Methodology for the NI Index of Production (IOP)

Background
The quarterly Index of Production (IOP) has been produced since 1949 and figures are available in the current format back to 2005. It provides a measure of growth in the output of the production industries in NI (this is defined as SIC07 sections B to E).

Index numbers
An index number is a convenient form of expressing a series in a way that makes it easier to see changes in that series. The numbers in the series are expressed relatively, with one number in that series chosen to be the 'base' (usually expressed as 100) and other numbers being measured relative to that base. Index numbers have the advantage that they allow different types of data to be combined on a consistent basis, e.g. deflated current price data with volume data. The aim of the IOP is to provide a reliable indicator of short-term changes in the output of the production sector. Index numbers are a very good way of communicating this message. For example, an IOP quarterly value of 97.2 means that the level of output for that quarter is 2.8% lower than the base year value of 100. The NI IOP is a Laspeyres volume index. The UK economic accounts are based on the European System of Accounts (ESA), which in turn is based on the UN System of Accounts (SNA). The ESA-preferred type of output indicator is one that measures deflated gross output (or turnover) for an industry. These use an approximate price change estimator to remove the effects of inflation. For this reason, we and the ONS, use a Laspeyres volume index (as opposed to Paasche, Lowe or Fisher indices). The ONS paper on the **Methodology of the Monthly Index of Services (Annex A: Mathematical Formulation of the Index of Services)** explains Index numbers theory.

Index sample
The IOP sample was refreshed for Quarter 1 2014 and was drawn on a SIC07 basis. The sample was boosted from around 650 businesses and it is now approximately 1,100 companies. Due, in part, to the significant number of companies which fall into the census element, more than 60% of businesses in the new sample were also in the old sample. The sample of production industries is selected directly from the Inter Departmental Business Register (IDBR), by stratifying companies by industry and company size. The sample consists of a census of dominant companies and a Neyman stratified random sample of the remaining companies.

The census element consists of all companies employing 40 or more employees and those employing 0 to 39 employees and having a turnover of £10 million or more. This sample has been designed to give sufficiently accurate results, yet keep the total costs to businesses to a minimum.

Questionnaires were issued to both the new and existing businesses on each sample, for three quarters, as a means to calculate a link factor between the old sample (up to and including Quarter 4 2013) and the new sample (from Quarter 1 2014 onwards). With advice from Office for National Statistics methodologists, as the result of a successful Quality Improvement Fund, a methodology has been developed in order to integrate the new samples without making significant changes to the back series data, thus giving a meaningful index.

Data collection, validation and index calculation
Survey forms are issued quarterly, immediately after the period to which they relate. For example, forms are issued in April asking for information relating to January to March. Since the beginning of 2016, a Quarterly Business Survey (QBS) form was issued to all businesses who previously received an IOP form and/or a QES form and companies are now asked to provide employment and/or turnover information at the same time. This combined survey form, coupled with the roll-out of an 'eForm' (designed to collect data electronically) is intended to reduce the burden to businesses currently receiving two separate forms at different times.

Historically a number of companies provided volume information rather than turnover data (e.g. litres of a product rather than the turnover value of the product). From Quarter 2, 2010 these companies were asked to also provide turnover data and from Quarter 2 2011 the IOP estimates have solely been based on turnover. In response to user demand information is also collected on the value of exports. This will be used to produce a quarterly index in due course once a sufficient back series has been established and development work has been undertaken.

Data validation is carried out ensuring that data falls within the expected limits, contacting the company where appropriate for clarification.

For practically all series, the value of sales deflated to allow for price changes, is used as the indicator. In the remaining cases, changes in the volume of production or the number of employees are used as a proxy measure.

From Quarter 2 2014, the individual series have been seasonally adjusted using X-13 ARIMA SEATS, which introduces improvements to the models used for seasonal adjustment. Also, during the seasonal adjustment review in December 2015 (from Quarter 3 2015) the smoothing methodology, applied to companies with particularly volatile returns, has now been removed for the remaining few companies. The main sectors affected are the water supply, sewerage, and waste management (Inc. recycling) and mining and quarrying along with some of the individual manufacturing subsectors.

Further information on the methodology and impact of the seasonal adjustment changes can be found in the methodological note found **here**.

It is also possible to aggregate all individual series to give indices by final use of goods produced. This is known as a market sector analysis and estimates are given in the quarterly statistical bulletin. It distinguishes between seasonally adjusted consumer, seasonally adjusted investment and seasonally adjusted intermediate goods. The latter are described as intermediate because they include materials used to produce goods for consumption.

The productivity index provides a measure of the number of units of output produced per person per paid hour. The productivity index is based on the seasonally adjusted manufacturing index, seasonally adjusted employees in employment and average weekly hours (based on hours worked for full-time adult manufacturing workers including overtime from the Annual Survey of Hours and Earnings). An index of total employee hours is calculated based on the number of employees in employment and average weekly hours.

The seasonally adjusted index of manufacturing is divided by the index of total employee hours to produce the Index of Productivity.

The seasonally adjusted NI IOP is annually chain-linked (chain-linking involves the linking of growth estimates between different periods in order to produce a continuous time series) using GVA estimates derived from regional accounts using the fourth quarter of the preceding year as the link period. Inaccuracies caused by the assumption of a stable relationship between GVA and turnover are reduced using this methodology. When annual weights are used the assumption only has to be maintained from one year to the next year. A paper on annual chain-linking from ONS is available **here**.

The standard method for linking two series (for example one based on a SIC03 sample and one based on a SIC07 sample) is to calculate the index under the old and new circumstances over some link period, and then apply the growth of the subsequent new series to the old series. As the relationship of both samples to the IDBR was known, the IDBR was used to provide the link period. Thus, the ratio of the IDBR turnover for Quarter 1 2011 and Quarter 2 2011 is known. We have the Quarter 2 2011 value (SIC07) and the Quarter 1 2011 value (converted from SIC03 to SIC07). We can, therefore, create the following link factor:

$$\text{link factor} = \frac{\text{(Q2 2011 sample estimate * IDBR Q1 2011 value)}}{\text{(Q1 2011 sample estimate * IDBR Q2 2011 value)}}$$

This can then be applied to the converted back series, thus retaining the previous growth rates.

For Quarter 1 2014 and Quarter 2 2014, questionnaires were issued to companies in both the existing sample and the new sample, thus allowing a link factor to be calculated based on the average percentage change between the two. This link factor was then applied to each of the quarterly turnover back series (grossed & deflated), in order to give a series of the same magnitude as the new sample series (from Quarter 1 2014 onwards).

Seasonal adjustment
The index numbers in the statistical bulletin are seasonally adjusted unless otherwise stated. This aids interpretation by removing annually recurring fluctuations, for example due to holidays or other regular seasonal patterns. All IOP time series are checked on an annual basis using X-13 ARIMA SEATS for evidence of seasonality, and those series where seasonality is detected are adjusted using X-13 ARIMA SEATS in order to obtain a clear picture of the general trend. Unadjusted data are also available.

The figures presented in this publication are calculated using the X-13 ARIMA SEATS method of seasonal adjustment. ONS have provided a **guide to seasonal adjustment with X-12 ARIMA,** as an updated guide for X-13 ARIMA SEATS is currently being finalised by ONS.

Summary quality report
A summary quality report for this publication can be found on the **IOP Quality and Revisions** page of the website.

Status of figures in IOP bulletin
The base year of the NI IOP is updated in line with ONS.

All figures are published to one decimal place. Figures for annual averages and percentage changes over the previous quarter and year are based on unrounded figures and may not agree with the published constituent parts.

Results, particularly for the latest quarter, are provisional and are subject to revision as more up to date information becomes available.

The overall IOP index has been produced using X-13 ARIMA SEATS seasonal adjustment. Some of the sectors and sub-sectors have also been seasonally adjusted, and those can be identified throughout the bulletin.

Comparisons between the IOP and the Annual Business Inquiry (ABI) may not necessarily match because of definitional and coverage differences.

Planned future revisions
One indicator of the reliability of the figures in this bulletin can be obtained by monitoring the size of revisions. The IOP revisions policy can be found **here**.

Publication of results on a SIC07 basis
A SIC was first introduced into the UK in 1948 for use in classifying business establishments by the type of economic activity in which they are engaged. The UK is required by European legislation to revise the SIC in parallel with NACE (the statistical classification of economic activities in the European Communities) so that both systems are identical down to and including the four digit class level. More information on SIC07 can be found **here** and **here**.

The SIC07 sections covered by the NI IOP are as follows:

Broad Industry Group / Sector	Section		Division	Description
Sector B - Mining and quarrying	B		5	Mining of coal and lignite
			6	Extraction of crude petroleum and natural gas
			7	Mining of metal ores
			8	Other mining and quarrying
			9	Mining support service activities
Sector C - Manufacturing	CA	Food products, beverages and tobacco	10	Manufacture of food products
			11	Manufacture of beverages
			12	Manufacture of tobacco products
	CB	Manufacture of textiles, wearing apparel and leather products	13	Manufacture of textiles
			14	Manufacture of wearing apparel
			15	Manufacture of leather and related products
	CECF	Manufacture of chemical and pharmaceutical products	20	Manufacture of chemicals and chemical products
			21	Manufacture of basic pharmaceutical products and pharmaceutical preparations
	CH	Basic metals and fabricated metal products	24	Manufacture of basic metals
			25	Manufacture of fabricated metal products, except machinery and equipment
	CICJ	Engineering and allied industries	26	Manufacture of computer, electronic and optical products
			27	Manufacture of electrical equipment
	CK		28	Manufacture of machinery and equipment n.e.c.
	CL		29	Manufacture of motor vehicles, trailers and semi-trailers
			30	Manufacture of other transport equipment
	CC	Total other manufacturing	16	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials
			17	Manufacture of paper and paper products
			18	Printing and reproduction of recorded media
	CDCM		19	Manufacture of coke and refined petroleum products
			31	Manufacture of furniture
			32	Other manufacturing
			33	Repair and installation of machinery and equipment
	CG		22	Manufacture of rubber and plastic products
			23	Manufacture of other non-metallic mineral products
Sector D - Electricity, gas, steam and air conditioning supply	D		35	Electricity, gas, steam and air conditioning supply
Sector E - Water supply, sewerage, waste management and remediation activities	E		36	Water collection, treatment and supply
			37	Sewerage
			38	Waste collection, treatment and disposal activities; materials recovery
			39	Remediation activities and other waste management services.