfaces	Plumbing
Floor finishes	Reinforcement
Heating and ventilation	Roofing
Insulation	Sanitary ware
Labour rates build	Structural steel
Landscaping	Timber
Linings and partitions	Wall finishes
Metalwork	Windows

The number and selection of resources in the master list is expected to change in-line with changes in industry technologies and practices over time, we will therefore review annually the content of the list to ensure representivity going forward. Purchasers prices for items on the list are collected each quarter, the aim being to obtain national and period (quarterly/annual) average prices paid by contractors for their inputs:

- Material/product cost data are collected from major materials/products suppliers
- Equipment hire cost data are collected from major equipment hire providers
- Labour cost data are taken from the ONS Average Weekly Earnings series (Construction: AWE K57Y)

For the material/product and equipment inputs the delivery to site costs are deemed implicit in the rates received. Energy and fuel costs are included as separate items in our schedules to reflect the costs of plant and machinery used as part of the construction process.

Sources for material/product and equipment hire cost data varies. Wherever possible contact is made directly (via telephone or e-mail) with the supplier, this particularly applies to major inputs i.e. bricks, concrete blocks, concrete and steel. Costs for other items are sourced via general builders' merchants and specialist suppliers again via telephone or e-mail. Costs are input directly into spreadsheet applications as we receive them. We have developed a convenience sample, based on our work compiling the Spon's⁶ Construction Price book series, of 110 respondents whom we approach to gather the quarterly price information. This provides data from a high proportion of the larger suppliers and merchants of construction products/materials and equipment hire that serve both larger and smaller firms in the industry.

It is important to note that we are concerned with measuring price changes, not price levels. We collect price data to ascertain how prices change from period to period.

Timeliness and Punctuality

Results are published at quarterly intervals, as follows:

- 1Q (January – March) is published in June
- 2Q (April – June) is published in September
- 3Q (July – September) is published in December
- 4Q (October – December) is published in March

As a result of the data collection method used there is limited need for provisional data with minimal amendments/revisions to previously published series. However, there are two elements which might be subject to revision and which could therefore result in amendments/revisions to the indices as previously published:

- Average Weekly Earnings
- Construction Output

How the Output is Created

Construction inputs for labour, plant and materials are gathered into groups and sub-groups for different types of construction work (residential, non-residential building, infrastructure, for example) and aggregated using un-weighted price relatives. Material, equipment and labour price relatives are combined into price relatives for types of work using appropriate resource mixes and these, in turn, are combined to produce an all construction price relative using appropriate expenditure weights (derived from construction output data <http://www.ons.gov.uk/ons/rel/construction/output-in-the-construction-industry/august-2014/stb-construction-august-2014.html#tab-Output-in-the-Construction-Industry---August-2014>).

To construct the index series we measure price differences from period to period for each item of materials, products, labour and equipment. Differences are calculated as percentage change and expressed as factors (an increase from one period to another of 3.5% would be expressed as 1.035).

Price changes for sub-groups of materials, sub-sets of labour and equipment, work types and all construction are calculated by adding aggregate period percentage changes to a base period value of 100 in period 1 and then to add the next period percentage change to the result of the first calculation, and so on.

For construction work types the un-weighted geometric mean of price changes in each sub-group or subset provides the aggregate price change for materials, labour and equipment for that work type. For the All Construction index the weighted arithmetic mean of price changes provides the aggregate price change for materials, labour and equipment for that series.

The diagrams that follow illustrate the process. Figures 3 and 4 below highlight an extract of the matrix that has been established to assign resources to each sector and type of work. Any individual resource can be applied to more than one sector.

⁶ <http://www.sponpress.com/pricebooks/>

Figure 3: Example of assigning resources by sector and type of work

			SECTOR				
Work Type	Resource	Unit	Housing	Non-housing	Housing R&M (private)	Housing R&M (public)	Non-housing R&M
EXCAVATE AND FILLING	Hardcore 6F2	tonne	y	y			
LININGS AND PARTITIONS	9.5 Gyproc Wallboard	m2	y	y	y	y	y

The matrix is completed for all items across all sectors

Resource items are grouped into work sections for each sector and the factors averaged using un-weighted price relatives for each work type. The work sections are then combined to produce an average construction price relative factor for labour, plant and materials across all the sectors.

Figure 4: Example of matrix and factors

WORK TYPE	SECTOR				
	Housing	Non-housing	Housing R&M (private)	Housing R&M (public)	Non-housing R&M
EXCAVATE AND FILLING	1.01595	1.00248			
LININGS AND PARTITIONS	1.02357	1.04633	1.03142	1.03142	1.05405
CEMENT AND CONCRETE	0.99255	0.98975	0.96497	0.96497	1.05114

Labour, plant and material weightings are then applied to each sector. These have been estimated through our expertise as construction cost consultants, by analysing Input/output tables and applying aggregate labour, plant and material weightings to the outcomes. The outcomes were tested via consultation with both AECOM sector specialists and industry stakeholders to confirm that the results were representative. Figure 5 below provides examples of the typical resource weighting applied.

Figure 5: Example of typical resource weightings

HOUSING			
Weight by resource			
Labour	Plant	Materials	Total
34%	3%	63%	100%

INFRASTRUCTURE			
Weight by resource			
Labour	Plant	Materials	Total
33%	30%	37%	100%

For the individual work types the un-weighted price relatives from one period to another are indexed with the first period being rebased to 100 in each case. Our approach for indexing individual work types uses a chain-linked Jevons index:

$$P_J = \prod \left(\frac{p_t}{p_0} \right)^{1/n}$$

Finally, the index for All Construction is estimated by applying expenditure weights derived from ONS data for Output in the Construction Industry (Table 4: Value of construction output in Great Britain current prices, non-seasonally adjusted – by sector). For the All Construction series the weighted arithmetic mean of price changes provides the aggregate price change for materials, labour and equipment for that index. Our approach for indexing the All Construction series uses a chain-linked Laspeyres index:

$$P_L = \frac{\sum(p_{c,t_n}) * (q_{c,t_0})}{\sum(p_{c,t_0}) * (q_{c,t_0})}$$

Regional Input Costs

Quarterly regional price differences are estimated and provided in a separate dataset to be used in conjunction with the input cost indices to enable users to calculate any regional adjustments as necessary. The regional factors are derived from the ONS Average Weekly Earnings series and based on the premise that most regional variations in input costs will be captured by earnings differentials rather than significant differences in materials and plant costs.

Methodology for Creating Regional Factors

The ONS provides monthly average weekly earnings for the different sectors of the economy at a national level, whereas regional earnings are only provided at a whole economy level. Using these sources AECOM and the ONS have estimated eleven regional factors derived from the regional wage differences at a whole economy level, applied to the specificity of the construction activity. This allows the creation of eleven regional factors representing the variations from the GB average among local construction earnings. These regional factors are applied to the labour component of the Input cost series and subsequently the creation of regional input series for each type of construction.

The methodology for the creation of the regional location-factors has been tested by triangulating the results with the outcome of two alternative approaches for producing regional factors, based respectively on the ONS series Annual Survey of Hours and Earnings (ASHE) and data from the UK's Census. The results derived from the testing exercise aligned relatively well suggesting that there were limited differences between the three methods. Due to the quarterly timeliness of publication of the Average Weekly Earnings data this was adopted as the preferred source for estimating the regional factors.

Concepts and Definitions

Construction input cost indices are produced for:

Type of work/sector⁷

- New Work
 - o Public housing
 - o Private housing
 - o Infrastructure
 - o Public non housing
 - o Private industrial
 - o Private commercial
- Repair and Maintenance Work
 - o Public housing
 - o Private housing
 - o Non-housing
- All Construction

Region	
Yorkshire and the Humber	East Midlands
East of England	London
South East	South West
Wales	West Midlands
North West	Scotland
North East	

⁷ <http://www.ons.gov.uk/ons/search/index.html?content-type=Guidance+and+methodology&pubdateRangeType=allDates&sortBy=none&sortDirection=none&newquery=types+of+work+construction&pageSize=50&applyFilters=true>

Reliability

Assessing the revision between the first published estimate and the final estimate provides an indication of reliability. Revisions are monitored on a quarterly basis.

Other information

Future changes

One area within the current approach where we believe there might be scope for further improvement is in the sampling techniques employed and we will be investigating the merits or otherwise of adopting random sampling rather than the convenience sample currently used.