

## Defining the engineering sector: the engineering footprint

The Oxford English dictionary defines engineering as:

*“the branch of science and technology concerned with the design, building, and use of machines, and structures; a field of study or activity concerned with modification or development in a particular area: software engineering”*  
(Oxford English Dictionary 2017)

However, there is no universally accepted operational definition of engineering. Large scale civil engineering projects (such as the Queensferry crossing, covered later in this chapter) or mechanical engineering products are easily recognised as engineering. There is less agreement on the boundaries of what is or isn't engineering.

The engineering footprint is a means of creating a working definition of engineering by classifying which jobs and industries count as 'engineering' using the Office for National Statistics (ONS) lists of jobs and industries (standard occupational classifications SOC2010 and SIC2007 respectively).<sup>1,2</sup> We use the resulting footprint as the basis for indicating the sector's contribution to the UK economy, its wider impacts, the needs for and supply of skills.

In the ONS SOC and SIC lists, jobs are grouped into classes by skill level and skill specialisation, while industries are grouped by activity. These codes go into several levels of detail. The engineering footprint is specified at the most detailed level for job (4 digit) and industry (4/5 digit). When we refer to engineers in this report, we mean those jobs within the engineering footprint. Similarly, when we discuss engineering enterprises, we are referring to organisations whose industrial classification is in the engineering footprint.

### **Standard occupational classification (2010)**

The standard occupational classification 2010 (SOC2010) has four levels of detail: the highest is major group level, followed by sub-major group, minor group, then unit group. For example:

Major group: 2 Professional occupations

Sub-major group: 21 Science, research, engineering and technology professionals

Minor group: 212 Engineering professionals

Unit group: 2127 Production and process engineers

The engineering footprint uses the most detailed level (unit group), but data can also be analysed at higher levels if necessary.

### **Standard industrial classification (SIC)**

The Standard Industrial Classification 2007 (SIC2010) has four to five levels of detail: the highest is section, followed by division, then group, then class. Some classes have sub-classes, which is the fifth and most detailed level. The section is used for grouping and is not required to identify the industry. For example:

<sup>1</sup> ONS, *Standard Occupational Classification 2010 volume 1: structure and descriptions of unit groups*, 2010.

<sup>2</sup> ONS, *UK SIC 2007*, 2007.

Section:	C Manufacturing
Division:	20 Manufacture of chemicals and chemical products
Group:	20.4 Manufacture of soap and detergents, cleaning and polishing preparations, perfumes and toilet preparations
Class:	20.41 Manufacture of soap and detergents, cleaning and polishing preparations
Sub-class:	20.41/1 Manufacture of soap and detergents

From the outset, our footprint has considered a job or industry to be either fully included or excluded as 'engineering'. We recognise that there are some limitations to this approach. One challenge we face in categorising job and industry codes as engineering or not comes from the level of detail available for each code and the breadth of the codes available. For example, airline pilots might not be considered to be engineers, while flight engineers would be; they are, however, covered by a single code, making it impossible to differentiate one from the other. Another challenge comes when using the model to estimate numbers, as data is not available to the same level of detail – or even at all – for some codes. There are also jobs and industries excluded from the footprint that require some level of engineering competency and may even be vital for the success of the engineering sector: for example, lecturers and teachers of engineering in higher and further education. This is because even at the most detailed SOC level, we are unable to distinguish those teaching engineering and technology subjects from all the other subjects.

Finally, these classifications are created by coding jobs and industries retrospectively, which means that they may not reflect the latest jobs. Bioengineers, for example, is a relatively new field which doesn't yet have a code. It is possible that it falls within code 2112: biological scientists and biochemists. However, this occupation didn't meet agreed criteria and so is not in the footprint, whereas 7211: research and experimental development on biotechnology is. For the same reason, the footprint may not capture emerging industry segments. For example, production, transmission and distribution of electricity have their own SIC 2007 codes (3511, 3512, 3513) and are included in the footprint. But there is no distinct code for the storage of electricity, an emerging industry driven by increased use of renewables and the availability of new technology.

It is highly likely that these codes will need to be revised in the next decade to more accurately reflect new jobs and industries. Although SOC codes have typically been revised every 10 years (SOC90, SOC2000, SOC2010), 78% of respondents to a consultation in 2016 thought that an update was needed sooner rather than later.<sup>3</sup> SIC codes have been revised 7 times since they were first introduced in 1948,<sup>4</sup> and those too may need revising within the next decade. In the meantime, we will necessarily struggle to capture emerging occupations and industry segments.

For these reasons, the engineering footprint should be considered as a model rather than an objective listing of all those people and organisations that make up the engineering sectors.

## Review of the engineering footprint

The version of the footprint used in this report differs from the version used in the 2017 *State of Engineering*.

Different variants of the footprint have been used by the Engineering Council, Royal Academy of Engineering and EngineeringUK. In 2017, colleagues (including senior representatives) from the Engineering Council, the Royal Academy of Engineering and EngineeringUK formed a panel to

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<sup>3</sup> ONS, *Consultation on revising the Standard Occupational Classification 2010 (SOC2010)*, 2016.

<sup>4</sup> ONS, *UK SIC 2007*, 2007.

review the engineering footprint model. This was done to update the footprint and reach closer agreement between organisations to use a single version.

Previously, EngineeringUK opted to use a binary approach (whereby a sector or occupation was seen to be either in or out of the footprint), while the Engineering Council determined proportions of each SOC classification that may be engineers. For example, in a binary approach, architects are considered to be within engineering, whereas a proportional model might determine that only 30% of architects are included.

In the first instance, the three organisations agreed to standardise on the binary approach, but to improve its precision by further classifying jobs within the footprint as **core** or **related** (Figure 2.1). Core engineering footprint jobs were defined as primarily engineering-based roles that require the consistent application of engineering knowledge and skills to execute them effectively. A production and process engineer is one example of a core engineering occupation. Meanwhile, related engineering footprint jobs were defined as those that require a mixed application of engineering knowledge and skill alongside other skill sets, which are often of greater importance to executing the role effectively. An architect is an example of a related engineering occupation.

This is the main difference made to the model between this report and the 2017 report. Core engineering jobs include those that are self-evidently engineering: the engineering professionals 'minor' group of civil, mechanical, electrical, electronics, design and development and production and process engineers. The 'core' definition also includes those that might not primarily be considered engineering but require consistent use of engineering competences, for example 5211: smiths and forge workers. The classification of core or related was only applied to jobs (SOC), not to industries (SIC).

#### Engineering footprint: rules for inclusion/exclusion

Representatives from EngineeringUK, the Royal Academy of Engineering, and the Engineering Council agreed a set of rules on which to decide which SOC and SIC codes were included in the engineering footprint.

1. All occupations within the level 9 major group elementary occupations were removed
2. All remaining occupations were examined on the following basis:
  - a. level of qualification required - if no formal qualifications were required above level 2, then:
    - i. the occupation SOC code skill descriptor was examined - if the panel agreed that there was no clear engineering skills content within the descriptor, the occupation was removed
    - ii. if the panel did not agree, further information was obtained from an external body with specific knowledge of the skills and competencies of the occupations
3. A second element of the classification was to decide whether the occupation can be defined as a 'core' engineering occupation or a 'related' engineering occupation, with the following definitions used:

**Core:** occupations that are primarily engineering-based and require the consistent application of engineering knowledge and skills to execute the role effectively

**Related:** occupations that require a mixed application of engineering knowledge and skill alongside other skill sets, which are often of greater importance to executing the role effectively

4. Where available, the numbers in a given job who were eligible for professional registration as an engineer were taken into consideration by the panel (using information from the Engineering Council's project MERCATOR)
5. Finally, the list of industries (SICs) was reviewed by the panel members, who decided if they should be included or excluded from the footprint model.

### **Project MERCATOR**

MERCATOR is a research project run by the Engineering Council, designed to estimate the number of engineers eligible for professional registration. We are doing this by mapping the office of national statistics (ONS) standard occupational codes (SOC) to the types of engineering we have across the professional engineering institutions. Using this mapping Engineering Council aim to get better estimates of the number of individuals working in each occupational area who may be eligible to register so this can be used to better target each occupational area.

As a result of this review, 10 job titles were removed from the footprint, 3 were added and 4 remained with input from external organisations. Fourteen industries were removed from the list of SICs and 2 were added. A full list of SOC and SIC codes within the revised footprint, and more details on the changes made, is available in our Annex.